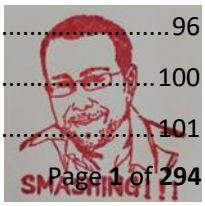
iG Chem ALL EQ FINAL MASTER P3 2015w to 2014s Papers 32 and 33 only 2023marks

Contents



DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radius 88	227 Ac Actinium 89 †															

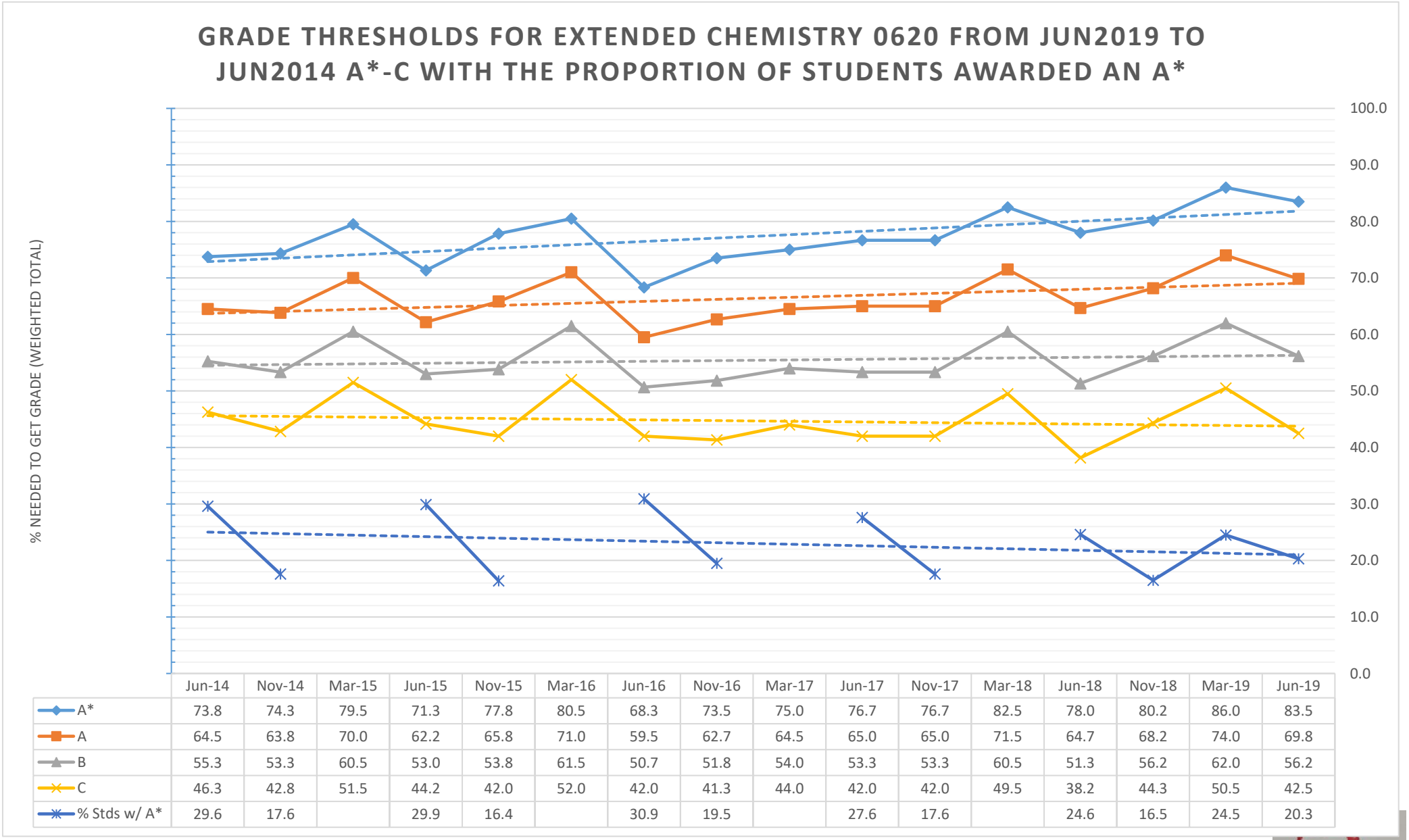
140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98		www.Smashing Science.Org	No Nobelium 102		Lr Lawrencium 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

How grade thresholds have changed across the years



	Jun-14	Nov-14	Mar-15	Jun-15	Nov-15	Mar-16	Jun-16	Nov-16	Mar-17	Jun-17	Nov-17	Mar-18	Jun-18	Nov-18	Mar-19	Jun-19
A*	73.8	74.3	79.5	71.3	77.8	80.5	68.3	73.5	75.0	76.7	76.7	82.5	78.0	80.2	86.0	83.5
A	64.5	63.8	70.0	62.2	65.8	71.0	59.5	62.7	64.5	65.0	65.0	71.5	64.7	68.2	74.0	69.8
B	55.3	53.3	60.5	53.0	53.8	61.5	50.7	51.8	54.0	53.3	53.3	60.5	51.3	56.2	62.0	56.2
C	46.3	42.8	51.5	44.2	42.0	52.0	42.0	41.3	44.0	42.0	42.0	49.5	38.2	44.3	50.5	42.5
% Stds w/ A*	29.6	17.6		29.9	16.4		30.9	19.5		27.6	17.6		24.6	16.5	24.5	20.3

Revision Timtable – Use this to assign blocks of time to different subjects

Period	Time	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
	5:00 AM							
	5:30 AM							
	6:00 AM							
	6:30 AM							
	7:00 AM							
Regstn	7:45 AM							
1	8:00 AM							
2	8:50 AM							
Break	9:35 AM							
3	9:45 AM							
4	10:35 AM							
Lunch 5	11:25 AM							
Lunch 6	12:10 PM							
7	1:00 PM							
8	1:55 PM							
9	2:45 PM							
10	3:30 PM							
	4:20 PM							
	5:00 PM							
	5:30 PM							
	6:00 PM							
	6:30 PM							
	7:00 PM							
	7:30 PM							
	8:00 PM							
	8:30 PM							
	9:00 PM							
	9:30 PM							
	10:00 PM							
	10:30 PM							

Calender for the next few months

School Week	Teach Week	Monday Start	Events	Your notes and events
24	20	13-Jan	Tue 14th DL for all marks into SIMS for EOS Report Fri 17th Last Teaching day of Semester	
25		20-Jan	Spring Festival	
26		27-Jan		
27		3-Feb	Sun 9th AM Students and teachers in for Registration, PM Students Assembly	
28	21	10-Feb	Mon 10th 2nd Semester teaching begins Wed 13th G1, G2, PreA, IB1, AS & A2 reports issued Sun 16th New spring classes in school for registration	
29	22	17-Feb	Fri 21st G1, G2, PreA IB1 Parents consultation (whole day)	
30	23	24-Feb		
31	24	2-Mar		
32	25	9-Mar	Fri 13th Completion of 2nd Student Survey	
33	26	16-Mar	Fri 20th DL G2, PreA, AS and A2 syllabi completed Sun 22nd UCS Spring Concert	
34	27	23-Mar	Mon 23rd Guided revision starts	
35	28	30-Mar	Thu 2nd Guided revision ends **Fri 3rd Qing Ming Holiday**	
36	29	6-Apr	Mon 6th EoY EXAMS START G2, preA, AS & A2) Sat 11th Making up day (EXAM day)	
37	30	13-Apr	Fri 17th EoY EXAMS ENDS	
38	31	20-Apr	Fri 24th G2, & PreA Optional Course Information Day	
39	32	27-Apr	**Fri 1st May OFF Mayday Holiday**	
40	33	4-May	Wed 6th DL All marks for G2, PreA, AS & A2 in SIMS	

School Week	Teach Week	Monday Start	Events	Your notes and events
41	34	11-May		
42	35	18-May		
43	36	25-May	Mon 25 to Fri 29th EoY EXAMS for G1 and IB1 Fri 29th DL for Submission of Departmental Budgets	Sun 31st DL for payments of students tuition and dormatory fees
44	37	1-Jun	Mon 1st G2, PreA, AS and A2 reports issued Fri 5th DL for inputting G1 marks	
45	38	8-Jun		
46	39	15-Jun	Wed 17th CAIE Summer session ends Fri 19th Last day of 2019 to 2020 Academic Year Sat 20 to Mon 22 Annual Summer Trip	
		22-Jun	Summer Holidays	
		29-Jun	Summer Holidays	
		6-Jul	Summer Holidays	
		13-Jul	Summer Holidays	
		20-Jul	Summer Holidays	
		27-Jul	Summer Holidays	
		3-Aug	Summer Holidays Sun 9th G1 and PreA studnets and form tutors in school for registration	
		10-Aug	Sun 16th C6 AS & A2 students registration **Sun 16th UCS Opening Ceremony All Staff am: G1, G2 & PreA, pm AS, A2 & IB**	
	1	17-Aug	Mon 17th Teaching for 2021 to 2022 year begins	

Section 1 Past exam questions, not published by me before by topic

Topic Chem 1 **Q# 1/** iGCSE Chemistry/2015/s/Paper 32/Q2

2 The table shows the melting points, boiling points and electrical properties of five substances, **A** to **E**.

substance	melting point /°C	boiling point /°C	electrical conductivity of solid	electrical conductivity of liquid
A	–7	59	poor	poor
B	1083	2567	good	good
C	755	1387	poor	good
D	43	181	poor	poor
E	1607	2227	poor	poor

Choose a substance from the table above to match each of the following descriptions. A substance may be used once, more than once or not at all. Justify each choice with evidence from the table.

One has been completed as an example.

This substance is covalent and is a solid at room temperature (25 °C). ..... **D** .....

evidence *Its melting point is above room temperature. It has a low melting point and it does not conduct as a liquid, so it is covalent.*

(c) This substance is a liquid at room temperature (25 °C). .....

evidence .....

..... [3]

Topic Chem 1 **Q# 2/** iGCSE Chemistry/2014/w/Paper 33/Q2

(ii) What is the significance of temperature t °C?

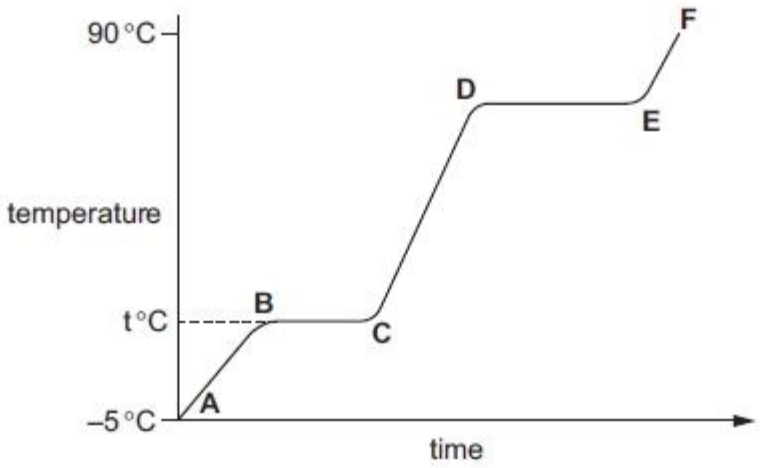
..... [1]

(iii) What is the physical state of compound X in the region **EF**?

..... [1]

2 Compound X is a colourless liquid at room temperature.

(a) A sample of pure X was slowly heated from –5.0 °C, which is below its melting point, to 90 °C, which is above its boiling point. Its temperature is measured every minute and the results are represented on the graph.



Topic Chem 1 **Q# 3/** iGCSE Chemistry/2014/w/Paper 33/Q2

2 Compound X is a colourless liquid at room temperature.

(ii) What is the significance of temperature t °C?

..... [1]

(iii) What is the physical state of compound X in the region **EF**?

..... [1]

(b) Compound X is a hydrocarbon. It contains 85.7% of carbon. The mass of one mole of X is 84 g.

(i) What is the percentage of hydrogen in the compound ?

..... [1]

(ii) Calculate the empirical formula of X. Show your working.

empirical formula = ... [3]

(iii) What is the molecular formula of compound X?

..... [1]

Topic Chem 1 **Q# 4/** iGCSE Chemistry/2014/s/Paper 33/Q2

(b) A liquid has a fixed volume but takes up the shape of the container. A gas takes up the shape of the container but it does not have a fixed volume.

.....

.....

.....

.....

..... [3]

Topic Chem 2

Q# 5/ iGCSE Chemistry/2015/w/Paper 33/Q1

(b) How could you show that a sample of water is pure?

..... [1]

Topic Chem 2 **Q# 6/** iGCSE Chemistry/2015/m/Paper 32/Q6

6 A student is told to produce the maximum amount of copper from a mixture of copper and copper(II) carbonate.

The student adds the mixture to an excess of dilute sulfuric acid in a beaker and stirs the mixture with a glass rod. The copper(II) carbonate reacts with the sulfuric acid, forming a solution of copper(II) sulfate but the copper does not react with the sulfuric acid.

The student then

- removes the unreacted copper from the mixture,
- converts the solution of copper(II) sulfate into copper by a series of reactions.

(b) Describe how the student can produce pure dry copper from the mixture of copper and copper(II) sulfate solution.

.....

.....

.....

..... [3]

Topic Chem 2 **Q# 7/** iGCSE Chemistry/2014/w/Paper 32/Q1

1 An important aspect of chemistry is purity and methods of purification.

(a) Give an example of substances used in everyday life which must be pure.

..... [1]

(b) A list of techniques used to separate mixtures is given below.

chromatography crystallisation diffusion dissolving

evaporation filtration fractional distillation simple distillation

(i) From the list, choose the most suitable technique to separate the following.

water from sea-water .....

helium from a mixture of helium and methane .....

ethanol from a mixture of ethanol and propanol .....

iron filings from a mixture of iron filings and water .....

a mixture of two amino acids, glycine and alanine .....

[5]

Topic Chem 2 **Q# 8/** iGCSE Chemistry/2014/s/Paper 33/Q5

(d) The equilibrium mixture leaving the reaction chamber contains 15% ammonia. Suggest how the ammonia could be separated from the mixture.

	boiling point / °C
hydrogen	–253
nitrogen	–196
ammonia	–33

.....

..... [2]

Topic Chem 3

Q# 9/ iGCSE Chemistry/2015/w/Paper 33/Q6

(d) What is the formula of a magnesium ion?

..... [1]

Topic Chem 3 **Q# 10/** iGCSE Chemistry/2015/w/Paper 33/Q3

3 Lithium bromide is an ionic compound. It can be electrolysed when it is molten or in aqueous solution. It cannot be electrolysed as a solid.

(a) Solid lithium bromide is a poor conductor of electricity. The ions cannot move to the electrodes, they are held in an ionic lattice by strong forces.

(i) Describe the motion of the ions in the solid state.

..... [1]

(ii) Define the term *ionic bonding*.

.....

..... [2]

(iii) What is meant by the term *ionic lattice*?

.....

..... [2]

Topic Chem 3 **Q# 11/** iGCSE Chemistry/2015/w/Paper 32/Q6

6 The table below shows the elements in the third period of the Periodic Table, the number of electrons in their outer energy level, their oxidation state in their common compounds and their melting points.

element	Na	Mg	Al	Si	P	S	Cl	Ar
number of outer electrons	1	2	3	4	5	6	7	8
oxidation state	+1	+2	+3	+4/–4	–3	–2	–1	0
melting point/°C	98	650	660	1414	317	115	–101	–189

(b) The first three elements, Na, Mg and Al, are metals.

Describe the structure of a typical metal.

.....

.....

..... [3]

(c) Explain why Na, Mg and Al are good conductors of electricity.

..... [1]

(d) Which element exists as diatomic molecules of the type X_2?

..... [1]

(e) Silicon has a similar structure to diamond.

Explain why silicon has the highest melting point in the period.

.....

..... [2]

(f) Sodium chloride is a crystalline solid with a high melting point. It dissolves in water to give a neutral solution. Phosphorus trichloride is a liquid at room temperature. It reacts with water to form an acidic solution.

Suggest an explanation for these differences in properties.

.....

.....

..... [2]

(h) Draw a dot-and-cross diagram showing the bonding in magnesium oxide. Show outer electrons only.

[3]

Topic Chem 3 **Q# 12/** iGCSE Chemistry/2015/w/Paper 32/Q1

1 Use your copy of the Periodic Table to help you answer some of these questions.

(a) Predict the formulae of the following compounds.

(i) nitrogen fluoride .....

(ii) phosphorus sulfide .....

[2]

(b) Deduce the formulae of the following ions.

(i) selenide .....

(ii) gallium .....

[2]

Topic Chem 3 **Q# 13/** iGCSE Chemistry/2015/s/Paper 33/Q2

2 This question is concerned with the following oxides.

aluminium oxide
carbon monoxide
copper(II) oxide
silicon(IV) oxide
sodium oxide
sulfur dioxide
zinc oxide

Choose **one** oxide from the above list to match each of the following descriptions. An oxide may be used once, more than once or not at all.

(e) This oxide has a giant covalent structure. ..... [1]

Topic Chem 3 **Q# 14/** iGCSE Chemistry/2015/s/Paper 33/Q1

1 Use your copy of the Periodic Table to help you answer these questions.

(a) Predict the formula of each of the following compounds.

(i) aluminium fluoride ..... [1]

(ii) arsenic oxide ..... [1]

(iii) silicon bromide ..... [1]

(b) Deduce the formula of each of the following ions.

(i) phosphide ..... [1]

(ii) barium ..... [1]

(iii) francium ..... [1]

(c) Draw a diagram showing the arrangement of the valency electrons in one molecule of the covalent compound carbon dioxide.

Use x to represent an electron from a carbon atom.
Use o to represent an electron from an oxygen atom.

[3]

2 The table shows the melting points, boiling points and electrical properties of five substances, **A** to **E**.

substance	melting point /°C	boiling point /°C	electrical conductivity of solid	electrical conductivity of liquid
A	–7	59	poor	poor
B	1083	2567	good	good
C	755	1387	poor	good
D	43	181	poor	poor
E	1607	2227	poor	poor

Choose a substance from the table above to match each of the following descriptions. A substance may be used once, more than once or not at all. Justify each choice with evidence from the table.

One has been completed as an example.

This substance is covalent and is a solid at room temperature (25 °C). ..... **D** .....

evidence *Its melting point is above room temperature. It has a low melting point and it does not conduct as a liquid, so it is covalent.*

(a) This substance has a giant covalent structure. .....

evidence .....

..... [3]

(b) This substance is a metal. .....

evidence .....

..... [2]

(d) This substance is an ionic solid. .....

evidence .....

..... [3]

Topic Chem 3 **Q# 16/** iGCSE Chemistry/2015/s/Paper 32/Q1

1 Complete the following table which gives the number of protons, electrons and neutrons in each of the five particles.

particle	number of protons	number of electrons	number of neutrons
.....	19	19	20
$^{56}_{26}Fe$	.....	.....	.....
.....	3	2	4
$^{70}_{31}Ga^{3+}$	.....	.....	.....
.....	34	36	45

[Total: 8]

Topic Chem 3 **Q# 17/** iGCSE Chemistry/2015/m/Paper 32/Q3

3 Ammonia is manufactured by the Haber process. Nitrogen and hydrogen are passed over a catalyst at a temperature of 450 °C and a pressure of 200 atmospheres.

The equation for the reaction is as follows.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The forward reaction is exothermic.

(g) Draw a dot-and-cross diagram to show the arrangement of the outer (valency) electrons in one molecule of ammonia.

[2]

Topic Chem 3 **Q# 18/** iGCSE Chemistry/2015/m/Paper 32/Q2

2 **(a)** Define the term *isotope*.

.....

..... [2]

(b) The table gives information about four particles, **A**, **B**, **C** and **D**.

Complete the table.
The first line has been done for you.

particle	number of protons	number of electrons	number of neutrons	nucleon number	symbol or formula
A	6	6	6	12	C
B	11	10	12		
C	8		8		O^{2-}
D		10		28	Al^{3+}

[7]

[Total: 9]

Topic Chem 3 **Q# 19/** iGCSE Chemistry/2015/m/Paper 32/Q1

1 For each of the following, give the name of an element from Period 3 (sodium to argon), which matches the description.

(a) an element which is gaseous at room temperature and pressure

..... [1]

Topic Chem 3 **Q# 20/** iGCSE Chemistry/2014/w/Paper 33/Q6

6 Rubidium and strontium are very reactive metals at the top of the reactivity series. Because their ions have different charges, their compounds behave differently when heated.

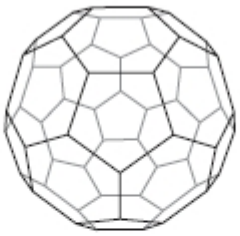
(a) The formulae of the ions of these two elements are Rb^+ and Sr^{2+}.
Explain why these metals, which are in different groups, form ions which have different charges.

.....

..... [2]

Topic Chem 3 **Q# 21/** iGCSE Chemistry/2014/w/Paper 33/Q3

3 In 1985 the fullerenes were discovered. They are solid forms of the element carbon. The structure of the C_{60} fullerene is given below.



(a) (i) In the C_{60} fullerene, how many other carbon atoms is each carbon atom bonded to?

..... [1]

(ii) Another fullerene has a relative molecular mass of 840.
How many carbon atoms are there in one molecule of this fullerene?

..... [1]

(b) Fullerenes are soluble in liquid hydrocarbons such as octane. The other solid forms of carbon are insoluble.
Describe how you could obtain crystals of fullerenes from soot which is a mixture of fullerenes and other solid forms of carbon.

.....

.....

.....

..... [3]

(c) A mixture of a fullerene and potassium is an excellent conductor of electricity.

(i) Which other form of solid carbon is a good conductor of electricity?

..... [1]

(ii) Explain why metals, such as potassium, are good conductors of electricity.

.....

..... [2]

Topic Chem 3 **Q# 22/** iGCSE Chemistry/2014/w/Paper 33/Q1

1 For each of the following elements give **one** physical property :

(b) $carbon_{graphite}$(C)

physical property ..... [1]

Topic Chem 3 **Q# 23/** iGCSE Chemistry/2014/s/Paper 33/Q4

(b) **(i)** Describe the structure of a typical metal such as iron. You may include a diagram.

.....

.....

[2]

(ii) Explain why pure iron is malleable.

.....

..... [2]

Topic Chem 3 **Q# 24/** iGCSE Chemistry/2014/s/Paper 32/Q6

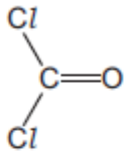
(b) Scandium fluoride is an ionic compound. The valency of scandium in scandium fluoride is three.
Draw a diagram which shows the formula of this compound, the charges on the ions and the arrangement of the valency electrons around the negative ions.

Use × to represent an electron from a fluorine atom.
Use ○ to represent an electron from a scandium atom.

[3]

Topic Chem 3 **Q# 25/** iGCSE Chemistry/2014/s/Paper 32/Q5

(c) The structural formula of carbonyl chloride is given below.



Draw a diagram showing the arrangement of the valency electrons around the atoms in one molecule of this covalent compound.

Use ○ to represent an electron from an oxygen atom.
Use × to represent an electron from a chlorine atom.
Use • to represent an electron from a carbon atom.

[3]

Topic Chem 3 **Q# 26/** iGCSE Chemistry/2014/s/Paper 32/Q1

1 The table below gives the electron distributions of atoms of different elements.

element	electron distribution
A	2 + 7
B	2 + 8 + 4
C	2 + 8 + 8 + 1
D	2 + 8 + 18 + 5
E	2 + 8 + 18 + 7
F	2 + 8 + 18 + 18 + 8

For each of the following, select an element or elements from the table that matches the description. Each element may be selected once, more than once or not at all.

(b) This element forms a fluoride with a formula of the type XF_3.

..... [1]

(d) This element has a macromolecular structure similar to that of diamond.

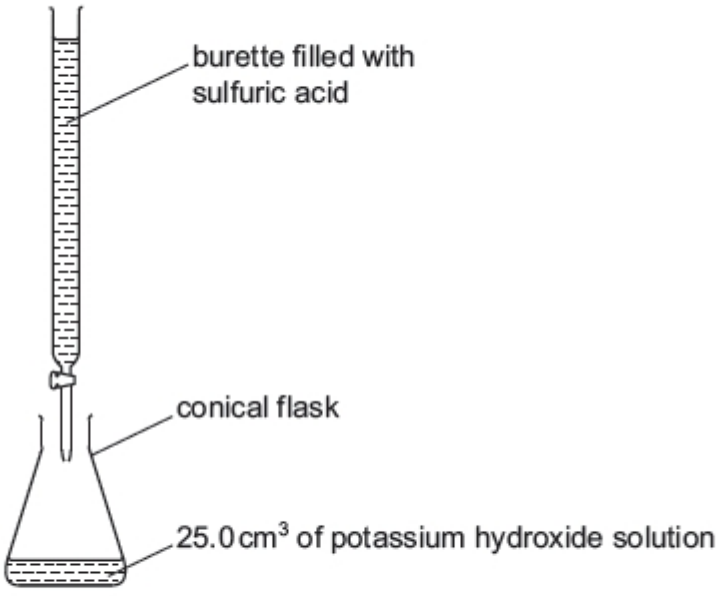
..... [1]

(g) This element is a good conductor of electricity.

..... [1]

Topic Chem 4 **Q# 27/** iGCSE Chemistry/2015/w/Paper 33/Q7

7 Two salts can be made from potassium hydroxide and sulfuric acid. They are potassium sulfate, K_2SO_4, and the acid salt potassium hydrogen sulfate, $KHSO_4$. They are both made by titration.



(a) 25.0 cm^3 of potassium hydroxide, concentration 2.53 mol / dm^3, was neutralised by 28.2 cm^3 of dilute sulfuric acid.

$$2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$$

Calculate the concentration of the sulfuric acid.

number of moles of KOH used = ...

number of moles of H_2SO_4 needed to neutralise the KOH = ...

concentration of dilute sulfuric acid = ... mol/dm^3

[3]

Topic Chem 4 **Q# 28/** iGCSE Chemistry/2015/w/Paper 33/Q6

(c) Deduce the formula of iron(III) sulfate.

..... [1]

Topic Chem 4 **Q# 29/** iGCSE Chemistry/2015/w/Paper 33/Q4

(c) Hydrocarbons burn in excess oxygen to form carbon dioxide and water. 20 cm^3 of a gaseous hydrocarbon burned in an excess of oxygen, 200 cm^3. After cooling, the volume of the residual gas at r.t.p. was 150 cm^3, 50 cm^3 of which was oxygen.

(i) Determine the volume of the oxygen used.

..... [1]

(ii) Determine the volume of the carbon dioxide formed.

..... [1]

Topic Chem 4 **Q# 30/** iGCSE Chemistry/2015/w/Paper 33/Q2

2 Choose from the following list of gases. A gas may be chosen once, more than once or not at all.

sulfur dioxide **hydrogen** **methane** **carbon monoxide**

argon **ethene** **butane**

(b) When burned in oxygen, the only product is water. ..... [1]

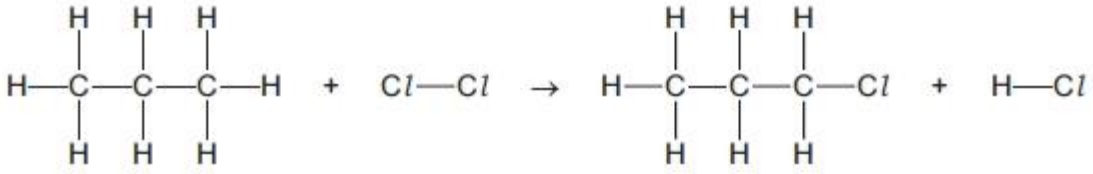
(e) When reacted with oxygen, the only product is carbon dioxide. ..... [1]

Topic Chem 4 **Q# 31/** iGCSE Chemistry/2015/w/Paper 32/Q4

4 **(a)** Propane reacts with chlorine to form a mixture of chloropropanes. This is a photochemical reaction.

(b) Bond breaking is an endothermic change and bond forming is an exothermic change.

Bond energy is the amount of energy in kJ/mol needed to break one mole of the specified bond.



Use the following bond energies to determine whether this reaction is exothermic or endothermic. You must show your reasoning.

Use the following bond energies to determine whether this reaction is exothermic or endothermic. You must show your reasoning.

bond	bond energies in kJ/mol
C–C*l*	338
C–H	412
C*l*–C*l*	242
H–C*l*	431
C–C	348

.....

.....

.....

..... [3]

Topic Chem 4 **Q# 32/** iGCSE Chemistry/2015/w/Paper 32/Q4

(d) Propanol reacts with methanoic acid to form the ester propyl methanoate.

$$CH_3CH_2CH_2OH + HCOOH \rightarrow HCOOCH_2CH_2CH_3 + H_2O$$

4.0 g of methanoic acid was reacted with 6.0 g of propanol.

(i) Calculate the M_r of methanoic acid = ... [1]

(ii) Calculate the M_r of propanol = ... [1]

(iii) Determine which one is the limiting reagent. Show your reasoning.

.....

.....

..... [2]

(iv) Calculate the maximum yield in grams of propyl methanoate, M_r = 88.

..... [1]

Topic Chem 4 **Q# 33/** iGCSE Chemistry/2015/w/Paper 32/Q1

1 Use your copy of the Periodic Table to help you answer some of these questions.

(c) Use the following ions to determine the formulae of the compounds.

ions OH^- Cr^{3+} Ba^{2+} SO_4^{2-}

compounds

(i) chromium(III) sulfate .....

(ii) barium hydroxide .....

[2]

Topic Chem 4 **Q# 34/** iGCSE Chemistry/2015/s/Paper 33/Q5

5 The law of constant composition states that all pure samples of a compound contain the same elements in the same proportion by weight.

A typical experiment to test this law is to prepare the same compound by different methods and then show that the samples have the same composition.

Methods of making copper(II) oxide include:

- heating copper carbonate,
- heating copper hydroxide,
- heating copper nitrate,
- heating copper foil in air.

(c) The table below shows the results obtained by reducing the copper(II) oxide produced by different methods to copper.

(i) Complete the table.

source of copper(II) oxide	mass of copper(II) oxide / g	mass of copper / g	percentage copper / %
$CuCO_3$	2.37	1.89	79.7
$Cu(OH)_2$	2.51	1.99	
$Cu(NO_3)_2$	2.11	1.68	
Cu and O_2	2.29	1.94	

[2]

(ii) One of the samples of copper(II) oxide is impure.

Identify this sample and suggest an explanation why the percentage of copper in this sample is bigger than in the other three samples.

.....

..... [2]

Topic Chem 4 **Q# 35/** iGCSE Chemistry/2015/s/Paper 32/Q6

(ii) Copper(II) nitrate forms a series of hydrates with the formula $Cu(NO_3)_2.xH_2O$.
All these hydrates decompose to form copper(II) oxide.
1 mole of $Cu(NO_3)_2.xH_2O$ forms 1 mole of CuO.

What is meant by 1 mole of a substance?

.....

..... [2]

(iii) 7.26 g of a hydrate, $Cu(NO_3)_2.xH_2O$, formed 2.4 g copper(II) oxide.

number of moles of CuO formed = ...

number of moles of $Cu(NO_3)_2.xH_2O$ in 7.26 g = ...

mass of 1 mole of $Cu(NO_3)_2.xH_2O$ = ... g

mass of 1 mole of $Cu(NO_3)_2$ is 188 g

the value of *x* in this hydrate = ...

[4]

Topic Chem 4 **Q# 36/** iGCSE Chemistry/2015/s/Paper 32/Q3

(b) In the lattice of calcium nitride, the ratio of calcium ions to nitride ions is 3 : 2.

(ii) In terms of ionic charges, explain why the ratio of ions is 3 : 2.

.....

..... [2]

Topic Chem 4 **Q# 37/** iGCSE Chemistry/2015/m/Paper 32/Q7

7 Ethanol is manufactured from glucose, $C_6H_{12}O_6$, by fermentation according to the following equation.

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

(b) In an experiment, 30.0 g of glucose was fermented.

(i) Calculate the number of moles of glucose in 30.0 g.

..... mol [2]

(ii) Calculate the maximum mass of ethanol that could be obtained from 30.0 g of glucose.

..... g [2]

(iii) Calculate the volume of carbon dioxide at room temperature and pressure that can be obtained from 30.0 g of glucose.

..... dm^3 [1]

Topic Chem 4 **Q# 38/** iGCSE Chemistry/2014/w/Paper 33/Q8

$$CoCO_3(s) + 2HCl(aq) \rightarrow CoCl_2(aq) + CO_2(g) + H_2O(l)$$

50 cm^3 of dilute hydrochloric acid, concentration 2.2 mol / dm^3, was heated and cobalt(II)

(c) 6.31 g of cobalt(II) chloride-6-water crystals were obtained. Calculate the percentage yield to 1 decimal place.

number of moles of HCl in 50 cm^3 of acid, concentration 2.2 mol / dm^3 = ...

maximum number of moles of $CoCl_2.6H_2O$ which could be formed = ...

mass of 1 mole of $CoCl_2.6H_2O$ = 238 g

maximum yield of $CoCl_2.6H_2O$ = ... g

percentage yield = ...%

[4]

Topic Chem 4 **Q# 39/** iGCSE Chemistry/2014/w/Paper 32/Q6

(iii) A mineral of the type $FeSO_4.xH_2O$ contains 37.2% of water.
Complete the calculation to determine x.

mass of one mole of H_2O = 18 g

mass of water in 100 g of $FeSO_4.xH_2O$ = 37.2 g

number of moles of H_2O in 100 g of $FeSO_4.xH_2O$ = ...

mass of $FeSO_4$ in 100 g of $FeSO_4.xH_2O$ = ... g

mass of one mole of $FeSO_4$ = 152 g

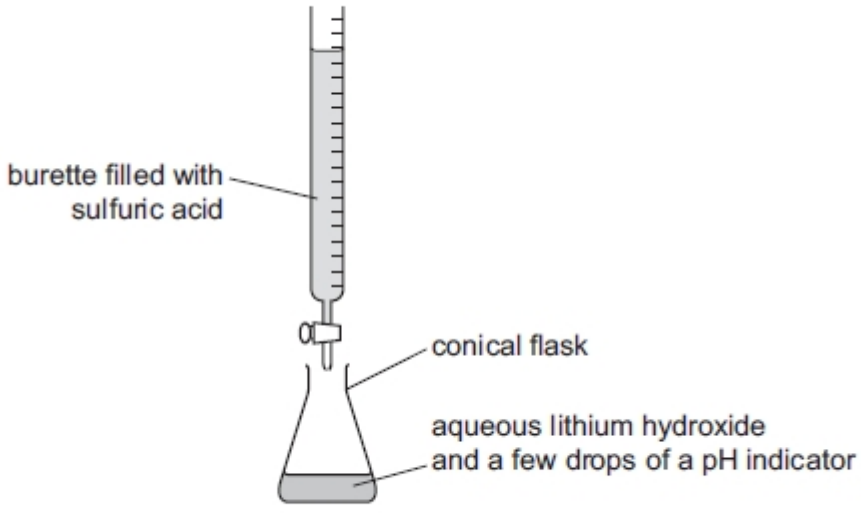
number of moles of $FeSO_4$ in 100 g of $FeSO_4.xH_2O$ = ...

x = ...

[4]

Topic Chem 4 **Q# 40/** iGCSE Chemistry/2014/s/Paper 32/Q7

7 The soluble salt hydrated lithium sulfate is made by titration from the soluble base lithium hydroxide.



(a) The sulfuric acid is added slowly from the burette until the indicator just changes colour. The volume of sulfuric acid needed to just neutralise the lithium hydroxide is noted.

(b) Using 25.0 cm^3 of aqueous lithium hydroxide, concentration 2.48 mol/dm^3, 2.20 g of hydrated lithium sulfate was obtained.
Calculate the percentage yield, giving your answer to **one** decimal place.

$$2LiOH + H_2SO_4 \rightarrow Li_2SO_4 + 2H_2O$$

$$Li_2SO_4 + H_2O \rightarrow Li_2SO_4.H_2O$$

Number of moles of LiOH used = ...

Number of moles of $Li_2SO_4.H_2O$ which could be formed = ...

Mass of one mole of $Li_2SO_4.H_2O$ = 128 g

Maximum yield of $Li_2SO_4.H_2O$ = ... g

Percentage yield = ...% [4]

(c) An experiment was carried out to show that the formula of the hydrated salt is $Li_2SO_4.H_2O$. A sample of the hydrated salt was weighed and its mass recorded. It was then heated and the anhydrous salt was weighed. This procedure was repeated until two consecutive masses were the same. This procedure is called 'heating to constant mass'.

(i) What is the reason for heating to constant mass?

..... [1]

(ii) The mass of the hydrated salt is m_1 and the mass of the anhydrous salt is m_2. Explain how you could show that the hydrated salt has **one** mole of water of crystallisation per mole of the anhydrous salt.

.....

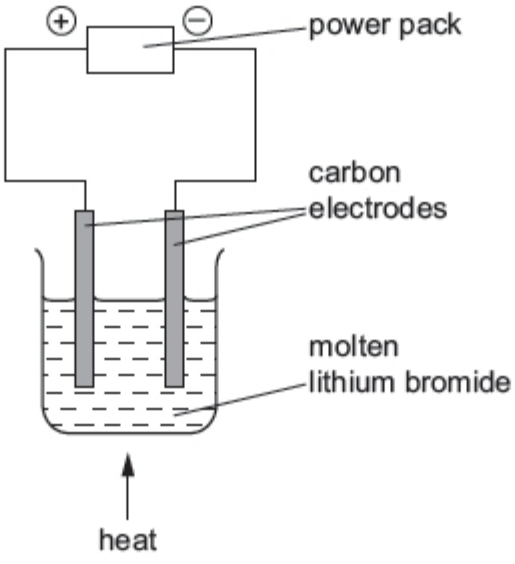
.....

..... [3]

Topic Chem 5 **Q# 41/** iGCSE Chemistry/2015/w/Paper 33/Q3

3 Lithium bromide is an ionic compound. It can be electrolysed when it is molten or in aqueous solution. It cannot be electrolysed as a solid.

(b) The diagram shows the electrolysis of molten lithium bromide.



(i) Mark on the diagram the direction of the electron flow. [1]

(ii) Write an ionic equation for the reaction at the negative electrode (cathode).

..... [1]

(iii) Write an ionic equation for the reaction at the positive electrode (anode).

..... [2]

(c) When aqueous lithium bromide is electrolysed, a colourless gas is formed at the negative electrode and the solution becomes alkaline.

Explain these observations and include an equation in your explanation.

.....

.....

.....

..... [3]

Topic Chem 5 **Q# 42/** iGCSE Chemistry/2015/w/Paper 32/Q3

3 Two of the main uses of zinc are for galvanising and for making alloys.

One of the main ores of zinc is zinc blende, ZnS. There are two stages in the extraction of zinc from this ore.

(a) Stage 1 Zinc oxide is made from zinc blende.

(c) The zinc produced by this process is impure. It can be purified by electrolysis using a method which is similar to the purification of copper. Under the conditions used in the process, zinc is the product at the negative electrode (cathode).

Complete the following description of this purification.

The electrolyte is aqueous ..... [1]

The negative electrode (cathode) is made of ..... [1]

The positive electrode (anode) is impure zinc.

The equation for the reaction at the cathode is ..... [1]

The equation for the reaction at the anode is ..... [1]

Explain why the concentration of the electrolyte does **not** change.

.....

..... [2]

Topic Chem 5 **Q# 43/** iGCSE Chemistry/2015/s/Paper 32/Q3

3 Calcium reacts with nitrogen to form the ionic compound calcium nitride, Ca_3N_2.

(a) Draw a diagram, based on the correct formula, which shows the charges on the ions and the arrangement of the electrons around the negative ion.

Use o to represent an electron from a calcium atom.
Use x to represent an electron from a nitrogen atom.

[3]

(b) In the lattice of calcium nitride, the ratio of calcium ions to nitride ions is 3:2.

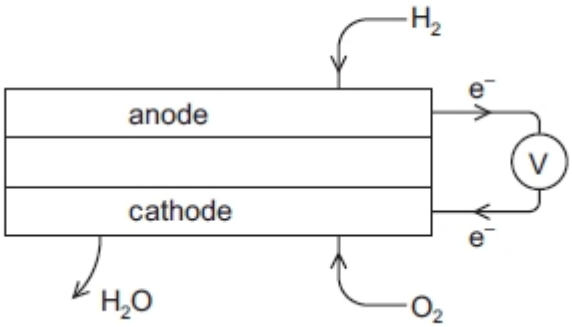
(i) What is meant by the term *lattice*?

.....

..... [2]

Topic Chem 5 **Q# 44/** iGCSE Chemistry/2014/w/Paper 33/Q4

4 A fuel cell produces electrical energy by the oxidation of a fuel by oxygen.
The fuel is usually hydrogen but methane and methanol are two other fuels which may be used.
A diagram of a hydrogen fuel cell is given below.



(b) Write the equation for the chemical reaction that takes place in a hydrogen fuel cell.

..... [1]

(c) **(i)** At which electrode does oxidation occur? Explain your choice.

..... [1]

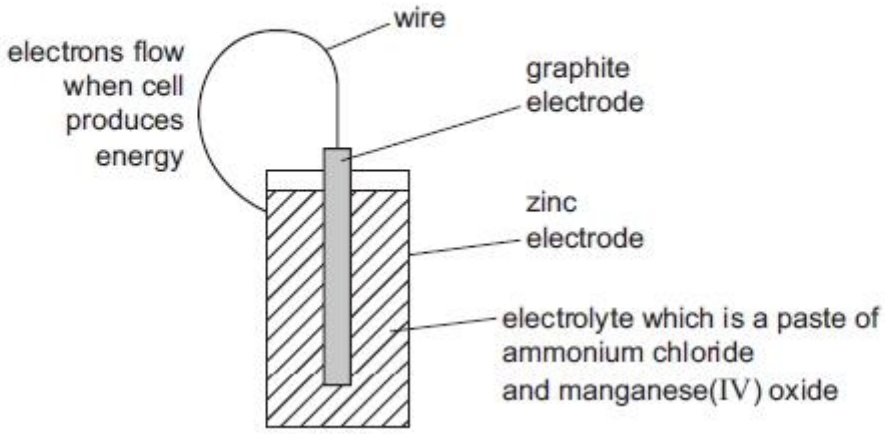
(ii) Write an ionic equation for the reaction at this electrode.

..... [2]

Topic Chem 5 **Q# 45/** iGCSE Chemistry/2014/w/Paper 32/Q4

4 Zinc is an important metal. Its uses include making alloys and the construction of dry cells (batteries).

(d) A dry cell (battery) has a central rod, usually made of graphite. This is the positive electrode which is surrounded by the electrolyte, typically a paste of ammonium chloride and manganese(IV) oxide, all of which are in a zinc container which is the negative electrode.



(i) Draw an arrow on the diagram to indicate the direction of electron flow. [1]

(ii) Suggest why the electrolyte is a paste.

..... [1]

(iii) The following changes occur in a dry cell.
For each change, decide if it is oxidation or reduction and give a reason for your choice.

Zn to Zn^{2+}

.....

manganese(IV) oxide to manganese(III) oxide

.....

[2]

Topic Chem 5 **Q# 46/** iGCSE Chemistry/2014/s/Paper 33/Q7

7 Aluminium is obtained from purified alumina, Al_2O_3, by electrolysis.

(b) Describe the extraction of aluminium from alumina. Include the electrolyte, the electrodes and the reactions at the electrodes.

.....

.....

.....

.....

.....

.....

..... [6]

(c) Aluminium is resistant to corrosion. It is protected by an oxide layer on its surface. The thickness of this oxide layer can be increased by anodising.

(ii) Anodising is an electrolytic process. Dilute sulfuric acid is electrolysed with an aluminium object as the anode. The thickness of the oxide layer is increased. Complete the equations for the reactions at the aluminium anode.

.....OH^- → O_2 + $2H_2O$ + ...e^-

....Al + ... → .....Al_2O_3 [4]

Topic Chem 5 **Q# 47/** iGCSE Chemistry/2014/s/Paper 32/Q5

(b) Chlorine is made by the electrolysis of concentrated aqueous sodium chloride.
Describe this electrolysis. Write ionic equations for the reactions at the electrodes and name the sodium compound formed.

.....

.....

.....

.....

.....

..... [5]

Topic Chem 6

Q# 48/ iGCSE Chemistry/2014/w/Paper 33/Q5

(b) The ions present in aqueous sodium chloride are $Na^+(aq)$, $Cl^-(aq)$, $H^+(aq)$ and $OH^-(aq)$.

The electrolysis of concentrated aqueous sodium chloride forms three products. They are hydrogen, chlorine and sodium hydroxide.

(i) Explain how these **three** products are formed. Give ionic equations for the reactions at the electrodes.

.....

.....

.....

.....

..... [4]

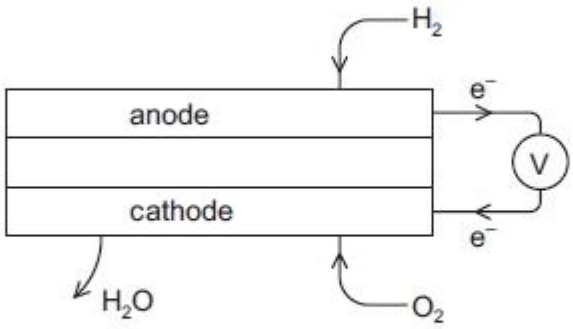
(ii) If the solution of the electrolyte is stirred, chlorine reacts with sodium hydroxide to form sodium chlorate(I), sodium chloride and water.
Write an equation for this reaction.

Cl_2 + ...NaOH → ..... + ... + ...

[2]

Topic Chem 6 **Q# 49/** iGCSE Chemistry/2014/w/Paper 33/Q4

4 A fuel cell produces electrical energy by the oxidation of a fuel by oxygen.
The fuel is usually hydrogen but methane and methanol are two other fuels which may be used.
A diagram of a hydrogen fuel cell is given below.



(a) When the fuel is hydrogen, the only product is water.
What additional product would be formed if methane was used?

..... [1]

(d) Fuel cells are used to propel cars.
Give **two** advantages of a fuel cell over a gasoline-fuelled engine.

.....

..... [2]

Topic Chem 6 **Q# 50/** iGCSE Chemistry/2014/w/Paper 32/Q2

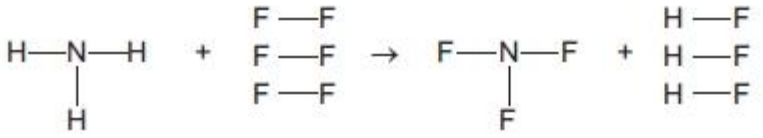
(ii) How can sodium metal be obtained from sodium chloride?

.....

..... [2]

Topic Chem 6 **Q# 51/** iGCSE Chemistry/2014/s/Paper 33/Q5

(e) Ammonia is used to make nitrogen trifluoride, NF_3.
Nitrogen trifluoride is essential to the electronics industry. It is made by the following reaction.



Determine if the above reaction is exothermic or endothermic using the following bond energies and by completing the following table. The first line has been done as an example.
Bond energy is the amount of energy, in kJ/mole, needed to break or make one mole of the bond.

bond	bond energy in kJ/mole
N–H	390
F–F	155
N–F	280
H–F	565

bond	energy change / kJ
N–H	(3 × 390) = 1170
F–F	
N–F	
H–F	

.....

..... [4]

Topic Chem 6 **Q# 52/** iGCSE Chemistry/2014/s/Paper 33/Q1

1 Choose a gas from the following list to answer the questions below. Each gas may be used once, more than once or not at all.

ammonia **carbon dioxide** **carbon monoxide** **fluorine**

hydrogen **krypton** **nitrogen** **propene** **sulfur dioxide**

(g) It burns to form water as the only product. ..... [1]

Topic Chem 6 **Q# 53/** iGCSE Chemistry/2014/s/Paper 32/Q2

2 **(a)** Natural gas, which is mainly methane, is a fossil fuel.

(i) What is meant by the term *fuel*?

.....

..... [1]

(iii) Name a **solid** fuel which is not a fossil fuel.

..... [1]

Topic Chem 7

Q# 54/ iGCSE Chemistry/2015/w/Paper 33/Q5

(b) Sulfurous acid forms salts called sulfites, which contain the ion SO_3^{2-}.

When barium nitrate solution is added to aqueous sulfurous acid, a white precipitate, **A**, forms.

Bromine water changes from brown to colourless when added to aqueous sulfurous acid.

Bromine oxidises sulfurous acid. When this solution is tested with acidified barium nitrate solution, a different white precipitate, **B**, is formed.

(iii) Write an ionic equation for the reduction of the bromine molecule.

..... [1]

Topic Chem 7 **Q# 55/** iGCSE Chemistry/2015/w/Paper 33/Q3 NOT WITH Q3 bii or biii

3 Lithium bromide is an ionic compound. It can be electrolysed when it is molten or in aqueous solution. It cannot be electrolysed as a solid.

The half equations for this reaction are given below:

$Li^+ + e^- \rightarrow Li$ / $Li^+ \rightarrow Li - e^-$;

$2Br^- \rightarrow Br_2 + 2e^-$ / $2Br^- - 2e^- \rightarrow Br_2$

(iv) Which ion is oxidised? Explain your answer.

.....

..... [2]

Topic Chem 7 **Q# 56/** iGCSE Chemistry/2015/w/Paper 32/Q6

6 The table below shows the elements in the third period of the Periodic Table, the number of electrons in their outer energy level, their oxidation state in their common compounds and their melting points.

element	Na	Mg	Al	Si	P	S	Cl	Ar
number of outer electrons	1	2	3	4	5	6	7	8
oxidation state	+1	+2	+3	+4/–4	–3	–2	–1	0
melting point/°C	98	650	660	1414	317	115	–101	–189

(a) Describe and explain the variation in oxidation state across the period.

.....

.....

..... [3]

Topic Chem 7 **Q# 57/** iGCSE Chemistry/2015/w/Paper 32/Q4

4 **(a)** Propane reacts with chlorine to form a mixture of chloropropanes. This is a photochemical reaction.

(i) What is meant by the phrase *photochemical reaction*?

.....

..... [1]

Topic Chem 7 **Q# 58/** iGCSE Chemistry/2015/s/Paper 33/Q6

(d) Photosynthesis is an unusual endothermic reaction.

(i) Where does the energy for photosynthesis come from?

..... [1]

(ii) Give the word equation for photosynthesis.

..... [1]

Topic Chem 7 **Q# 59/** iGCSE Chemistry/2015/s/Paper 33/Q3

3 Quicklime, which is calcium oxide, is made by heating limestone in a furnace.

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

The reaction does not come to equilibrium.

(a) Suggest why the conversion to calcium oxide is complete.

..... [1]

Topic Chem 7 **Q# 60/** iGCSE Chemistry/2015/s/Paper 32/Q7

7 Alcohols can be made by fermentation or from petroleum.

(a) Ethanol can be made by the fermentation of glucose.

$$C_6H_{12}O_6(aq) \xrightarrow{\text{yeast}} 2C_2H_5OH(aq) + 2CO_2(g) \quad \text{exothermic reaction}$$

Yeast are living single-cell fungi which ferment glucose by anaerobic respiration. This reaction is catalysed by enzymes from the yeast.

(iii) What are enzymes?

..... [1]

(iv) Suggest a method of measuring the rate of this reaction.

.....

..... [1]

(b) The following observations were noted.

- When a small amount of yeast was added to the aqueous glucose the reaction started and the solution went slightly cloudy.
- The reaction rate increased and the solution became cloudier and warmer.
- After a while, the reaction rate decreased and eventually stopped, leaving a 14% solution of ethanol in water.

(i) Why did the reaction rate increase?

..... [1]

(ii) Suggest an explanation for the increase in cloudiness of the solution.

..... [1]

(iii) Give **two** reasons why the fermentation stopped.

.....

..... [2]

Topic Chem 7 **Q# 61/** iGCSE Chemistry/2015/s/Paper 32/Q6

(b) All nitrates decompose when heated. The extent to which a nitrate decomposes is determined by the metal in the salt.

(ii) Sodium nitrite is a reducing agent.

What would be observed if an excess of sodium nitrite solution was added to a solution of acidified potassium manganate(VII)?

..... [2]

Topic Chem 7 **Q# 62/** iGCSE Chemistry/2015/s/Paper 32/Q3

(c) The reaction between calcium and nitrogen to form calcium nitride is a redox reaction.

In terms of electron transfer, explain why calcium is the reducing agent.

.....

.....

.....

..... [3]

Topic Chem 7 **Q# 63/** iGCSE Chemistry/2014/w/Paper 33/Q8

8 **(a)** Describe how cobalt chloride paper can be used to test for the presence of water.

.....

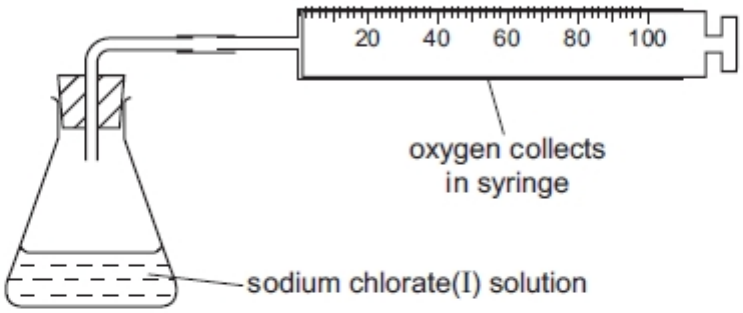
..... [2]

Topic Chem 7 **Q# 64/** iGCSE Chemistry/2014/w/Paper 33/Q5

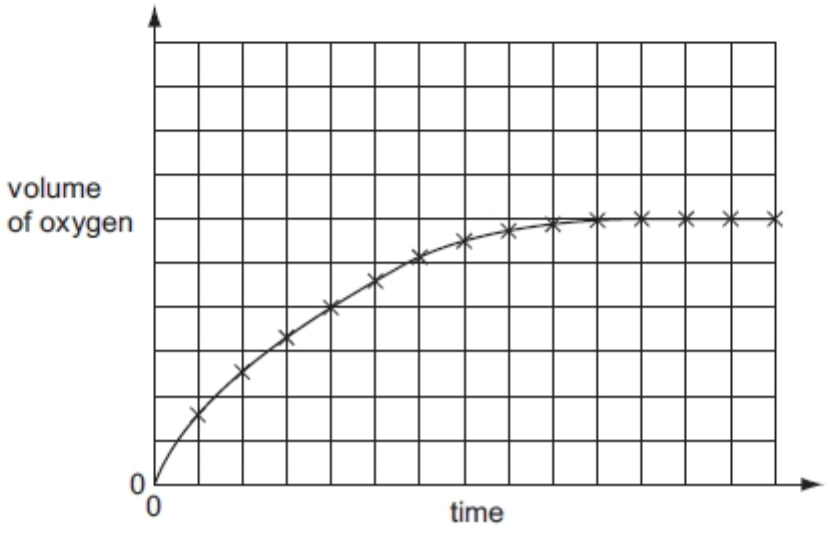
5 **(a)** Sodium chlorate(I) decomposes to form sodium chloride and oxygen. The rate of this reaction is very slow at room temperature provided the sodium chlorate(I) is stored in a dark bottle to prevent exposure to light.

$$2NaClO \rightarrow 2NaCl + O_2$$

The rate of this decomposition can be studied using the following experiment.



Sodium chlorate(I) is placed in the flask and 0.2 g of copper(II) oxide is added. This catalyses the decomposition of the sodium chlorate(I) and the volume of oxygen collected is measured every minute. The results are plotted to give a graph of the type shown below.



7

(i) Explain why the gradient (slope) of this graph decreases with time.

.....

..... [2]

(ii) Cobalt(II) oxide is a more efficient catalyst for this reaction than copper(II) oxide.
Sketch, on the grid, the graph for the reaction catalysed by cobalt(II) oxide.
All other conditions were kept constant. [2]

(iii) What can you deduce from the comment that sodium chlorate(I) has to be shielded from light?

.....

..... [1]

(iv) Explain, in terms of collisions between particles, why the initial gradient would be steeper if the experiment was repeated at a higher temperature.

.....

.....

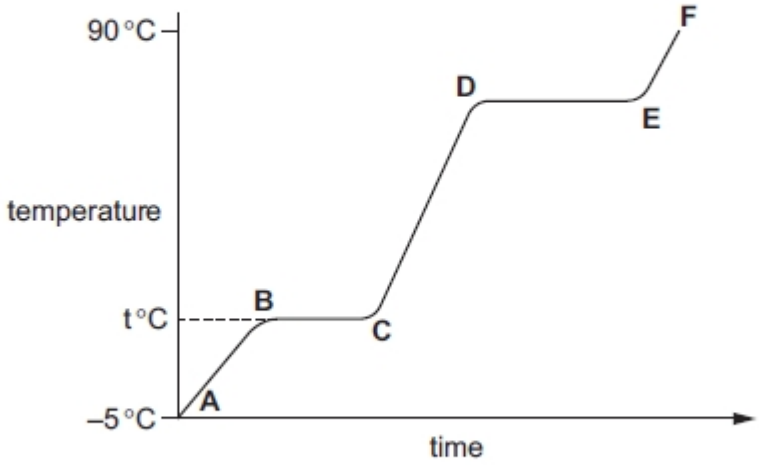
.....

..... [3]

Topic Chem 7 **Q# 65/** iGCSE Chemistry/2014/w/Paper 33/Q2

2 Compound X is a colourless liquid at room temperature.

(a) A sample of pure X was slowly heated from –5.0 °C, which is below its melting point, to 90 °C, which is above its boiling point. Its temperature is measured every minute and the results are represented on the graph.



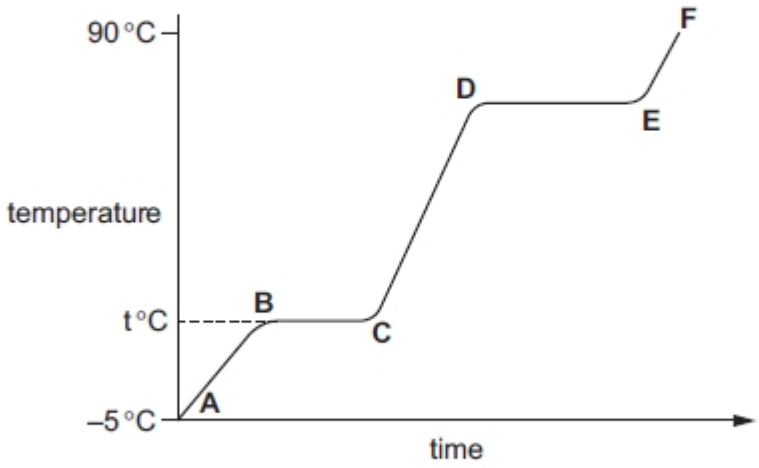
(i) Complete the equation for the equilibrium present in the region **BC**.

X(s) ⇌ ..... [1]

Topic Chem 7 **Q# 66/** iGCSE Chemistry/2014/w/Paper 33/Q2

2 Compound X is a colourless liquid at room temperature.

(a) A sample of pure X was slowly heated from –5.0 °C, which is below its melting point, to 90 °C, which is above its boiling point. Its temperature is measured every minute and the results are represented on the graph.



(i) Complete the equation for the equilibrium present in the region **BC**.

$X(s) \rightleftharpoons$ ..... [1]

Topic Chem 7 **Q# 67/** iGCSE Chemistry/2014/w/Paper 32/Q6

6 Sulfuric acid is an important acid, both in the laboratory and in industry.
Sulfuric acid is manufactured in the Contact Process. Originally, it was made by heating metal sulfates and by burning a mixture of sulfur and potassium nitrate.

(b) A group of naturally occurring minerals have the formula of the type $FeSO_4.xH_2O$ where x is 1, 4, 5, 6 or 7. The most common of these minerals is iron(II) sulfate-7-water.

(i) When this mineral is heated gently it dehydrates.

$$\underset{\text{green}}{FeSO_4.7H_2O} \rightleftharpoons \underset{\text{pale yellow}}{FeSO_4} + 7H_2O$$

Describe how you could show that this reaction is reversible.

.....

.....

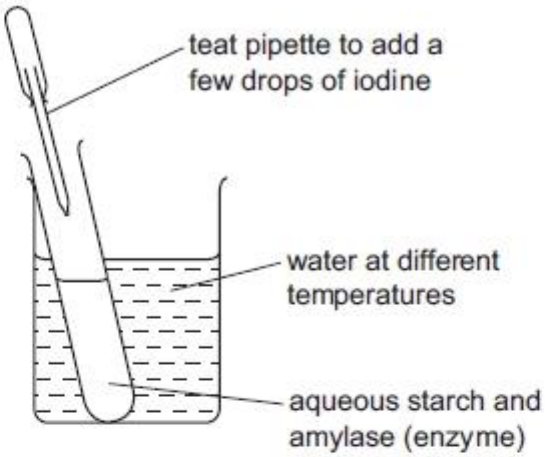
..... [2]

Topic Chem 7 **Q# 68/** iGCSE Chemistry/2014/w/Paper 32/Q5

(b) Starch hydrolyses to glucose in the presence of the enzyme, amylase.
What is meant by the term *enzyme*?

..... [2]

(c) The effect of temperature on this reaction can be studied by the experiment shown below.
Starch and iodine form a blue-black colour.
Glucose and iodine do not form a blue-black colour.



The experiment is set up as in the diagram and the time measured for the mixture to change from blue-black to colourless. The experiment is repeated at different temperatures.
Typical results of this experiment are given in the table below.

experiment	temperature / °C	time for blue-black colour to disappear / min
A	20	30
B	40	15
C	70	remained blue-black

(i) Put the experiments in order of reaction rate – slowest first and fastest last.

..... [2]

(ii) Explain why the reaction rates in experiments A and B are different.

.....

.....

.....

..... [3]

(iii) Suggest why the colour remains blue-black in experiment C.

..... [1]

Topic Chem 7 **Q# 69/** iGCSE Chemistry/2014/s/Paper 33/Q3

3 **(a)** Biological catalysts produced by microbes cause food to deteriorate and decay.

(i) What is the name of these biological catalysts?

..... [1]

(ii) Freezing does not kill the microbes.
Suggest why freezing is still a very effective way of preserving food.

.....

..... [2]

Topic Chem 7 **Q# 70/** iGCSE Chemistry/2014/s/Paper 33/Q3

(c) Describe how the pea plant makes a sugar such as glucose.

.....

.....

.....

.....

..... [3]

Topic Chem 7 **Q# 71/** iGCSE Chemistry/2014/s/Paper 33/Q2

2 Explain each of the following in terms of the kinetic particle theory.

(a) The rate of most reactions increases at higher temperatures.

.....

.....

.....

..... [3]

Topic Chem 7 **Q# 72/** iGCSE Chemistry/2014/s/Paper 32/Q5

5 Carbonyl chloride is made from carbon monoxide and chlorine.

$$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$$

(a) Two methods of preparing carbon monoxide are from methane and oxygen, and from methane and steam.

(ii) The following reaction is used to make carbon monoxide and hydrogen.
The reaction is carried out at 1100 °C and normal pressure.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$$

The reaction is reversible and comes to equilibrium. Suggest why a high temperature is used.

.....

.....

..... [2]

(iii) What is the disadvantage of using a high pressure for the reaction given in **(a)(ii)**?

.....

..... [2]

Topic Chem 7 **Q# 73/** iGCSE Chemistry/2014/s/Paper 32/Q4

(d) A piece of magnesium was added to 100 cm^3 of an aqueous acid. The time taken for the metal to react completely was measured. This experiment was repeated using different aqueous acids. The same volume of acid was used in each experiment and the pieces of magnesium used were identical. In one experiment the reaction was carried out at a different temperature.

experiment	acid	concentration in mol/dm^3	temperature /°C	time /minutes
A	propanoic	1.0	20	5
B	propanoic	1.0	30	3
C	propanoic	0.5	20	8
D	hydrochloric	1.0	20	1

Explain the following in terms of collision rate between reacting particles.

(i) Why is the rate in experiment **C** slower than the rate in experiment **A**?

.....

.....

..... [2]

(ii) Why is the rate in experiment **B** faster than the rate in experiment **A**?

.....

.....

..... [2]

(iii) Why is the rate in experiment **D** faster than the rate in experiment **A**?

.....

.....

..... [3]

Topic Chem 7 **Q# 74/** iGCSE Chemistry/2014/s/Paper 32/Q1

1 The table below gives the electron distributions of atoms of different elements.

element	electron distribution
A	2 + 7
B	2 + 8 + 4
C	2 + 8 + 8 + 1
D	2 + 8 + 18 + 5
E	2 + 8 + 18 + 7
F	2 + 8 + 18 + 18 + 8

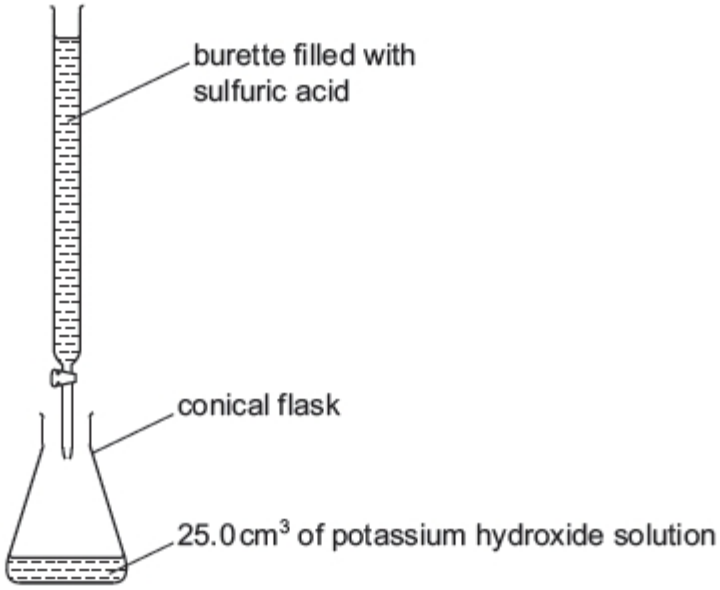
For each of the following, select an element or elements from the table that matches the description. Each element may be selected once, more than once or not at all.

(e) The only oxidation state of this element is 0.

..... [1]

Topic Chem 8 **Q# 75/** iGCSE Chemistry/2015/w/Paper 33/Q7

7 Two salts can be made from potassium hydroxide and sulfuric acid. They are potassium sulfate, K_2SO_4, and the acid salt potassium hydrogen sulfate, $KHSO_4$. They are both made by titration.



(b) In the conical flask there is a neutral solution of potassium sulfate which still contains the indicator used in the titration.

(i) Describe how you could obtain a solution of potassium sulfate without the indicator.

.....

..... [2]

(ii) Potassium hydrogen sulfate can be made by the following reaction.

$$KOH(aq) + H_2SO_4(aq) \rightarrow KHSO_4(aq) + H_2O(l)$$

Suggest how you could make a solution of potassium hydrogen sulfate without using an indicator.

.....

.....

..... [2]

(c) Describe a test which would distinguish between aqueous solutions of potassium sulfate and sulfuric acid.

test .....

result .....

[2]

5 Sulfuric acid is a strong acid. In aqueous solution, it ionises as shown below.

$$H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$$

(a) (i) What is meant by the term *acid*?

..... [1]

(ii) Sulfurous acid, H_2SO_3, is a weak acid.

State the difference between a weak acid and a strong acid.

.....

..... [2]

(b) Sulfurous acid forms salts called sulfites, which contain the ion SO_3^{2-}.

When barium nitrate solution is added to aqueous sulfurous acid, a white precipitate, **A**, forms.

Bromine water changes from brown to colourless when added to aqueous sulfurous acid.

Bromine oxidises sulfurous acid. When this solution is tested with acidified barium nitrate solution, a different white precipitate, **B**, is formed.

(i) Identify the white precipitate, **A**.

..... [1]

(ii) Identify the white precipitate, **B**.

..... [1]

(iv) Name the product formed by the oxidation of sulfurous acid.

..... [1]

(c) Complete the following word equations.

(i) magnesium hydroxide + dilute sulfuric acid

..... [1]

(ii) zinc + dilute sulfuric acid

..... [1]

(iii) copper carbonate + dilute sulfuric acid

..... [1]

(d) Write equations for the reaction of dilute sulfuric acid with each of the following.

(i) ammonia

..... [2]

(ii) sodium hydroxide

..... [2]

(iii) iron

..... [2]

Topic Chem 8 **Q# 77/** iGCSE Chemistry/2015/w/Paper 33/Q1

1 (a) Describe a chemical test which shows the presence of water.

test .....

colour change if water is present .....

.....

[3]

Topic Chem 8 **Q# 78/** iGCSE Chemistry/2015/w/Paper 32/Q6

(g) Describe how you could show that magnesium oxide is a basic oxide and not an amphoteric oxide.

.....

..... [2]

Topic Chem 8 **Q# 79/** iGCSE Chemistry/2015/s/Paper 33/Q4

(b) The burning of fossil fuels is largely responsible for the formation of acid rain. Two of the acids in acid rain are sulfuric acid and nitric acid.

(iii) Nitric acid contains nitrate ions.

Describe a test for nitrate ions.

.....

..... [2]

(iv) Explain how you could determine which one of two samples of acid rain had the higher concentration of hydrogen ions.

.....

..... [2]

Topic Chem 8 **Q# 80/** iGCSE Chemistry/2015/s/Paper 33/Q2

2 This question is concerned with the following oxides.

aluminium oxide
carbon monoxide
copper(II) oxide
silicon(IV) oxide
sodium oxide
sulfur dioxide
zinc oxide

Choose **one** oxide from the above list to match each of the following descriptions. An oxide may be used once, more than once or not at all.

(a) This oxide does not react with acid or alkali. ..... [1]

(b) This oxide reacts with water to give a strong alkali solution. ..... [1]

(d) This oxide is amphoteric. ..... [1]

(f) This oxide is soluble in water and it is acidic. ..... [1]

Topic Chem 8 **Q# 81/** iGCSE Chemistry/2015/s/Paper 32/Q5

5 Three common methods of preparing salts are shown below.

method **A** adding an excess of an insoluble base or carbonate or metal to a dilute acid and removing excess by filtration

method **B** using a burette and indicator

method **C** mixing two solutions to obtain the salt by precipitation

For each of the following salt preparations, choose a method, **A**, **B** or **C**. Name any additional reagent which is needed and complete the equation.

(a) the soluble salt, nickel chloride, from the insoluble compound nickel carbonate

method .....

reagent .....

word equation .....

[3]

(b) the insoluble salt, lead(II) bromide, from aqueous lead(II) nitrate

method .....

reagent .....

ionic equation ..... + ... → $PbBr_2$

[3]

(c) the soluble salt, lithium sulfate, from the soluble base lithium hydroxide

method .....

reagent .....

equation .....

[4]

Topic Chem 8 **Q# 82/** iGCSE Chemistry/2015/m/Paper 32/Q6

6 A student is told to produce the maximum amount of copper from a mixture of copper and copper(II) carbonate.

The student adds the mixture to an excess of dilute sulfuric acid in a beaker and stirs the mixture with a glass rod. The copper(II) carbonate reacts with the sulfuric acid, forming a solution of copper(II) sulfate but the copper does not react with the sulfuric acid.

The student then

- removes the unreacted copper from the mixture,
- converts the solution of copper(II) sulfate into copper by a series of reactions.

(a) Describe **two** things that the student would observe when the mixture is added to the dilute sulfuric acid.

.....

..... [2]

(c) The student then adds sodium hydroxide solution to the copper(II) sulfate solution to produce copper(II) hydroxide.

(i) Describe what the student would observe.

..... [1]

(ii) Write an **ionic** equation for this reaction.

..... [1]

Topic Chem 8 **Q# 83/** iGCSE Chemistry/2015/m/Paper 32/Q3

3 Ammonia is manufactured by the Haber process. Nitrogen and hydrogen are passed over a catalyst at a temperature of 450 °C and a pressure of 200 atmospheres.

The equation for the reaction is as follows.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The forward reaction is exothermic.

(h) Ammonia acts as a base when it reacts with sulfuric acid.

(i) What is a base?

..... [1]

(ii) Write a balanced equation for the reaction between ammonia and sulfuric acid.

..... [2]

Topic Chem 8 **Q# 84/** iGCSE Chemistry/2015/m/Paper 32/Q1

1 For each of the following, give the name of an element from Period 3 (sodium to argon), which matches the description.

(c) an element that forms a basic oxide of the type XO

..... [1]

(e) an element that forms an amphoteric oxide

..... [1]

Topic Chem 8 **Q# 85/** iGCSE Chemistry/2015/m/Paper 32/Q1

1 For each of the following, give the name of an element from Period 3 (sodium to argon), which matches the description.

Topic Chem 8 **Q# 86/** iGCSE Chemistry/2014/w/Paper 33/Q8

(b) Complete the description of the preparation of crystals of the soluble salt, cobalt(II) chloride-6-water, $CoCl_2.6H_2O$, from the insoluble base, cobalt(II) carbonate.

$$CoCO_3(s) + 2HCl(aq) \rightarrow CoCl_2(aq) + CO_2(g) + H_2O(l)$$

50 cm^3 of dilute hydrochloric acid, concentration 2.2 mol/dm^3, was heated and cobalt(II) carbonate was added in small amounts until .....

.....

.....

.....

.....

..... [4]

Topic Chem 8 **Q# 87/** iGCSE Chemistry/2014/w/Paper 33/Q6

6 Rubidium and strontium are very reactive metals at the top of the reactivity series. Because their ions have different charges, their compounds behave differently when heated.

(b) Strontium carbonate is similar to calcium carbonate. It is insoluble in water and it decomposes when heated. Rubidium carbonate is soluble in water and does not decompose when heated.

(i) Describe a method to prepare a pure sample of the insoluble salt, strontium carbonate, by precipitation.

.....

.....

.....

.....

..... [4]

Topic Chem 8 **Q# 88/** iGCSE Chemistry/2014/w/Paper 32/Q6

(c) When a mixture of sulfur and potassium nitrate is burned and the products are dissolved in water, sulfuric acid is formed.

(i) The sulfuric acid formed by this method is not pure. It contains another acid.
Deduce the identity of this acid.

..... [1]

Topic Chem 8 **Q# 89/** iGCSE Chemistry/2014/w/Paper 32/Q1

1 An important aspect of chemistry is purity and methods of purification.

chromatography **crystallisation** **diffusion** **dissolving**

evaporation **filtration** **fractional distillation** **simple distillation**

(ii) Describe how you would obtain a pure sample of copper(II) sulfate-5-water crystals from a mixture of copper(II) sulfate-5-water with copper(II) oxide using some of the techniques listed above.

.....

.....

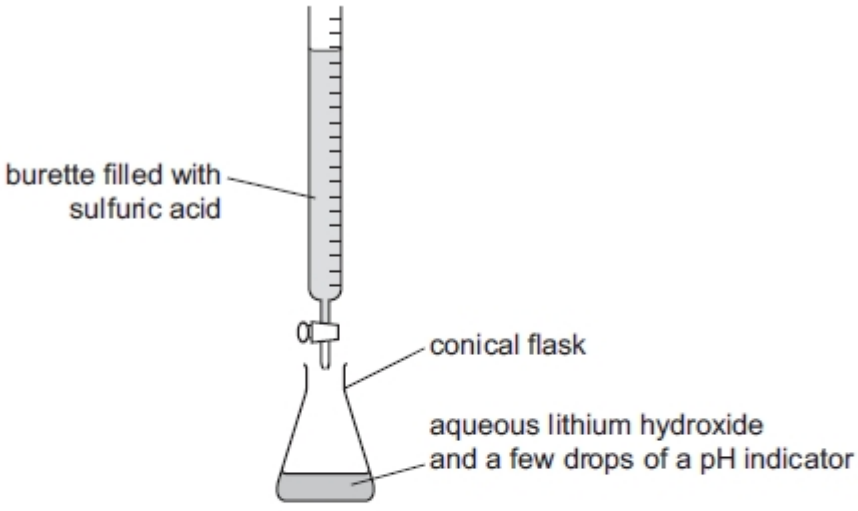
.....

.....

..... [4]

Topic Chem 8 **Q# 90/** iGCSE Chemistry/2014/s/Paper 32/Q7

7 The soluble salt hydrated lithium sulfate is made by titration from the soluble base lithium hydroxide.



(a) The sulfuric acid is added slowly from the burette until the indicator just changes colour. The volume of sulfuric acid needed to just neutralise the lithium hydroxide is noted.
Describe how you would continue the experiment to obtain pure dry crystals of hydrated lithium sulfate.

.....

.....

.....

.....

.....

.....

..... [5]

Topic Chem 8 **Q# 91/** iGCSE Chemistry/2014/s/Paper 32/Q6

(c) Scandium oxide is insoluble in water. Describe how you could show that it is an amphoteric oxide.

.....

.....

.....

..... [3]

Topic Chem 9

Q# 92/ iGCSE Chemistry/2015/w/Paper 33/Q6

6 A reactivity series of metals is given below.

most reactive ↓ least reactive

metal name	symbol
sodium	Na
lithium	Li
magnesium	Mg
zinc	Zn
manganese	Mn
iron	Fe
copper	Cu
rhodium	Rh

(a) Which **two** metals will react most vigorously with cold water?

..... [1]

(f) Manganese is a typical transition metal.

Predict **three** physical and **two** chemical properties of this metal.

physical properties

.....

.....

.....

chemical properties

.....

..... [5]

Topic Chem 9 **Q# 93/** iGCSE Chemistry/2015/w/Paper 33/Q2

2 Choose from the following list of gases. A gas may be chosen once, more than once or not at all.

sulfur dioxide **hydrogen** **methane** **carbon monoxide**

argon **ethene** **butane**

(d) It is used to provide an inert atmosphere for welding. ..... [1]

Topic Chem 9 **Q# 94/** iGCSE Chemistry/2015/m/Paper 32/Q1

1 For each of the following, give the name of an element from Period 3 (sodium to argon), which matches the description.

(d) an element used as an inert atmosphere in lamps

..... [1]

(f) an element that reacts vigorously with cold water to produce hydrogen

..... [1]

Topic Chem 9 **Q# 95/** iGCSE Chemistry/2014/w/Paper 33/Q3

(c) A mixture of a fullerene and potassium is an excellent conductor of electricity.

(iii) The mixture of fullerene and potassium has to be stored out of contact with air. There are substances in unpolluted air which will react with potassium.
Name **two** potassium compounds which could be formed when potassium is exposed to air.

..... [2]

Topic Chem 9 **Q# 96/** iGCSE Chemistry/2014/w/Paper 33/Q1

1 For each of the following elements give **one** physical property and **one** chemical property.

(a) bromine (Br_2)

physical property .....

chemical property .....

[2]

(c) manganese (Mn)

physical property .....

chemical property .....

[2]

Topic Chem 9 **Q# 97/** iGCSE Chemistry/2014/s/Paper 33/Q1

1 Choose a gas from the following list to answer the questions below. Each gas may be used once, more than once or not at all.

ammonia **carbon dioxide** **carbon monoxide** **fluorine**

hydrogen **krypton** **nitrogen** **propene** **sulfur dioxide**

(c) It is a noble gas. ..... [1]

(e) It is a very reactive non-metal. ..... [1]

Topic Chem 9 **Q# 98/** iGCSE Chemistry/2014/s/Paper 32/Q6

6 Scandium, proton number 21, is not a typical transition element.

(a) Scandium is a low density metal which has only one oxidation state in its compounds. Scandium compounds are white solids which form colourless solutions. Titanium, the next metal in the period, is a far more typical transition element. How would the properties of titanium differ from those of scandium?

.....

.....

.....

..... [3]

Topic Chem 9 **Q# 99/** iGCSE Chemistry/2014/s/Paper 32/Q1

1 The table below gives the electron distributions of atoms of different elements.

element	electron distribution
A	2 + 7
B	2 + 8 + 4
C	2 + 8 + 8 + 1
D	2 + 8 + 18 + 5
E	2 + 8 + 18 + 7
F	2 + 8 + 18 + 18 + 8

For each of the following, select an element or elements from the table that matches the description. Each element may be selected once, more than once or not at all.

(a) These **two** elements are in the same group.

..... [1]

(c) This element reacts violently with cold water.

..... [1]

(f) This element is bromine.

..... [1]

Topic Chem 10 **Q# 100/** iGCSE Chemistry/2015/w/Paper 33/Q6

6 A reactivity series of metals is given below.

	metal name	symbol
most reactive	sodium	Na
	lithium	Li
	magnesium	Mg
	zinc	Zn
	manganese	Mn
	iron	Fe
least reactive	copper	Cu
	rhodium	Rh

(b) Which **two** metals will not react with dilute hydrochloric acid?

..... [1]

(e) Describe a test-tube experiment which will show that manganese is more reactive than copper.

.....

.....

..... [3]

Topic Chem 10 **Q# 101/** iGCSE Chemistry/2015/w/Paper 32/Q5

5 Iron is extracted from its ore, hematite, in a blast furnace.

Substances added to the furnace are:

- iron ore, hematite, containing impurities such as silica, SiO_2
- air
- coke, C
- limestone, $CaCO_3$

Substances formed in the blast furnace are:

- molten iron
- molten slag
- waste gases such as carbon dioxide

(a) State the **two** functions of the coke used in the blast furnace.

.....

..... [2]

(b) Write an equation for the conversion of hematite, Fe_2O_3, to iron.

..... [2]

(c) Explain how the silica impurity is removed and separated from the molten iron.

.....

.....

.....

..... [3]

(d) The molten iron from the furnace is impure.
It contains impurities which include the element carbon.

Explain how the carbon is removed. Include an equation in your answer.

.....

.....

..... [3]

[Total: 10]

Topic Chem 10 **Q# 102/** iGCSE Chemistry/2015/w/Paper 32/Q3

3 Two of the main uses of zinc are for galvanising and for making alloys.

One of the main ores of zinc is zinc blende, ZnS. There are two stages in the extraction of zinc from this ore.

(a) Stage 1 Zinc oxide is made from zinc blende.

Describe how this is done and write a word equation for the reaction.

.....

.....

..... [2]

(b) Stage 2 Zinc oxide is reduced to zinc.

Write a word equation for the reduction of zinc oxide by coke.

..... [1]

(d) Brass is an alloy which contains zinc.

(i) Name the other metal in brass.

..... [1]

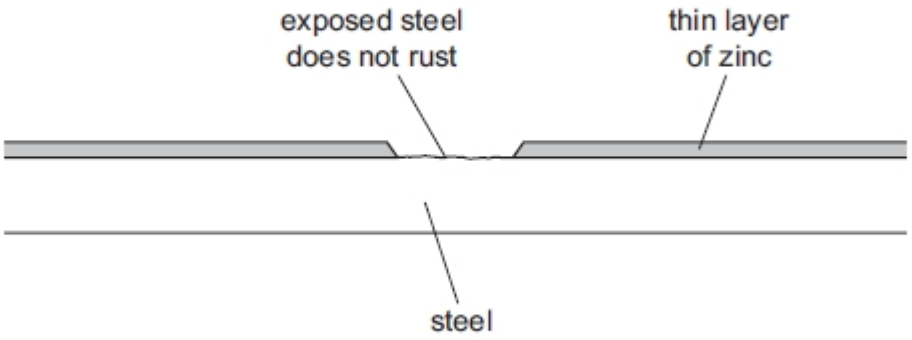
(ii) Suggest **two** reasons why an alloy such as brass is preferred to either of its constituent metals.

.....

..... [2]

(e) In an experiment to investigate the rate of rusting of steel, three pieces of steel were used. One piece of steel was completely coated with copper, one piece completely coated with zinc and the third piece was left uncoated. All three pieces were left exposed to the atmosphere.

(ii) The coating on both of the other two pieces was scratched, exposing the steel.



The piece of steel coated with zinc still did not rust but the copper-coated piece of steel rusted very rapidly.

Explain these observations in terms of the formation of ions and the transfer of electrons.

.....

.....

.....

.....

..... [4]

Topic Chem 10 **Q# 103/** iGCSE Chemistry/2015/w/Paper 32/Q3

(e) In an experiment to investigate the rate of rusting of steel, three pieces of steel were used. One piece of steel was completely coated with copper, one piece completely coated with zinc and the third piece was left uncoated. All three pieces were left exposed to the atmosphere.

(i) Explain why the uncoated piece started to rust.

.....

..... [1]

Topic Chem 10 **Q# 104/** iGCSE Chemistry/2015/s/Paper 33/Q6

6 Chemical reactions are always accompanied by an energy change.

(a) Aluminium is extracted by the electrolysis of a molten mixture which contains aluminium oxide, Al_2O_3. This decomposes to form aluminium at the negative electrode and oxygen at the positive electrode.

(i) Write an ionic equation for the reaction at the negative electrode.

..... [2]

(ii) Complete the ionic equation for the reaction at the positive electrode.

$2O^{2-} \rightarrow$ ..... + ...

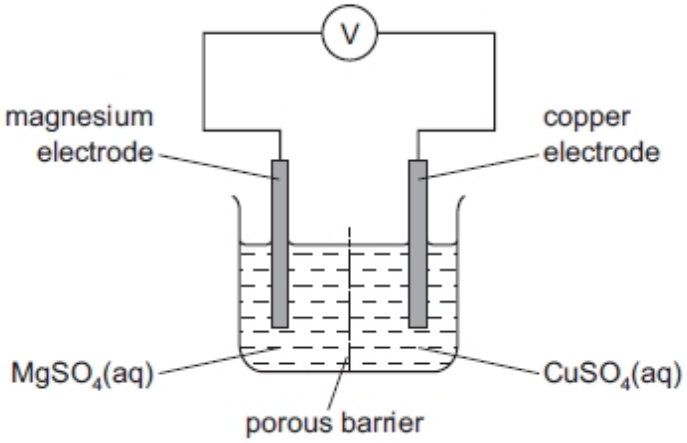
[2]

(iii) Is the reaction exothermic or endothermic? Explain your answer.

.....

..... [1]

(b) The cell shown below can be used to determine the order of reactivity of metals.



(i) Is the reaction in the cell exothermic or endothermic? Explain your answer.

.....

..... [1]

(ii) Explain why the mass of the magnesium electrode decreases and the mass of the copper electrode increases.

.....

..... [2]

(iii) How could you use this cell to determine which is the more reactive metal, magnesium or manganese?

.....

..... [2]

Topic Chem 10 **Q# 105/** iGCSE Chemistry/2015/s/Paper 33/Q5

5 The law of constant composition states that all pure samples of a compound contain the same elements in the same proportion by weight.

A typical experiment to test this law is to prepare the same compound by different methods and then show that the samples have the same composition.

Methods of making copper(II) oxide include:

- heating copper carbonate,
- heating copper hydroxide,
- heating copper nitrate,
- heating copper foil in air.

(a) Complete the following equations.

(i) $CuCO_3 \rightarrow$ ..... + ... [1]

(ii) $Cu(OH)_2 \rightarrow$ ..... + ... [1]

(iii) $2Cu(NO_3)_2 \rightarrow$ ..... + $4NO_2$ + ... [2]

(b) Copper oxide can be reduced to copper by heating in hydrogen.

(i) What colour change would you observe during the reduction?

..... [1]

(ii) Explain why the copper must be allowed to cool in hydrogen before it is exposed to air.

..... [2]

(iii) Name another gas which can reduce copper(II) oxide to copper.

..... [1]

(iv) Name a solid which can reduce copper(II) oxide to copper.

..... [1]

Topic Chem 10 **Q# 106/** iGCSE Chemistry/2015/s/Paper 32/Q6

(b) All nitrates decompose when heated. The extent to which a nitrate decomposes is determined by the metal in the salt.

(i) Sodium nitrate decomposes to form sodium nitrite, $NaNO_2$.

Write the equation for decomposition of sodium nitrate.

..... [2]

(iii) Copper(II) nitrate decomposes to form copper(II) oxide, nitrogen dioxide and oxygen.

What is the relationship between the extent of decomposition and the reactivity of the metal in the nitrate?

.....

..... [1]

(c) The equation for the decomposition of copper(II) nitrate is given below.

$$2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$$

(i) Predict what you would observe when copper(II) nitrate is heated.

.....

.....

..... [3]

6 A student is told to produce the maximum amount of copper from a mixture of copper and copper(II) carbonate.

The student adds the mixture to an excess of dilute sulfuric acid in a beaker and stirs the mixture with a glass rod. The copper(II) carbonate reacts with the sulfuric acid, forming a solution of copper(II) sulfate but the copper does not react with the sulfuric acid.

The student then

- removes the unreacted copper from the mixture,
- converts the solution of copper(II) sulfate into copper by a series of reactions.

(d) After separating the copper(II) hydroxide from the mixture, the copper(II) hydroxide is heated strongly. The copper(II) hydroxide decomposes into copper(II) oxide and steam.

(i) Write an equation for the decomposition of copper(II) hydroxide. Include state symbols.

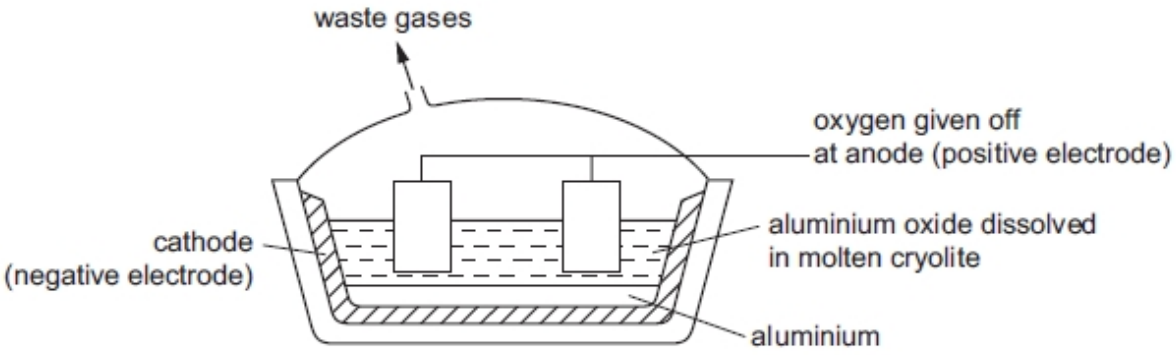
..... [2]

(ii) Name a non-metallic element that can be used to convert copper(II) oxide into copper.

..... [1]

5 Aluminium and iron are extracted from their ores by different methods.

Aluminium is extracted from its purified oxide ore by electrolysis.



(a) What is the name of the ore of aluminium which consists mainly of aluminium oxide?

..... [1]

(b) The electrodes are both made of the same substance.

Name this substance.

..... [1]

(c) Aluminium oxide is dissolved in molten cryolite before it is electrolysed.

Give **two** reasons why aluminium oxide dissolved in molten cryolite is electrolysed rather than molten aluminium oxide alone.

.....

..... [2]

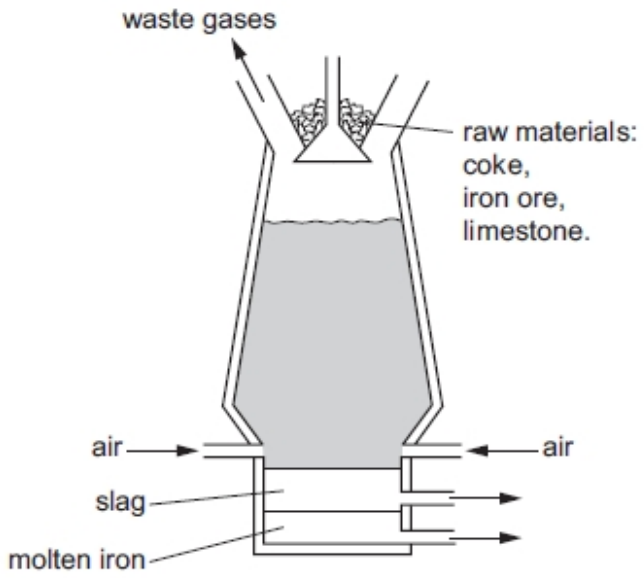
(d) Write the **ionic** equations for the reactions at the electrodes in this electrolysis.

anode (positive electrode) .....

cathode (negative electrode) .....

[2]

(e) Iron is extracted from its oxide ore by reduction using carbon in a blast furnace.



(i) Place the elements aluminium, carbon and iron in order of reactivity with the **least** reactive element first.

..... [1]

(ii) Use your answer to **(e)(i)** to explain why iron is extracted by reduction using carbon but aluminium is not.

.....

..... [1]

(f) What is the name of the ore of iron which consists mainly of iron(III) oxide?

..... [1]

(g) Write balanced equations for the reactions occurring in the blast furnace which involve

(i) the complete combustion of coke (carbon),

..... [1]

(ii) the production of carbon monoxide from carbon dioxide,

..... [1]

(iii) the reduction of iron(III) oxide,

..... [1]

(iv) the formation of slag.

..... [1]

Topic Chem 10 **Q# 109/** iGCSE Chemistry/2014/w/Paper 33/Q6

6 Rubidium and strontium are very reactive metals at the top of the reactivity series. Because their ions have different charges, their compounds behave differently when heated.

(ii) Complete the equation for the decomposition of strontium carbonate.

$$SrCO_3 \rightarrow \text{.....} + \text{.....}$$

[1]

(c) Metal nitrates decompose when heated.

(i) Rubidium nitrate decomposes as follows:

$$2RbNO_3 \rightarrow 2RbNO_2 + O_2$$

What is the name of the compound $RbNO_2$?

..... [1]

(ii) The nitrates of most other metals decompose in a different way.
Complete the equation for the decomposition of strontium nitrate.

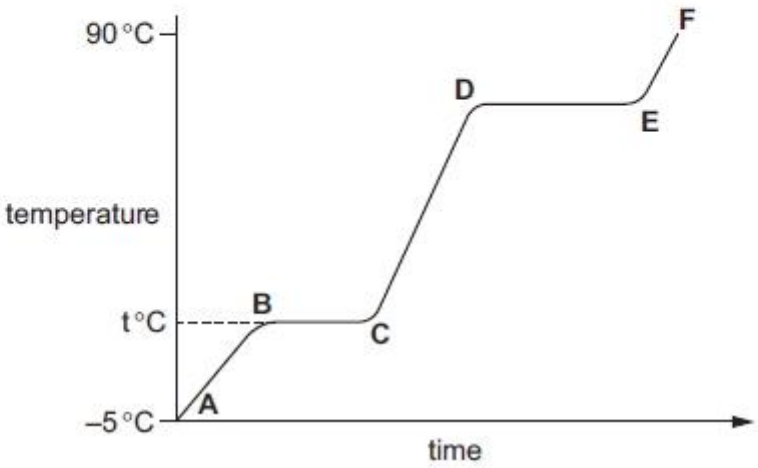
$$\text{.....}Sr(NO_3)_2 \rightarrow \text{.....} + 4NO_2 + \text{.....}$$

[2]

Topic Chem 10 **Q# 110/** iGCSE Chemistry/2014/w/Paper 33/Q2

2 Compound X is a colourless liquid at room temperature.

(a) A sample of pure X was slowly heated from –5.0 °C, which is below its melting point, to 90 °C, which is above its boiling point. Its temperature is measured every minute and the results are represented on the graph.



(iv) What would be the difference in the region **BC** if an impure sample of X had been used?

..... [1]

Topic Chem 10 **Q# 111/** iGCSE Chemistry/2014/w/Paper 33/Q1

1 For each of the following elements give **one** chemical property.

(b) $carbon_{graphite}$(C)

chemical property ..... [1]

Topic Chem 10 **Q# 112/** iGCSE Chemistry/2014/w/Paper 32/Q6

6 Sulfuric acid is an important acid, both in the laboratory and in industry.
Sulfuric acid is manufactured in the Contact Process. Originally, it was made by heating metal sulfates and by burning a mixture of sulfur and potassium nitrate.

(ii) The heat causes some of the potassium nitrate to decompose.
Write the equation for the action of heat on potassium nitrate.

..... [2]

Topic Chem 10 **Q# 113/** iGCSE Chemistry/2014/w/Paper 32/Q4

4 Zinc is an important metal. Its uses include making alloys and the construction of dry cells (batteries).

(a) Name an alloy which contains zinc. What is the other metal in this alloy?

name of alloy .....

other metal in alloy .....

[2]

(b) The main ore of zinc is zinc blende, ZnS.

(i) The ore is heated in the presence of air to form zinc oxide and sulfur dioxide.
Write the equation for this reaction.

..... [2]

Topic Chem 10 **Q# 114/** iGCSE Chemistry/2014/w/Paper 32/Q2

2 Aluminium is obtained by the reduction of aluminium ions to aluminium atoms.

(a) Write an ionic equation for the reduction of an aluminium ion to an aluminium atom.

..... [2]

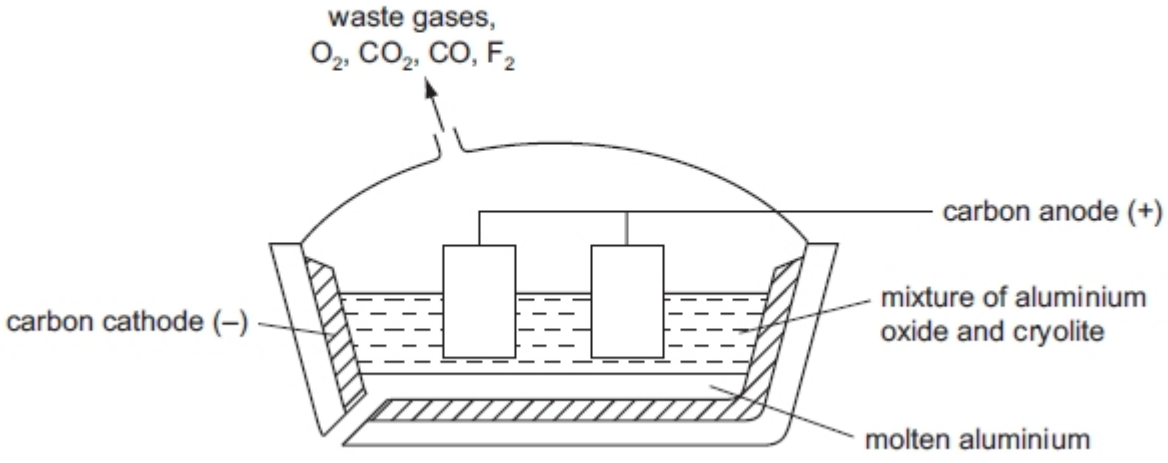
(b) The original method of extracting aluminium involved the reduction of aluminium chloride using the reactive metal sodium. Aluminium obtained by this method was very expensive due to the high cost of extracting sodium from sodium chloride.

(i) Complete the equation for this reduction.

$AlCl_3$ + ...Na → ..... + ...

[2]

(c) In the modern method, aluminium is obtained by the electrolysis of aluminium oxide (alumina) dissolved in molten cryolite, Na_3AlF_6.



(i) The major ore of aluminium is impure aluminium oxide.
What is the name of this ore?

..... [1]

(ii) This ore is a mixture of aluminium oxide, which is amphoteric, and iron(III) oxide which is basic.
Explain how these two oxides can be separated by the addition of aqueous sodium hydroxide.

.....

.....

..... [2]

(iii) Give **two** reasons why the electrolyte contains cryolite.

.....

.....

..... [2]

(iv) The mixture of gases evolved at the positive electrode includes:

carbon dioxide
carbon monoxide
fluorine
oxygen

Explain the presence of these gases in the gaseous mixture formed at the positive electrode. Include at least **one** equation in your explanation.

.....

.....

.....

.....

..... [5]

(d) A major use of aluminium is the manufacture of pots and pans. One reason for this is its resistance to corrosion.

(i) Explain why aluminium, a reactive metal, is resistant to corrosion.

.....

..... [1]

(ii) Suggest **two** other reasons why aluminium is suitable for making pots and pans.

.....

..... [2]

Topic Chem 10 **Q# 115/** iGCSE Chemistry/2014/s/Paper 33/Q7

7 Aluminium is obtained from purified alumina, Al_2O_3, by electrolysis.

(a) Alumina is obtained from the main ore of aluminium.
State the name of this ore.

..... [1]

(c) Aluminium is resistant to corrosion. It is protected by an oxide layer on its surface.
The thickness of this oxide layer can be increased by anodising.

(i) State a use of aluminium due to its resistance to corrosion.

..... [1]

Topic Chem 10 **Q# 116/** iGCSE Chemistry/2014/s/Paper 33/Q4

4 Iron from a blast furnace contains about 5% of the impurities – carbon, silicon, phosphorus and sulfur. Most of this impure iron is used to make steels, such as mild steel, and a very small percentage is used to make pure iron.

(a) Calcium oxide and oxygen are used to remove the impurities from the iron produced in the blast furnace.

(ii) Describe how these two chemicals remove the four impurities. Include at least one equation in your answer.

.....

.....

.....

.....

.....

.....

..... [5]

(iii) Mild steel is an alloy of iron and carbon.
Suggest why mild steel is harder than pure iron.

.....

.....

..... [2]

Topic Chem 11 **Q# 117/** iGCSE Chemistry/2015/w/Paper 33/Q1

(c) Describe how water is treated before it is supplied to homes and industry.

.....

..... [2]

(d) State **two** industrial uses of water.

.....

..... [2]

2 **(a)** Polluted air contains two oxides of carbon and two oxides of nitrogen. A major source of these pollutants is motor vehicles.

(i) Describe how carbon dioxide and carbon monoxide are formed in motor vehicle engines.

.....

.....

.....

..... [3]

(ii) State **one** adverse effect of each of these gases.

.....

..... [2]

(iii) Nitrogen monoxide, NO, is released by motor vehicle exhausts.

Explain how nitrogen monoxide is formed in motor vehicle engines.

.....

..... [2]

(iv) When nitrogen monoxide is released into the atmosphere, nitrogen dioxide, NO_2, is formed.

Suggest an explanation why this happens.

..... [1]

(b) Predict the possible adverse effect on the environment when this non-metal oxide, NO_2, reacts with water and oxygen.

.....

..... [2]

(c) How are the amounts of carbon monoxide and nitrogen monoxide emitted by modern motor vehicles reduced? Include an equation in your answer.

.....

.....

..... [3]

Topic Chem 11 **Q# 119/** iGCSE Chemistry/2015/s/Paper 33/Q4

(b) The burning of fossil fuels is largely responsible for the formation of acid rain. Two of the acids in acid rain are sulfuric acid and nitric acid.

(i) Explain how the combustion of coal can form sulfuric acid.

.....

.....

..... [3]

(ii) High temperatures generated by the combustion of fossil fuels can lead to the formation of nitric acid. Explain.

.....

.....

..... [3]

Topic Chem 11 **Q# 120/** iGCSE Chemistry/2015/s/Paper 32/Q7

7 Alcohols can be made by fermentation or from petroleum.

(a) Ethanol can be made by the fermentation of glucose.

$$C_6H_{12}O_6(aq) \xrightarrow{\text{yeast}} 2C_2H_5OH(aq) + 2CO_2(g) \quad \text{exothermic reaction}$$

Yeast are living single-cell fungi which ferment glucose by anaerobic respiration. This reaction is catalysed by enzymes from the yeast.

(i) What is meant by the term *respiration*?

.....

.....

..... [3]

(ii) *Anaerobic* means in the absence of oxygen.

Name the products formed from respiration in the **presence** of oxygen.

..... [1]

Topic Chem 11 **Q# 121/** iGCSE Chemistry/2015/s/Paper 32/Q6

6 The Atacama desert in Chile has deposits of the salt sodium nitrate. Very large amounts of this salt were exported to Europe for use as a fertiliser. After the introduction of the Haber process in 1913, this trade rapidly diminished.

(a) **(i)** Explain why the introduction of the Haber process reduced the demand for sodium nitrate.

.....

..... [2]

(ii) Suggest why surface deposits of sodium nitrate only occur in areas with very low rainfall such as desert areas.

..... [1]

(iii) The desert has smaller surface deposits of potassium nitrate.

Suggest why potassium nitrate is a better fertiliser than the sodium salt.

..... [1]

Topic Chem 11 **Q# 122/** iGCSE Chemistry/2015/s/Paper 32/Q4

4 Ammonia is made by the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.

Typical reaction conditions are:

- finely divided iron catalyst,
- temperature 450 °C,
- pressure 200 atmospheres.

(a) Explain why the catalyst is used as a very fine powder and larger pieces of iron are not used.

.....

.....

..... [2]

(b) Using the above conditions, the equilibrium mixture contains about 15% ammonia.

State two changes to the reaction conditions which would increase the percentage of ammonia at equilibrium.

.....

.....

..... [2]

(c) Suggest why the changes you have described in **(b)** are **not** used in practice.

.....

.....

..... [2]

3 Ammonia is manufactured by the Haber process. Nitrogen and hydrogen are passed over a catalyst at a temperature of 450 °C and a pressure of 200 atmospheres.

The equation for the reaction is as follows.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The forward reaction is exothermic.

(a) State **one** use of ammonia.

..... [1]

(b) What is the meaning of the symbol $\rightleftharpoons$?

..... [1]

(c) What are the sources of nitrogen and hydrogen used in the Haber process?

nitrogen .....

hydrogen .....

[2]

(d) Name the catalyst in the Haber process.

..... [1]

(e) **(i)** If a temperature higher than 450 °C was used in the Haber process, what would happen to the **rate** of the reaction? Give a reason for your answer.

.....

.....

..... [2]

(ii) If a temperature higher than 450 °C was used in the Haber process, what would happen to the **yield** of ammonia? Give a reason for your answer.

.....

.....

..... [2]

(f) **(i)** If a pressure higher than 200 atmospheres was used in the Haber process, what would happen to the **yield** of ammonia? Give a reason for your answer.

.....

.....

..... [2]

(ii) Explain why the rate of reaction would be faster if the pressure was greater than 200 atmospheres.

.....

..... [1]

(iii) Suggest **one** reason why a pressure higher than 200 atmospheres is not used in the Haber process.

.....

..... [1]

Topic Chem 11 **Q# 124/** iGCSE Chemistry/2015/m/Paper 32/Q1

1 For each of the following, give the name of an element from Period 3 (sodium to argon), which matches the description.

(b) an element that is added to water to kill bacteria

..... [1]

Topic Chem 11 **Q# 125/** iGCSE Chemistry/2014/s/Paper 33/Q5

5 Ammonia is made by the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.
The conditions in the reaction chamber are:

- a pressure of 200 atmospheres,
- a catalyst of finely divided iron,
- a temperature of 400 to 450 °C.

(a) What are the **two** advantages of using a high pressure? Give a reason for both.

advantage 1 .....

reason .....

.....

advantage 2 .....

reason .....

.....

[4]

(b) A higher temperature would give a faster reaction rate.
Why is a higher temperature **not** used?

.....

.....

..... [3]

(c) (i) Why is the iron catalyst used as a fine powder?

.....

..... [1]

(ii) Give **two** reasons why a catalyst is used.

.....

.....

.....

..... [2]

Topic Chem 11 **Q# 126/** iGCSE Chemistry/2014/s/Paper 33/Q4

4 Iron from a blast furnace contains about 5% of the impurities – carbon, silicon, phosphorus and sulfur. Most of this impure iron is used to make steels, such as mild steel, and a very small percentage is used to make pure iron.

(a) Calcium oxide and oxygen are used to remove the impurities from the iron produced in the blast furnace.

(i) State how these chemicals are manufactured.

oxygen .....

..... [2]

Topic Chem 11 **Q# 127/** iGCSE Chemistry/2014/s/Paper 33/Q1

1 Choose a gas from the following list to answer the questions below. Each gas may be used once, more than once or not at all.

ammonia carbon dioxide carbon monoxide fluorine

hydrogen krypton nitrogen propene sulfur dioxide

(a) It is a product of respiration. ..... [1]

Topic Chem 11 **Q# 128/** iGCSE Chemistry/2014/s/Paper 33/Q1

1 Choose a gas from the following list to answer the questions below. Each gas may be used once, more than once or not at all.

ammonia carbon dioxide carbon monoxide fluorine

hydrogen krypton nitrogen propene sulfur dioxide

(d) It is the main component of air. ..... [1]

Topic Chem 11 **Q# 129/** iGCSE Chemistry/2014/s/Paper 32/Q5

5 Carbonyl chloride is made from carbon monoxide and chlorine.

$$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$$

(a) Two methods of preparing carbon monoxide are from methane and oxygen, and from methane and steam.

(i) The reaction between methane and oxygen can also form carbon dioxide. How can carbon monoxide be made instead of carbon dioxide?

..... [1]

Topic Chem 11 **Q# 130/** iGCSE Chemistry/2014/s/Paper 32/Q3

3 Plant growth is improved by the availability of essential elements, such as nitrogen, and by the soil having a suitable pH.

(a) Nitrogen-based fertilisers are made from ammonia. Ammonia is manufactured by the Haber process.

(i) Describe the Haber process giving reaction conditions and a balanced equation.
(Do not discuss reaction rate and yield.)

.....

.....

.....

.....

..... [5]

(ii) Fertilisers contain nitrogen.
Name the other **two** elements essential for plant growth commonly found in fertilisers.

..... [2]

(b) Crops do not grow well if the soil is too acidic.

(i) One cause of acidity in soil is acid rain. Explain how acid rain is formed.

.....

.....

.....

..... [3]

Topic Chem 11 **Q# 131/** iGCSE Chemistry/2014/s/Paper 32/Q2b

2 (a) Natural gas, which is mainly methane, is a fossil fuel.

(ii) What are the **two** main disadvantages in the widespread use of fossil fuels?

.....

.....

..... [2]

Topic Chem 12 **Q# 132/** iGCSE Chemistry/2015/w/Paper 33/Q2

2 Choose from the following list of gases. A gas may be chosen once, more than once or not at all.

sulfur dioxide **hydrogen** **methane** **carbon monoxide**

argon **ethene** **butane**

(a) It is used to bleach wood pulp. ..... [1]

Topic Chem 12 **Q# 133/** iGCSE Chemistry/2015/s/Paper 33/Q2

2 This question is concerned with the following oxides.

aluminium oxide
carbon monoxide
copper(II) oxide
silicon(IV) oxide
sodium oxide
sulfur dioxide
zinc oxide

Choose **one** oxide from the above list to match each of the following descriptions. An oxide may be used once, more than once or not at all.

(c) This oxide is used as a bleach. ..... [1]

Topic Chem 12 **Q# 134/** iGCSE Chemistry/2014/w/Paper 32/Q6

6 Sulfuric acid is an important acid, both in the laboratory and in industry.
Sulfuric acid is manufactured in the Contact Process. Originally, it was made by heating metal sulfates and by burning a mixture of sulfur and potassium nitrate.

(a) Give a major use of sulfuric acid.

..... [1]

(ii) When the iron(II) sulfate is heated strongly, further decomposition occurs.

$$2FeSO_4(s) \rightarrow Fe_2O_3(s) + SO_2(g) + SO_3(g)$$

The gases formed in this reaction react with water and oxygen to form sulfuric acid.
Explain how the sulfuric acid is formed.

.....

..... [2]

Topic Chem 12 **Q# 135/** iGCSE Chemistry/2014/w/Paper 32/Q4

(ii) Give a major use of sulfur dioxide.

..... [1]

Topic Chem 12 **Q# 136/** iGCSE Chemistry/2014/s/Paper 33/Q1

1 Choose a gas from the following list to answer the questions below. Each gas may be used once, more than once or not at all.

ammonia **carbon dioxide** **carbon monoxide** **fluorine**

hydrogen **krypton** **nitrogen** **propene** **sulfur dioxide**

(f) It is used to kill micro-organisms in fruit juice. ..... [1]

Topic Chem 13

Q# 137/ iGCSE Chemistry/2015/s/Paper 33/Q3

3 Quicklime, which is calcium oxide, is made by heating limestone in a furnace.

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

The reaction does not come to equilibrium.

(b) Calcium hydroxide, slaked lime, is made from calcium oxide.

Write an equation for this reaction.

..... [2]

(c) Calculate the maximum mass of calcium oxide which could be made from 12.5 tonnes of calcium carbonate. 1 tonne = 1×10^6 g.

.....

.....

..... [2]

(d) Limestone is used in agriculture to reduce the acidity of soil and for the desulfurisation of flue gases in power stations.

(i) Most crops thrive in soils whose pH is close to 7. Calcium carbonate, which is insoluble in water, and calcium oxide, which is slightly soluble in water, are both used to reduce the acidity of soils.

Suggest **two** advantages of using calcium carbonate for this purpose.

1. .....

2. ..... [2]

(ii) Explain the chemistry of desulfurisation of flue gases.

.....

.....

.....

..... [3]

(iii) Give **one** other use of calcium carbonate.

..... [1]

Topic Chem 13 **Q# 138/** iGCSE Chemistry/2014/s/Paper 33/Q4

4 Iron from a blast furnace contains about 5% of the impurities – carbon, silicon, phosphorus and sulfur. Most of this impure iron is used to make steels, such as mild steel, and a very small percentage is used to make pure iron.

(a) Calcium oxide and oxygen are used to remove the impurities from the iron produced in the blast furnace.

(i) State how these chemicals are manufactured.

calcium oxide .....

..... [1]

3 Plant growth is improved by the availability of essential elements, such as nitrogen, and by the soil having a suitable pH.

(b) Crops do not grow well if the soil is too acidic.

(ii) Name **two** bases which are used to increase the pH of acidic soils.

..... [2]

Topic Chem 14 **Q# 140/** iGCSE Chemistry/2015/w/Paper 33/Q4

4 Two homologous series of hydrocarbons are the alkanes and the alkenes.

(a) (i) One general characteristic of a homologous series is that the physical properties vary in a predictable way.

State **three** other general characteristics of a homologous series.

.....

.....

..... [3]

(ii) How can the molecular formula of a hydrocarbon show whether it is an alkane or an alkene?

.....

..... [2]

(iii) How do alkanes and alkenes differ in their molecular structures?

.....

..... [2]

(b) Cracking is the thermal decomposition of alkanes into smaller hydrocarbons and possibly hydrogen.

(i) State **two** conditions required for the cracking of an alkane.

..... [2]

(ii) One type of cracking produces an alkane and an alkene.

Complete an equation for the cracking of heptane into an alkane and an alkene.

$C_7H_{16} \rightarrow$ ..... + ... [1]

(iii) Complete an equation for the cracking of heptane into hydrogen and two other products.

$C_7H_{16} \rightarrow$ ..... + ... + H_2 [1]

(iv) Suggest **one** reason why cracking is important.

..... [1]

2 Choose from the following list of gases. A gas may be chosen once, more than once or not at all.

sulfur dioxide **hydrogen** **methane** **carbon monoxide**

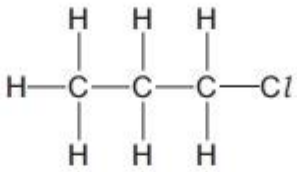
argon **ethene** **butane**

(c) It can polymerise. ..... [1]

(f) It is produced by the decay of vegetation in the absence of oxygen. ..... [1]

4 **(a)** Propane reacts with chlorine to form a mixture of chloropropanes. This is a photochemical reaction.

(ii) The products of this reaction include two isomers, one of which has the following structural formula.



Draw the structural formula of the other isomer.

[1]

(iii) Explain why these two different compounds are isomers.

.....

..... [2]

(c) **(i)** Chloropropane can be hydrolysed to propanol, $CH_3CH_2CH_2OH$, by sodium hydroxide.

Write the equation for this reaction.

..... [2]

(ii) Propanol can be dehydrated. It loses a water molecule to form a hydrocarbon.

Give the name and structural formula of this hydrocarbon.

name .....

structural formula

[2]

(iii) Propanol is oxidised to a carboxylic acid by acidified potassium manganate(VII).

Deduce the name of this acid.

..... [1]

Topic Chem 14 **Q# 143/** iGCSE Chemistry/2015/s/Paper 33/Q7

7 **(a)** Alkanes and alkenes are both hydrocarbons.

(i) How does the structure of alkenes differ from the structure of alkanes?

..... [1]

(ii) Is the straight-chain hydrocarbon $C_{22}H_{44}$ an alkane or an alkene? Explain your choice.

.....

..... [2]

(iii) Describe how you could distinguish between pentane and pentene.

test .....

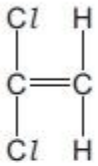
result with pentane .....

result with pentene .....

[3]

(b) Alkenes polymerise to form poly(alkenes).

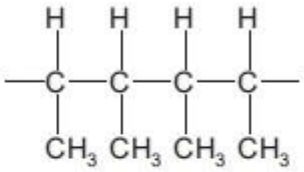
(i) The alkene 1,1-dichloroethene has the structural formula given below.



Draw the structural formula of the polymer formed by the polymerisation of 1,1-dichloroethene.

[3]

(ii) The structural formula of a different polymer is given below.



Deduce the structural formula of the monomer used to form this polymer.

[2]

(iii) There are two types of polymerisation - addition and condensation.

Explain the difference between them.

.....

.....

..... [2]

(iv) There are two types of condensation polymer.

Give the name of **one** type of condensation polymer.

.....

..... [1]

[Total: 14]

Topic Chem 14 **Q# 144/** iGCSE Chemistry/2015/s/Paper 33/Q6

(c) The combustion of propane, C_3H_8, is exothermic.

Give an equation for the complete combustion of propane.

..... [2]

Topic Chem 14 **Q# 145/** iGCSE Chemistry/2015/s/Paper 33/Q4

4 (a) (i) Coal is a solid fossil fuel.

Name another fossil fuel.

..... [1]

(ii) Explain what is meant by the term *fossil fuel*.

.....

..... [2]

Topic Chem 14 **Q# 146/** iGCSE Chemistry/2015/s/Paper 32/Q7

(c) One use of ethanol is in alcoholic drinks.

Give **two** other uses of ethanol.

..... [2]

(d) Alcohols can be made from petroleum by the following sequence of reactions.

alkanes from petroleum → alkene → alcohol

Describe the manufacture of ethanol from hexane, C_6H_{14}. Include in your description an equation and type of reaction for each step.

.....

.....

.....

..... [5]

Topic Chem 14 **Q# 147/** iGCSE Chemistry/2015/m/Paper 32/Q7

7 Ethanol is manufactured from glucose, $C_6H_{12}O_6$, by fermentation according to the following equation.

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

(a) State the conditions required for this reaction.

.....

..... [2]

(c) Ethanol can also be manufactured from ethene.

(i) Name the raw material which is the source of ethene.

..... [1]

(ii) Write a balanced equation for the manufacture of ethanol from ethene.

..... [1]

Topic Chem 14 **Q# 148/** iGCSE Chemistry/2015/m/Paper 32/Q4

4 **(a)** A compound **X** contains 82.76% of carbon by mass and 17.24% of hydrogen by mass.

(i) Calculate the empirical formula of compound **X**.

[2]

(ii) Compound **X** has a relative molecular mass of 58.

Deduce the molecular formula of compound **X**.

[2]

(b) Alkenes are unsaturated hydrocarbons.

(i) State the general formula of alkenes.

..... [1]

(ii) State the empirical formula of alkenes.

..... [1]

(c) What is meant by the term *unsaturated hydrocarbon*?

unsaturated .....

.....

hydrocarbon .....

.....

[2]

(d) Describe a test that would distinguish between saturated and unsaturated hydrocarbons.

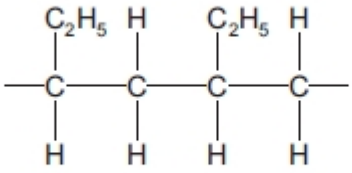
reagent .....

observation (saturated hydrocarbon) .....

observation (unsaturated hydrocarbon) .....

[3]

(e) Addition polymers can be made from alkenes. The diagram shows part of an addition polymer.



(i) Draw a circle on the diagram to show one repeat unit in this polymer. [1]

(ii) Give the structure and the name of the monomer used to make this polymer.

structure

name ..... [2]

(iii) Give the structure of an isomer of the alkene in **(e)(ii)**.

[1]

Topic Chem 14 **Q# 149/** iGCSE Chemistry/2015/m/Paper 32/Q4

4 **(a)** A compound **X** contains 82.76% of carbon by mass and 17.24% of hydrogen by mass.

(i) Calculate the empirical formula of compound **X**.

[2]

(ii) Compound **X** has a relative molecular mass of 58.

Deduce the molecular formula of compound **X**.

[2]

(b) Alkenes are unsaturated hydrocarbons.

(i) State the general formula of alkenes.

..... [1]

(ii) State the empirical formula of alkenes.

..... [1]

(c) What is meant by the term *unsaturated hydrocarbon*?

unsaturated .....

.....

hydrocarbon .....

.....

[2]

(d) Describe a test that would distinguish between saturated and unsaturated hydrocarbons.

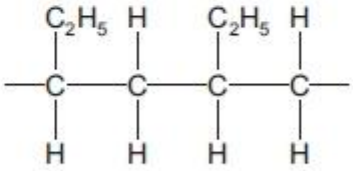
reagent .....

observation (saturated hydrocarbon) .....

observation (unsaturated hydrocarbon) .....

[3]

(e) Addition polymers can be made from alkenes. The diagram shows part of an addition polymer.



(i) Draw a circle on the diagram to show one repeat unit in this polymer. [1]

(ii) Give the structure and the name of the monomer used to make this polymer.

structure

name ..... [2]

(iii) Give the structure of an isomer of the alkene in **(e)(ii)**.

[1]

[Total: 15]

7 Butane is oxidised to a mixture of carboxylic acids by oxygen in the presence of a catalyst. The acids formed are methanoic acid, ethanoic acid and propanoic acid – the first three members of the carboxylic acid homologous series.

(a) (i) Give the name and structural formula of the fourth member of this series.

name .....

structural formula showing all the atoms and bonds

[3]

(ii) State **three** characteristics of a homologous series.

.....

.....

..... [3]

(b) Carboxylic acids react with alcohols to form esters. Ethanol reacts with ethanoic acid to form the ester ethyl ethanoate, $CH_3COOCH_2CH_3$.

(i) Give the name and formula of the ester which is formed from methanol and propanoic acid.

name .....

formula .....

[2]

(ii) What is the name of the ester which has the formula CH_3COOCH_3?

..... [1]

(c) (i) Complete the equation for the oxidation of butane to propanoic acid.

$$3C_4H_{10} + ...O_2 \rightarrow 4C_2H_5COOH + ...H_2O$$

[1]

(ii) Name **another** compound which can be oxidised to propanoic acid.

..... [1]

Topic Chem 14 **Q# 151/** iGCSE Chemistry/2014/w/Paper 32/Q5

5 **(a)** Glucose, sucrose and starch are all carbohydrates. Their formulae are:

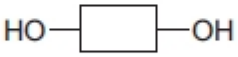
glucose, $C_6H_{12}O_6$,
sucrose, $C_{12}H_{22}O_{11}$,
starch, $(C_6H_{10}O_5)_n$.

(i) Identify **two** common features in the formulae of these carbohydrates.

.....

..... [2]

(ii) Draw the structure of a complex carbohydrate, such as starch. The formula of glucose, can be represented by

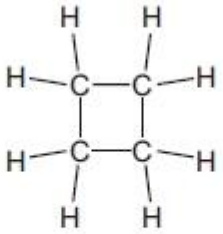


Include **three** glucose units in the structure.

[2]

Topic Chem 14 **Q# 152/** iGCSE Chemistry/2014/w/Paper 32/Q3

3 **(a)** A hydrocarbon has the following structural formula.



(i) State the molecular formula and the empirical formula of this hydrocarbon.

molecular formula .....

empirical formula .....

[2]

(ii) Draw the structural formula of an isomer of the above hydrocarbon.

[1]

(iii) Explain why these two hydrocarbons are isomers.

.....

..... [2]

(iv) Are these two hydrocarbons members of the same homologous series?
Give a reason for your choice.

.....

..... [1]

(b) Alkenes can be made from alkanes by cracking.

(i) Explain the term *cracking*.

.....

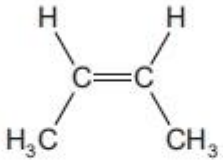
..... [2]

(ii) One mole of an alkane, when cracked, produced one mole of hexane, C_6H_{14}, and two moles of ethene.
What is the molecular formula of the original alkane?

..... [1]

(c) Alkenes are used in polymerisation reactions and addition reactions.

(i) Draw the structural formula of the product formed by the addition polymerisation of but-2-ene. Its formula is given below.



[3]

(ii) Give the name and structural formula of the addition product formed from ethene and bromine.

name .....

structural formula

[2]

6 The alkanes are a family of saturated hydrocarbons. Their reactions include combustion, cracking and substitution.

(a) **(i)** What is meant by the term *hydrocarbon*?

.....[1]

(ii) What is meant by the term *saturated*?

.....[1]

(b) **(i)** What is the general formula for the homologous series of alkanes?

.....[1]

(ii) Calculate the mass of one mole of an alkane with 14 carbon atoms.

.....

.....[2]

(c) The complete combustion of hydrocarbons produces carbon dioxide and water only.

(i) Write the equation for the complete combustion of nonane, C_9H_{20}.

.....[2]

(ii) 20 cm^3 of a gaseous hydrocarbon was mixed with an excess of oxygen, 200 cm^3. The mixture was ignited. After cooling, 40 cm^3 of oxygen and 100 cm^3 of carbon dioxide remained. Deduce the formula of the hydrocarbon and the equation for its combustion. All volumes were measured at r.t.p..

.....

.....

.....

.....

.....[3]

(d) Cracking is used to obtain short-chain alkanes, alkenes and hydrogen from long-chain alkanes.

(i) Give a use for each of the three products listed above.

short-chain alkanes .....

alkenes .....

hydrogen .....[3]

(ii) Write an equation for the cracking of decane, $C_{10}H_{22}$, which produces two different alkenes and hydrogen as the only products.

.....[1]

(e) Chlorine reacts with propane in a substitution reaction to form 1-chloropropane.

$$CH_3-CH_2-CH_3 + Cl_2 \rightarrow CH_3-CH_2-CH_2-Cl + HCl$$

(i) What is the essential condition for the above reaction?

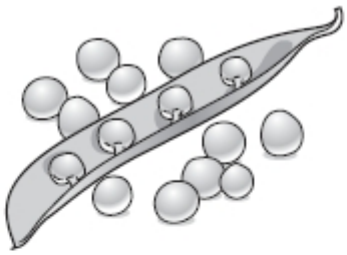
..... [1]

(ii) There is more than one possible substitution reaction between chlorine and propane. Suggest the structural formula of a different product.

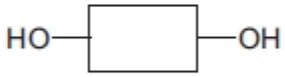
..... [1]

Topic Chem 14 **Q# 154/** iGCSE Chemistry/2014/s/Paper 33/Q3

(b) Pea seeds grow in pods on pea plants.



Freshly picked pea seeds contain a sugar. The sugar can form a polymer.
Give the structural formula of the polymer and name the other product of this polymerisation reaction.
You may represent the sugar by the formula:



structural formula of the polymer

other product ..... [3]

Topic Chem 14 **Q# 155/** iGCSE Chemistry/2014/s/Paper 33/Q1

1 Choose a gas from the following list to answer the questions below. Each gas may be used once, more than once or not at all.

ammonia **carbon dioxide** **carbon monoxide** **fluorine**

hydrogen **krypton** **nitrogen** **propene** **sulfur dioxide**

(b) It polymerises to form a poly(alkene). ..... [1]

Topic Chem 14 **Q# 156/** iGCSE Chemistry/2014/s/Paper 32/Q4

4 Propanoic acid is a carboxylic acid. Its formula is $CH_3–CH_2–COOH$.

(a) Propanoic acid is the third member of the homologous series of carboxylic acids.

(i) Give the name and structural formula of the fourth member of this series.

name .....

formula ..... [2]

(ii) Members of a homologous series have very similar chemical properties.
State **three** other characteristics of a homologous series.

.....

.....

.....

..... [3]

(b) Carboxylic acids can be made by the oxidation of alcohols.

(i) Draw the structural formula of the alcohol which can be oxidised to propanoic acid.
Show all atoms and bonds.

[1]

(ii) Name a reagent, other than oxygen, which can oxidise alcohols to carboxylic acids.

..... [2]

(c) Complete the following equations for some of the reactions of propanoic acid.
The salts of this acid are called propanoates.

(i) zinc + propanoic acid → .... + hydrogen [1]

(ii) calcium oxide + propanoic acid → .... + ... [1]

(iii) $LiOH + CH_3CH_2COOH \rightarrow$ ..... + ... [1]

Topic Chem 14 **Q# 157/** iGCSE Chemistry/2014/s/Paper 32/Q2

2 **(a)** Natural gas, which is mainly methane, is a fossil fuel.

(ii) Name **two** other fossil fuels.

..... [2]

(b) Fossil fuels are formed by the anaerobic decomposition of organic matter. Anaerobic means in the absence of oxygen.

(i) The organic matter contains hydrogen and carbon. Suggest the products that would be formed if the decomposition occurred in the presence of oxygen.

..... [2]

Mark Scheme for Section 1

MS Topic Chem 1 **Q# 1/** iGCSE Chemistry/2015/s/Paper 32/Q2

2(c)	A; melting point/ –7 (°C) is below room temperature/ 25 (°C)/ RTP ora; boiling point/ 59 (°C) is above room temperature/ 25 (°C)/ RTP ora;	3	low melting point/ boiling point/ conductivity 25 (°C)/ room temperature/ RTP is in between –7 (°C) and 59 (°C) **OR** 25 (°C)/ room temperature/ RTP is between mpt and bpt would both score the 2 evidence marks

Topic Chem 1 **Q# 2/** iGCSE Chemistry/2014/w/Paper 33/Q2

(ii) melting point/freezing point (of X) [1]

(iii) gas/gaseous or vapour [1]

Topic Chem 1 **Q# 3/** iGCSE Chemistry/2014/w/Paper 33/Q2

(b) (i) 14.3 [1]

(ii) 85.7 ÷ 12 and 14.3 ÷ 1 **or** 7.14 and 14.3 [1]
ratio 1:2 [1]
CH_2 [1]
note: Award all 3 marks for correct answer
allow: alternative working e.g.
85.7 × 84 ÷ 100 and 14.3 × 84 ÷ 100 **or** 71.988/72 and 12/12.012 [1]
6:12 **or** ratio 1:2 [1]
CH_2 [1]

(iii) C_6H_{12} [1]

Topic Chem 1 **Q# 4/** iGCSE Chemistry/2014/s/Paper 33/Q2

(b) particles move in all directions/randomly in both liquids and gases (1)

no bonds/very weak forces between particles in gases (1)
molecules can move apart/separate (to fill entire volume) (1)
OR
bonds/forces/IMF between particles in liquids (1)
molecules cannot move apart/separate (so fixed volume in liquids) (1) [3]

MS Topic Chem 2 **Q# 5/** iGCSE Chemistry/2015/w/Paper 33/Q1

1(b)	boils at 100 °C/boiling point 100 °C/freezes at 0 °C/freezing point 0 °C/ melts at 0 °C/ melting point 0 °C;	1

Topic Chem 2 **Q# 6/** iGCSE Chemistry/2015/m/Paper 32/Q6

(b) filter/centrifuge/decant [1]

wash with (distilled) water [1]

(dry with) filter paper/tissues/warm windowsill/in sun/oven/fan/heat [1]

Topic Chem 2 **Q# 7/** iGCSE Chemistry/2014/w/Paper 32/Q1

1 **(a)** foodstuffs or drugs [1]

(b) (i) simple distillation
fractional distillation **or** diffusion
fractional distillation
filtration **or** evaporation
chromatography [5]

Topic Chem 2 **Q# 8/** iGCSE Chemistry/2014/s/Paper 33/Q5

(d) lower the temperature (1)
only ammonia will liquefy (1)
OR
add water (1)
only ammonia will dissolve (1)
OR
increase pressure (1)
only ammonia will liquefy (1) [2]

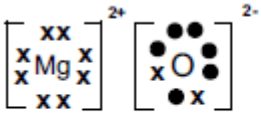
MS Topic Chem 3 **Q# 9/** iGCSE Chemistry/2015/w/Paper 33/Q6

6(d)	Mg^{2+};	1

Topic Chem 3 **Q# 10/** iGCSE Chemistry/2015/w/Paper 33/Q3

3(a)(i)	vibrate (about fixed position)/vibration;	1
3(a)(ii)	electrostatic force of) attraction; (between) positive ions and negative ions/oppositely charged ions/unlike charged ions/cations and anions;	1 1
3(a)(iii)	regular/repeated/pattern/framework/ordered/alternating/organised (arrangement of); positive and negative ions/oppositely charged ions/cations and anions/unlike charged ions;	1 1

Topic Chem 3 **Q# 11/** iGCSE Chemistry/2015/w/Paper 32/Q6

6(b)	**M1** positive ions/cations/metallic ions; the (correct) particles named in **M1** are arranged in a lattice/rows/layers; sea of electrons/delocalised electrons;	3
6(c)	they have mobile electrons;	1
6(d)	chlorine;	1
6(e)	strong covalent bonds ; in a giant lattice/macromolecule/giant (structure);	2
6(f)	any two from: • sodium chloride is ionic **and** PCl_3 is covalent; • ionic bonds are strong **and** intermolecular forces are weak; • PCl_3 reacts with water **and** NaCl does not;	2
6(h)	 magnesium with 8 or 0 outer shell electrons; oxygen with 8 outer shell electrons and 2 indicated differently from the other 6 and these 2 electrons must match the Mg electrons if these have been shown; correct charges;	3

Topic Chem 3 **Q# 12/** iGCSE Chemistry/2015/w/Paper 32/Q1

1(a)(i)	NF_3;	1
1(a)(ii)	P_2S_3;	1
1(b)(i)	Se^{2-};	1
1(b)(ii)	Ga^{3+};	1

Topic Chem 3 **Q# 13/** iGCSE Chemistry/2015/s/Paper 33/Q2

2(e)	silicon(IV) oxide;	1	**A** silicon (di)oxide or SiO_2

Topic Chem 3 **Q# 14/** iGCSE Chemistry/2015/s/Paper 33/Q1

1(a)(i)	AlF_3;	1	
1(a)(ii)	As_2O_3;	1	**A** As_2O_5
1(a)(iii)	$SiBr_4$;	1	
1(b)(i)	P^{3-};	1	
1(b)(ii)	Ba^{2+};	1	
1(b)(iii)	Fr^{+};	1	

1(c)	M1 2 double bonds, one between each O and the C atom; M2 each O has 8 outer electrons; M3 each C has 8 outer electrons;	3	**R** wrong symbols for O for M2 **R** wrong symbols for C for M3 **I** missing symbols **A** any combination of x and o

Topic Chem 3 **Q# 15/** iGCSE Chemistry/2015/s/Paper 32/Q2

2(a)	E; high melting point/ mp/mpt **OR** high boiling point/bp/bpt; poor/non conductor (when liquid and/or solid);	3	**I** mpt/bpt above room temp
2(b)	B; (good) conductor when solid (and liquid);	2	**A** (good) conductor in any state/both states **I** high melting point/boiling point **R** low melting point/boiling point
2(d)	C; high melting point/ mp/mpt **OR** high boiling point/bp/bpt; **BOTH** poor/non conductor when solid **and** good conductor when liquid **OR** molten/only conduct when liquid;	3	**A** melting point **and** boiling point both above room temp/25 °C/ RTP **I** conducts when aqueous or in solution **I** conducts in liquid due to free electrons

Topic Chem 3 **Q# 16/** iGCSE Chemistry/2015/s/Paper 32/Q1

1	$^{39}_{19}K$; 26p 26e 30n All three for 1 mark; $^{7}_{3}Li^{+}$ numbers and symbol; charge +; 31p 28e 39n All three for 2 marks, any two for 1 mark; $^{79}_{34}Se^{2-}$ numbers and symbol; charge 2^{-};	8	

Topic Chem 3 **Q# 17/** iGCSE Chemistry/2015/m/Paper 32/Q3

(g) 3 bond pairs between N & H [1]

Lone pair on N [1]

Topic Chem 3 **Q# 18/** iGCSE Chemistry/2015/m/Paper 32/Q2

2 (a) Atoms of the same element/atoms with same proton number/atoms with same atomic number [1]

different neutron number/nucleon number/mass number [1]

(b)

particle	number of protons	number of electrons	number of neutrons	nucleon number	symbol or formula
A					
B				23 (1)	Na(1) $^{+}$(1)
C		10(1)		16(1)	
D	13 (1)		15 (1)		

[7]

[Total:9]

Topic Chem 3 **Q# 19/** iGCSE Chemistry/2015/m/Paper 32/Q1

1 (a) chlorine/argon [1]

Topic Chem 3 **Q# 20/** iGCSE Chemistry/2014/w/Paper 33/Q6

6 (a) Rb loses 1 electron/1 electron in outer shell/1 valency or valence electron [1]

Sr loses 2 electrons/2 electrons in outer shell/2 valency or valence electrons [1]

Topic Chem 3 **Q# 21/** iGCSE Chemistry/2014/w/Paper 33/Q3

3 (a) (i) 3 [1]

(ii) 70 [1]

(b) Add octane (or other liquid hydrocarbon) (to soot) [1]

COND(on addition of **any** solvent) filter (to remove insoluble forms of carbon) [1]

(allow to) evaporate **or** heat **or** warm **or** leave in sun(to get crystals of fullerene) [1]

(c) (i) graphite [1]

(ii) delocalised electrons/free electrons/sea of electrons [1]

COND (on electrons) move/mobile/electrons flow [1]

Topic Chem 3 **Q# 22/** iGCSE Chemistry/2014/w/Paper 33/Q1

(b) **Graphite**
Physical: (good) conductor (of electricity) **or** soft **or** lubricant **or** high melting point/high boiling point **or** grey black **or** black solid **or** slippery or greasy (to touch) **or** brittle/breaks when subjected to stress **or** insoluble in water [1]

Topic Chem 3 **Q# 23/** iGCSE Chemistry/2014/s/Paper 33/Q4

4 (a) (i) heat limestone/calcium carbonate (1)
(b) (i) lattice/rows/regular arrangement of cations/positive ions/Fe^{2+} (1)
mobile/free/delocalised/sea of electrons (1) [2]

(ii) the rows of ions/ions can move past each other (1)
without the metal breaking/bonds are not directional/not rigid (1) [2]

Topic Chem 3 **Q# 24/** iGCSE Chemistry/2014/s/Paper 32/Q6

(b) ScF_3 (1)

correct charges on **both** ions (1)

8 electrons around (each) fluoride (1) [3]

Topic Chem 3 **Q# 25/** iGCSE Chemistry/2014/s/Paper 32/Q5

5 (c) each chlorine 1 bond pair and 3 non-bond pair (1)

oxygen atom 2 non-bond pairs and 2 bond pairs as double bond (1)

carbon atom 4 bond pairs including 2 bond pairs as double bond (1) [3]

Topic Chem 3 **Q# 26/** iGCSE Chemistry/2014/s/Paper 32/Q1

(b) D (1) [1]

(d) B (1) [1]

(f) E (1) [1]

MS Topic Chem 4 **Q# 27/** iGCSE Chemistry/2015/w/Paper 33/Q7

7(a)	*moles of KOH used* (= 0.025 × 2.53 =) 0.06325/0.063; *number of moles of H_2SO_4 needed to neutralise the KOH* = 0.031625/0.032; *concentration of dilute sulfuric acid* = 1.121/1.1 (mol/dm^3);	3

Topic Chem 4 **Q# 28/** iGCSE Chemistry/2015/w/Paper 33/Q6

6(c)	$Fe_2(SO_4)_3$;	1

Topic Chem 4 **Q# 29/** iGCSE Chemistry/2015/w/Paper 33/Q4

4(c)(i)	150 (cm^3);	1
4(c)(ii)	100 (cm^3);	1

Topic Chem 4 **Q# 30/** iGCSE Chemistry/2015/w/Paper 33/Q2

2(b)	hydrogen/H_2;	1
2(e)	carbon monoxide/CO;	1

Topic Chem 4 **Q# 31/** iGCSE Chemistry/2015/w/Paper 32/Q4

4(b)	**M1** bonds breaking = (8 × 412) + (2 × 348) + 242 = 4234; **M2** bonds forming = (7 × 412) + (2 × 348) + 338 + 431 = 4349; **M3** 4234 – 4349 = –115 **and** exothermic;	3

Topic Chem 4 **Q# 32/** iGCSE Chemistry/2015/w/Paper 32/Q4

4(d)(i)	46;	1
4(d)(ii)	60;	1
4(d)(iii)	moles of $CH_3CH_2CH_2OH$ = 0.1; moles of HCOOH = 0.087 (0.09) **and** limiting reagent is methanoic acid;	2
4(d)(iv)	88 × (mol of limiting reagent in **4(d)(iii)**); expected answer: 88 × 0.087 = 7.65 g;	1

Topic Chem 4 **Q# 33/** iGCSE Chemistry/2015/w/Paper 32/Q1

1(c)(i)	$Cr_2(SO_4)_3$;	1
1(c)(ii)	$Ba(OH)_2$;	1

Topic Chem 4 **Q# 34/** iGCSE Chemistry/2015/s/Paper 33/Q5

5(c)(i)	79.2828685; 79.6205853; 84.7161572;	2	Minimum 3 sig figs **A** rounding or truncating *All three correct = 2 marks,* *Two correct = 1 mark*
5(c)(ii)	the last one **OR** Cu and O_2 **OR** the one from copper; not all the copper oxidised **OR** the outside of the pieces of copper oxidised but the inside did not **OR** (still) contains copper (metal);	2	ecf of biggest for M1

Topic Chem 4 **Q# 35/** iGCSE Chemistry/2015/s/Paper 32/Q6

6(c)(ii)	Avogadro('s) number/constant/6.02×10^{23}; **COND** particles; **OR** (the number of particles which is equal to the number of atoms in) 12 g of carbon 12; **COND** atoms; **OR** the mass **in grams** which contains Avogadro('s) Number; **COND** particles; **OR** (the amount of substance which has a mass equal to) its relative formula mass/RFM/relative atomic mass/Ar/relative molecular mass/Mr/molar mass; **COND** in grams; **OR** (the amount of substance which has a volume equal to) 24 dm^3; **COND** of a gas **at** RTP;	2	**A** any values from 6 to 6.023×10^{23} **A** atoms/ions/molecules/electrons **A** one mark for reference to C12 **A** equivalent statement for any element **or** compound e.g. 32 grams of oxygen(1) **COND** molecules/O_2(1) e.g. 16 grams of oxygen (1) **COND** atoms/O(1) **A** different volumes under different conditions e.g. 22.4 dm^3 at STP or volumes in different units e.g. 24 000 cm^3 at RTP

Topic Chem 4 **Q# 36/** iGCSE Chemistry/2015/s/Paper 32/Q3

3(b)(ii)	M1 (so that ionic) charges balance or cancel/charge = 0/no charge/number of positive = number of negative charges/charge is neutral or neutralised; M2 3(–) × 2 = 2(+) × 3 ;	2	**A** 6(+) = 6(–) **I** statements about electron transfer/valency/ox state unless valency is referring to ionic charges e.g. valencies 3+ and 2– can get credit if used properly Ratio of ions is 3:2 therefore ratio of charges is 2:3 scores 2

Topic Chem 4 **Q# 37/** iGCSE Chemistry/2015/m/Paper 32/Q7

(b) (i) Mr = 180 (1) (30/180) = 0.167 (1) [2]

(ii) 2 × 0.167 or 2 × 46 or 0.333 or 92 [1]

(2 × 0.167 × 46) = 15.3(33) (g) [1]

(iii) (2 × 0.167 × 24) = 8 (dm^3) [1]

Topic Chem 4 **Q# 38/** iGCSE Chemistry/2014/w/Paper 33/Q8

(c) number of moles of HCl in 50 cm^3 of acid, concentration 2.2 mol/dm^3 = 0.11 [1]

maximum number of moles of $CoCl_2.6H_2O$ which could be formed = 0.055 [1]

mass of 1 mole of $CoCl_2.6H_2O$ = 238 g

maximum yield of $CoCl_2.6H_2O$ = 13.09 g [1]

percentage yield = 48.2% **or** ecf mass of $CoCl_2.6H_2O$ above/13.09 × 100% to 1 dp [1]

Topic Chem 4 **Q# 39/** iGCSE Chemistry/2014/w/Paper 32/Q6

(iii) M1 = 2.07 Allow 2.1 or 2.0666…7

M2 = 62.8.g

M3 =(M2/152 =) 0.41(3)

M4 (=M1/M3) rounded to the nearest whole number × = 5 [4]

Topic Chem 4 **Q# 40/** iGCSE Chemistry/2014/s/Paper 32/Q7

(b) 0.062 (1)

0.031 (1)

3.97 g (1)

55.4% (1) [4]

(c) (i) (to prove) **all** water driven off or evaporated or boiled/no water remains/to make salt anhydrous (1)

(ii) $m_1 - m_2$ = mass of water (1)

(calculate) moles of water **AND** moles of hydrated or anhydrous salt (1)

1:1 ratio/should be equal (1) [3]

MS Topic Chem 5 **Q# 41/** iGCSE Chemistry/2015/w/Paper 33/Q3

3(b)(i)	correct direction (going towards negative electrode);	1
3(b)(ii)	$Li^+ + e^- \rightarrow Li$ / $Li^+ \rightarrow Li - e^-$;	1
3(b)(iii)	$2Br^- \rightarrow Br_2 + 2e^-$ / $2Br^- - 2e^- \rightarrow Br_2$ formulae; balancing;	2
3(b)(iv)	Br^- /bromide (ion); electron lost/ donated electrons/ increased oxidation state/increased oxidation number/oxidation numbers changed from –1 to 0/increased valency;	1 1
3(c)	**M1** (gas) hydrogen (given off at cathode)/H_2; **M2** hydroxide ions/lithium hydroxide/OH^-/LiOH are alkali(ne); **M3** $2LiBr + 2H_2O \rightarrow 2LiOH + H_2 + Br_2$; **or** $2H^+ + 2e^- \rightarrow H_2$ / $2H^+ \rightarrow H_2 - 2e^-$; **or** $2Br^- \rightarrow Br_2 + 2e^-$ / $2Br^- - 2e^- \rightarrow Br_2$; **or** $2H^+ + 2Br^- \rightarrow H_2 + Br_2$;	3

Topic Chem 5 **Q# 42/** iGCSE Chemistry/2015/w/Paper 32/Q3

3(c)	zinc sulfate; pure zinc; $Zn^{2+} + 2e^- \rightarrow Zn$; $Zn \rightarrow Zn^{2+} + 2e^-$; zinc ions are removed (from solution) and replaced (into solution); at the same rate/speed;	6

Topic Chem 5 **Q# 43/** iGCSE Chemistry/2015/s/Paper 32/Q3

3(a)	M1 both correct charges of ions (calcium 2+ and nitrogen 3–); M2 8 electrons around nitrogen (can be 3 dots and 5 crosses **or** 5 crosses and 3 dots **or** all dots **or** all crosses, but reject any other combinations of dots and crosses); M3 Two electrons on the inner shell on any nitride ions/nitrogen atom: allow 2x or 2o once;	3	Charges can be shown anywhere **I** missing symbols for nitrogen **R** wrong symbol of nitrogen **anywhere** **A** if electron configuration of nitride is given as 2,8 or N is given as 2,5 **I** any missing inner shells as long as one is present *General guidance:* **I** electron configuration/symbol of calcium ion **I** formulae/stoichiometry Covalent can score **only** M3
3(b)(i)	regular/repeated/pattern/framework/periodic/ordered/alternating/organised; (of)particles/atoms/molecules/ions/cations/anions;	2	**I** layers **A** ionic/molecular/atomic **I** arrangement/bonding/properties

Topic Chem 5 **Q# 44/** iGCSE Chemistry/2014/w/Paper 33/Q4

(b) $2H_2 + O_2 \rightarrow 2H_2O$ [1]

(c) (i) anode/negative electrode **and** electrons lost(by hydrogen/H/H_2)/electrons move from this electrode [1]

(ii) $H_2 \rightarrow 2H^+ + 2e(^-)$ / $H_2 - 2e(^-) \rightarrow 2H^+$ / $H_2 + 2OH^- \rightarrow 2H_2O + 2e(^-)$ / $H_2 + 2OH^- - 2e(^-) \rightarrow 2H_2O$ [2]
Species (1) Balancing (1)

Topic Chem 5 **Q# 45/** iGCSE Chemistry/2014/w/Paper 32/Q4

4 (d) (i) from zinc to carbon
(clockwise direction on or near the wire) [1]

(ii) to allow ions to flow [1]

(iii) oxidation
and loss of electron(s) or increase in oxidation number/state [1]

reduction
and decrease in oxidation number/state or gain of electron(s) [1]

Topic Chem 5 **Q# 46/** iGCSE Chemistry/2014/s/Paper 33/Q7

7 (a) bauxite (1) [1]

(ii) $4OH^- \rightarrow O_2 + 2H_2O + 4e$ (2) [2]

$4Al + 3O_2 \rightarrow 2Al_2O_3$ (2) [2]

Topic Chem 5 **Q# 47/** iGCSE Chemistry/2014/s/Paper 32/Q5

5 (b) hydrogen **and** chlorine/H_2 **and** Cl_2 (1)

sodium hydroxide/NaOH/Na^+OH^- (1)

$2H^+ + 2e \rightarrow H_2$/$2H^+ \rightarrow H_2 - 2e$ (1)

$2Cl^- \rightarrow Cl_2 + 2e$/$2Cl^- - 2e \rightarrow Cl_2$ (1)

Hydrogen/H_2/H/H^+ at cathode **and** chlorine/chloride/Cl_2/Cl/Cl^- at anode (1) [5]

MS Topic Chem 6 **Q# 48/** iGCSE Chemistry/2014/w/Paper 33/Q5

(b) (i) $2Cl^- \rightarrow Cl_2 + 2e^-$ / $2Cl^- - 2e^- \rightarrow Cl_2$ [1]

$2H^+ + 2e^- \rightarrow H_2$ / $2H^+ \rightarrow H_2 - 2e^-$ [1]

hydrogen formed at cathode/– and chlorine at anode/+ [1]

Na^+ and OH^- **or** sodium ions and hydroxide ions left in solution/form/become sodium hydroxide [1]

(ii) $Cl_2 + 2NaOH \rightarrow NaClO/NaOCl + NaCl + H_2O$ [2]
Species (1) Balancing (1)

Topic Chem 6 **Q# 49/** iGCSE Chemistry/2014/w/Paper 33/Q4

4 (a) carbon dioxide/CO_2 [1]

(d) Any **two** from:

CELL:	lightweight
	quieter
	fewer working parts/less maintenance
	more efficient **or** less energy wasted **or** more energy produced
SUSTAINABILITY:	conserves a limited resource/petroleum/fossil fuels
	unlimited supplies of renewable resource(of hydrogen from water)
POLLUTION:	No or less greenhouse effect
	No or less acid rain
	No or less toxic gases
	No or less smog
POLLUTANTS:	No or less C/soot
	No or less CO_2
	No or less CO
	No or less SO_2
	No or less oxides of nitrogen/NO/NO_2/N_2O_4/NO_x
	No or less (unburnt) hydrocarbons
	No or less low level ozone
	H_2O is the **only** product [2]

[Total: 7]

Topic Chem 6 **Q# 50/** iGCSE Chemistry/2014/w/Paper 32/Q2

(ii) M1 electrolysis [1]

M2 molten sodium chloride [1]
or
M1 Add named more reactive metal (e.g. K)
M2 Molten sodium chloride

Topic Chem 6 **Q# 51/** iGCSE Chemistry/2014/s/Paper 33/Q5

(e) second line $+3 \times 155 = +465$
third line $-3 \times 280 = (-)840$
fourth line $-3 \times 565 = (-)1695$
all **three** correct (2)
two correct (1)

$1170 + 465 = 1635$
$840 + 1695 = 2535$
both numerically correct (1)
exothermic reaction with some reasoning (1) [4]

Topic Chem 6 **Q# 52/** iGCSE Chemistry/2014/s/Paper 33/Q1

(g) hydrogen (1) [1]

Topic Chem 6 **Q# 53/** iGCSE Chemistry/2014/s/Paper 32/Q2

2 (a) (i) substance/material/compound/element/mixture (burnt) to produce/release energy **or** heat (1) [1]

(iii) wood/charcoal/animal dung/biomass/Uranium/U/plutonium/Pu (1) [1]

MS Topic Chem 7 **Q# 54/** iGCSE Chemistry/2015/w/Paper 33/Q5

5(b)(iii)	$Br_2 + 2e^- \rightarrow 2Br^-$ / $Br_2 \rightarrow 2Br^- - 2e^-$;	1

Topic Chem 7 **Q# 55/** iGCSE Chemistry/2015/w/Paper 33/Q3

3(b)(iv)	Br^- /bromide (ion); electron lost/donated electrons/increased oxidation state/increased oxidation number/oxidation numbers changed from –1 to 0/increased valency;	1 1

Topic Chem 7 **Q# 56/** iGCSE Chemistry/2015/w/Paper 32/Q6

6(a)	the number of e^- gained or lost = numerical value of oxidation state; any two from: • Na to A*l* (Si) lose e^-; • (Si) P to C*l* gain e^-; • Si gains and loses e^- / Ar neither gains nor loses e^-;	1 2

Topic Chem 7 **Q# 57/** iGCSE Chemistry/2015/w/Paper 32/Q4

4(a)(i)	a reaction whose rate is influenced by light/reaction which occurs in presence of light;	1

Topic Chem 7 **Q# 58/** iGCSE Chemistry/2015/s/Paper 33/Q6

6(d)(i)	(light from the) sun/sunlight;	1	**A** uv
6(d)(ii)	carbon dioxide + water → glucose + oxygen;	1	**A** starch/sugar/(named)carbohydrate **I** energy or light on LHS

Topic Chem 7 **Q# 59/** iGCSE Chemistry/2015/s/Paper 33/Q3

3(a)	carbon dioxide escapes/leaves/lost/released **OR** not a closed system;	1	**A** gas escapes/leaves/lost/released

Topic Chem 7 **Q# 60/** iGCSE Chemistry/2015/s/Paper 32/Q7

7(a)(i)	living/organism or named example e.g. yeast/cells/plants/animals/part of animal or plant e.g. muscle/humans/micro-organisms; produces/releases or gain or obtain energy/exothermic/heat; from food/named foodstuff/carbohydrate/named carbohydrate/sugar/named sugar/glucose/nutrients;	3	**A** 'we/us' for 'humans' **I** products/breathing/oxygen/anaerobic/aerobic
7(a)(iii)	biological catalyst or protein catalyst;	1	**R** biocatalyst/living biological catalyst
7(a)(iv)	**answer must include both** measuring the time and measuring a relevant quantity; **OR** alternatively measuring the time taken for something to happen; alternatives to time are: units of time/apparatus to measure time/regular intervals/how long examples of relevant quantities are: (Increase in/decrease in) amount/mass/volume/bubbles of carbon dioxide/bubbles of gas **OR** (Increase in/decrease in) mass of apparatus;	1	Examples: **A** time taken for lime water to turn milky **A** time taken for bubbling to stop/gas stop being evolved **A** count bubbles per minute **A** measure temperature (change) with time **R** time taken for reaction to end **R** measure carbon dioxide/gas with time (no reference to amount)
7(b)(i)	temperature increase/heat increase/warmer/high temperature/exothermic/**more** yeast/yeast reproduces/yeast increases/yeast multiplies;	1	**R** yeast was added
7(b)(ii)	**more** yeast/yeast reproduces/increases/multiplies;	1	**R** yeast was added
7(b)(iii)	all glucose or reactant(s) reacted **OR** no glucose or reactant(s) left **OR** glucose or reactant(s) used up/finished/runs out/reacted completely/fully reacted; yeast (cells) dies **OR** enzymes denatured **OR** ethanol is toxic to yeast/ethanol kills yeast;	2	**I** glucose or reactants reacted/stopped reacting **R** enzyme dies/yeast denatures **R** yeast used up

Topic Chem 7 **Q# 61/** iGCSE Chemistry/2015/s/Paper 32/Q6

6(b)(ii)	(colour changes) from pink/purple; to colourless/decolourised;	2	**I** clear/discoloured/effervescence **I** brown fumes/brown gas **NOTE:** stays pink or purple gets first mark but turns purple or pink is 0

Topic Chem 7 **Q# 62/** iGCSE Chemistry/2015/s/Paper 32/Q3

3(c)	it (refers to Ca)/ Calcium/Ca (atom) loses/gives/donates electrons/e/e^-;		**A** half-equation with electrons on right-hand side **R** calcium ion/Ca^{2+}
	(these are) gained by nitrogen/N/N_2;		**A** half-equation with electrons on left-hand side **R** nitride ion/N^{3-} **I** numbers of electrons/charges on ions/oxidation state/valency if mentioned **R** reference to oxygen/hydrogen if there is a suggestion that oxygen/hydrogen are involved in the reaction **I** reference to oxygen/hydrogen if in general statement e.g. oxidation is gain of oxygen
	nitrogen/N/N_2 is reduced so calcium/Ca is the reducing agent (these two statements could be split i.e. not in same sentence) **OR** reducing agents are electron donors/give/lose electrons **OR** calcium/Ca is oxidised (by electron loss) therefore calcium is the reducing agent (these two statements could be split i.e. not in same sentence);	3	Electrons/e/e^- move from calcium to nitrogen get marks 1 and 2 **A** calcium/Ca/it is a reductant or calcium/Ca/it reduces

Topic Chem 7 **Q# 63/** iGCSE Chemistry/2014/w/Paper 33/Q8

8 (a) (changes from) blue (1) to pink (1) [2]

Topic Chem 7 **Q# 64/** iGCSE Chemistry/2014/w/Paper 33/Q5

5 (a) (i) rate decreases [1]
concentration of sodium chlorate ((I))/reactant decreases [1]

(ii) (initial) gradient greater/steeper (must start at origin) [1]
same final volume of oxygen [1]

(iii) (to prevent)photochemical reaction/(to prevent)reaction catalysed by light/light breaks down or decomposes sodium chlorate((I)) [1]

(iv) particles have more energy/particles move faster/ [1]
more collisions [1]
collisions more frequent or more often/greater chance of collision/collision
rate increases/more particles have energy to react/more collisions are successful or effective [1]

Topic Chem 7 **Q# 65/** iGCSE Chemistry/2014/w/Paper 33/Q2

2 (a) (i) (X(s) ↔) X(l) [1]

Topic Chem 7 **Q# 66/** iGCSE Chemistry/2014/w/Paper 33/Q2

2 (a) (i) (X(s) ↔) X(l) [1]

Topic Chem 7 **Q# 67/** iGCSE Chemistry/2014/w/Paper 32/Q6

(b) (i) add water (to yellow solid or to (anhydrous) iron(II) sulfate or to $FeSO_4$ or to products [1]

goes green [1]

Topic Chem 7 **Q# 68/** iGCSE Chemistry/2014/w/Paper 32/Q5

5 (b) catalyst [1]

biological or protein [1]

5 (c) (i) C A B [2]

ABC = 1 ACB = 1 BCA = 1 CBA = 1 BAC = 0
Allow 70 for C, 40 for B and 20 for A

(ii) M1 Energy mark: at higher temperature particles/molecules more have more energy or move faster [1]

M2 Collision frequency mark: collide more frequently/often **or** more collisions per unit time **or** higher rate of collisions. [1]
Ignore: 'more collisions'

M3 Collision energy mark: more molecules have enough energy to react or more collisions are above activation energy or successful [1]

(iii) C rate zero or enzymes denatured [1]

Topic Chem 7 **Q# 69/** iGCSE Chemistry/2014/s/Paper 33/Q3

3 (a) (i) enzymes (1) [1]

(ii) reduces growth of microbes/rate of reproduction of microbes is lower/ microbes are dormant (1)
fewer (enzymes) to decay food (1)
OR
enzymes less efficient at lower temperatures (1)
slower reaction rate (1) [2]

Topic Chem 7 **Q# 70/** iGCSE Chemistry/2014/s/Paper 33/Q3

(c) any **three** from:
photosynthesis (1)
light/photochemical (1)
chlorophyll/chloroplasts (1)
carbon dioxide and water needed (1)
(glucose and) oxygen (1) [3]

Topic Chem 7 **Q# 71/** iGCSE Chemistry/2014/s/Paper 33/Q2

2 (a) any **three** from:
particles have more energy (1)
move faster (1)
collide more frequently (1)
more particles have energy greater than E_a [3]
guidance: more colliding molecules have enough energy to react is worth (2)

Topic Chem 7 **Q# 72/** iGCSE Chemistry/2014/s/Paper 32/Q5

(ii) any **two** from:

(forward) reaction is endothermic (1)

high temperature increases yield/favours forward reaction/shifts equilibrium to right (1)

faster reaction (rate) (1) [2]

(iii) any **two** from:

high pressure reduces yield **or** favours LHS (1)

because LHS has smaller volume **or** number of moles/number of molecules (of gas) ORA (1)

(high pressure plant is) expensive/dangerous/explosion/leaks [2]

Topic Chem 7 **Q# 73/** iGCSE Chemistry/2014/s/Paper 32/Q4

(d) (i) concentration (of acid in C) is less / halved **or** concentration of A is more / doubled. (1)

less collisions **or** more collisions in A (than in C) (1) [2]

(ii) (higher temperature in B particles / molecules / atoms) move faster / have more energy / more have E_a **or** (particles / molecules / atoms) in A move slower / have less energy / less have E_a (1)

more collisions **or** less collisions in A (than in B) (1) [2]

(iii) It (D) has strong (acid) **and** A has weak acid / (D) stronger / (D) ionises more / (D) dissociates more **or** A is weaker / A ionises less / A dissociates less (1)

It (D) has higher concentration of hydrogen ions **or** A has a lower concentration of hydrogen ions (1)

more collisions (in D) **or** fewer collisions in A (1) [3]

Topic Chem 7 **Q# 74/** iGCSE Chemistry/2014/s/Paper 32/Q1

(e) F (1) [1]

MS Topic Chem 8 **Q# 75/** iGCSE Chemistry/2015/w/Paper 33/Q7

7(b)(i)	repeat experiment using same volume / amount of (same) H_2SO_4; and same volume / amount of (same) KOH; **or** (add activated) charcoal / carbon; filter out the charcoal; **or** mix volumes / amounts of H_2SO_4 and KOH in the ratio 1:2; of the same concentration;	**2**
7(b)(ii)	make solution of potassium sulfate as above; add same volume / amount of acid again; **or** same volume / amount of KOH; add double the volume / amount of H_2SO_4; 25 cm^3 KOH + 56.4 cm^3 H_2SO_4 = [2] **or** same volume / amount of H_2SO_4; add half the volume / amount of KOH; 12.5 cm^3 KOH + 28.2 cm^3 H_2SO_4 = [2] **or** mix equal volumes / amounts of H_2SO_4 and KOH ; of the same concentration; mix solutions containing equal numbers moles of KOH and H_2SO_4 = [2]	**2**
7(c)	*test:* reactive metal / name or formula of suitable metal, e.g. Mg / Fe / Zn; *result* bubbles or gas or hydrogen or H_2 evolved / dissolves; *test:* insoluble carbonate or name / formula of suitable insoluble carbonate, e.g. $CaCO_3$; *result* bubbles or gas or carbon dioxide or CO_2 evolved / dissolves provided that carbonate is insoluble; *test:* alkali or name / formula of suitable alkali, e.g. NaOH / KOH; *result* temperature change; *test:* alkali or name / formula of suitable alkali, e.g. NaOH / KOH and indicator; *result* colour change; *test:* insoluble base or name / formula of suitable insoluble base; *result* dissolves; *test:* indicator, e.g. blue litmus; *result* colour change (colour need not be specified); *test:* measure pH / pH paper / UI paper / pH meter; *result* pH 0–3 or indicator red / orange or pH lower than pH of K_2SO_4;	**2**

Topic Chem 8 **Q# 76/** iGCSE Chemistry/2015/w/Paper 33/Q5

5(a)(i)	proton donor / H^+ donor / hydrogen ion donor;	**1**
5(a)(ii)	strong acid completely or fully ionises / completely or fully dissociates / completely or fully splits into ions; weak acid partially or incompletely ionises or dissociates or splits into ions / does not ionise fully;	**1** **1**

5(b)(i)	barium sulphite/barium sulfate(IV)/ $BaSO_3$;	1
5(b)(ii)	barium sulfate /$BaSO_4$;	1
5(b)(iii)	$Br_2 + 2e^- \rightarrow 2Br^-$ / $Br_2 \rightarrow 2Br^- - 2e^-$;	1
5(b)(iv)	sulfuric acid;	1
5(c)(i)	(→) magnesium sulfate + water;	1
5(c)(ii)	(→) zinc sulfate + hydrogen;	1
5(c)(iii)	(→) copper(II) sulfate /copper sulfate + carbon dioxide + water;	1
5(d)(i)	$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ / $NH_3 + H_2SO_4 \rightarrow (NH_4)HSO_4$;	1
5(d)(ii)	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ Na_2SO_4; rest of equation correct; **or** $H^+ + OH^- \rightarrow H_2O$ H_2O as the only product on the right hand side; rest of equation correct; **or** $NaOH + H_2SO_4 \rightarrow NaHSO_4 + H_2O$ $NaHSO_4$; rest of equation correct; **or** $OH^- + H_2SO_4 \rightarrow HSO_4^- + H_2O$ HSO_4^-; rest of equation correct;	2
5(d)(iii)	$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$; $FeSO_4$; rest of equation correct; **or** $Fe + 2H^+ \rightarrow Fe^{2+} + H_2$; Fe^{2+}; rest of equation correct; **or** $2Fe + 3H_2SO_4 \rightarrow Fe_2(SO_4)_3 + 3H_2$; $Fe_2(SO_4)_3$; rest of equation correct; **or** $2Fe + 6H^+ \rightarrow 2Fe^{3+} + 3H_2$; Fe^{3+}; rest of equation correct;	2

Topic Chem 8 **Q# 77/** iGCSE Chemistry/2015/w/Paper 33/Q1

1(a)	cobalt chloride (paper)/anhydrous cobalt chloride/ $CoCl_2$; from blue; to pink; **or** copper sulfate /anhydrous copper sulfate/ $CuSO_4$; from white; to blue;	3

Topic Chem 8 **Q# 78/** iGCSE Chemistry/2015/w/Paper 32/Q6

6(g)	MgO will react with/dissolve in/neutralise hydrochloric acid/acid/acid oxide; if amphoteric, MgO will react with or dissolve in or neutralise hydrochloric acid or acid or acid oxide **and** MgO will react with dissolve in or neutralise sodium hydroxide or alkali or base or basic oxide; MgO will not react with or dissolve in or neutralise sodium hydroxide or alkali or base or basic oxide = [2]	2

Topic Chem 8 **Q# 79/** iGCSE Chemistry/2015/s/Paper 33/Q4

4(b)(iii)	add sodium hydroxide (solution) and aluminium; (warm) and ammonia made;	2	**A** zinc or Devarda's **A** description of smell of ammonia or test for ammonia
4(b)(iv)	M1 measure pH/ describe how to measure pH (such as use universal indicator); M2 lower pH greater concentration of H^+; **OR** M1 add Ca, Mg, Zn, Fe; M2 faster reaction greater concentration of H^+ /faster bubbles or more hydrogen (in same time); **OR** M1 rate of reaction with (metal) carbonate; M2 faster reaction greater concentration of H^+ /faster bubbles or more carbon dioxide (in same time); **OR** M1 electrical conductivity; M2 greater conductivity greater concentration of H^+; **OR** M1 titrate with (named) alkali; M2 correct result;	2	**A** M2 if non specified or other metal added in M1

Topic Chem 8 **Q# 80/** iGCSE Chemistry/2015/s/Paper 33/Q2

2(a)	carbon monoxide;	1	**A** CO
2(b)	sodium oxide;	1	**A** Na_2O
2(d)	zinc oxide **OR** aluminium oxide;	1	**A** ZnO or Al_2O_3
2(f)	sulfur dioxide;	1	**A** SO_2

Topic Chem 8 **Q# 81/** iGCSE Chemistry/2015/s/Paper 32/Q5

5(a)	method A; hydrochloric acid / HC*l* / hydrogen chloride solution; nickel carbonate + hydrochloric acid → nickel chloride + water + carbon dioxide;	3	hydrochloric acid / HC*l* can only score if written in the reagent space i.e. **R** hydrochloric acid / HC*l* in equation if reagent space is blank **I** hydrogen chloride (therefore 'hydrogen chloride + HC*l* would get mark 2 BOD) **I** nickel carbonate **A** fully correct balanced chemical equation i.e. $NiCO_3 + 2HCl \rightarrow NiCl_2 + CO_2 + H_2O$ for the third mark **R** combination of words and formulae in the same equation for the third mark **I** concentration of acid for marks 2 and 3
5(b)	method C; any (aqueous / dilute / solution of soluble) bromide including potassium bromide / KBr, hydrogen bromide / HBr i.e. all bromides except silver, lead and mercury; $Pb^{2+} + 2Br^- \rightarrow PbBr_2$;	3	**A correct** formula of soluble bromide **I** lead nitrate **I** state symbols **A** multiples
5(c)	method B; sulfuric acid / hydrogen sulfate / H_2SO_4 ; $2LiOH + H_2SO_4 \rightarrow Li_2SO_4 + 2H_2O$ species; balancing;	4	**I** concentration of acid for mark 2 **I** indicators / lithium hydroxide **I** state symbols **A** multiples

Topic Chem 8 **Q# 82/** iGCSE Chemistry/2015/m/Paper 32/Q6

6 (a) Any **two** from:

- bubbles / effervescence / fizzing
- (some of the) solid / copper carbonate dissolves / disappears **or** some (brown) solid seen (undissolved)
- (colourless) solution or liquid turns blue [2]

(c) (i) Blue precipitate / ppt [1]

(ii) $Cu^{2+} + 2OH^- \rightarrow Cu(OH)_2$ [1]

(d) (i) $Cu(OH)_2(s) \rightarrow CuO(s) + H_2O(g)$

Equation [1]

State symbols of correct chemical equation [1]

Topic Chem 8 **Q# 83/** iGCSE Chemistry/2015/m/Paper 32/Q3

(h) (i) proton / H^+ acceptor [1]

(ii) $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ [2]

Formula of $(NH_4)_2SO_4$ (1)
The rest (1)

Topic Chem 8 **Q# 84/** iGCSE Chemistry/2015/m/Paper 32/Q1

(c) magnesium [1]

(e) aluminium [1]

Topic Chem 8 **Q# 85/** iGCSE Chemistry/2015/m/Paper 32/Q1

Topic Chem 8 **Q# 86/** iGCSE Chemistry/2014/w/Paper 33/Q8

(b) no more (solid) dissolves **or** no more cobalt(II) carbonate dissolves **or** no more effervescence **or** bubbling **or** fizzing [1]

filter(residue)/centrifuge/decant [1]

evaporate/heat/warm/boil/leave in sun **AND** until most of the water has gone/some water is left/until it is concentrated/saturation (point)/crystallisation point/crystals form on glass rod or microscope slide/crystals start to form [1]

Leave/allow to cool/allow to crystallise/filter (off crystals)/wash(with distilled water)/dry crystals with filter paper/dry crystals in warm place **or** dry in oven **or** dry on windowsill [1]

Topic Chem 8 **Q# 87/** iGCSE Chemistry/2014/w/Paper 33/Q6

(b) (i) (mix solutions of) rubidium carbonate/Rb_2CO_3 [1]

strontium chloride/$SrCl_2$ **or** strontium nitrate/$Sr(NO_3)_2$ **or** strontium sulfate/$SrSO_4$ **or** strontium hydroxide/$Sr(OH)_2$ [1]

COND (on two correct reactants) filter **or** centrifuge **or** decant (the residue) [1]

wash <u>with water</u> **and** dry/press between filter paper/put in (low) oven/put on a (sunny) windowsill/put in sun/heat [1]

Topic Chem 8 **Q# 88/** iGCSE Chemistry/2014/w/Paper 32/Q6

6 (c) (i) nitric acid or nitric(V) acid or HNO_3 [1]

Topic Chem 8 **Q# 89/** iGCSE Chemistry/2014/w/Paper 32/Q1

(ii) M1 dissolving
M2 filtration
M3 evaporation or heat (to crystallisation point)
M4 crystallisation or allow leave to cool [4]
or
M3 crystallisation
M4 filtration

OR: Adding to H_2SO_4 method

M1 Add excess mixture to acid (or until no more dissolves)
M2 Filtration
or
M1 Add excess acid to mixture
M2 With heat

M3 evaporation or heat (to crystallisation point) Stop marking if heated to dryness.
M4 crystallisation or allow leave to cool
or
M3 crystallisation
M4 filtration

[Total: 10]

Topic Chem 8 **Q# 90/** iGCSE Chemistry/2014/s/Paper 32/Q7

7 **(a)** repeat without indicator/repeat using same volumes of acid and alkali **or** use carbon/charcoal to remove indicator (1)

evaporate/heat/warm/boil/leave in sun (1)

until most of the water has gone/some water is left/saturation (point)/ crystallisation point (1)

leave/allow to cool/allow to crystallise (1)

filter (off crystals)/wash(with distilled water)/dry crystals with filter paper/dry crystals in warm place/oven/windowsill (1) [5]

Topic Chem 8 **Q# 91/** iGCSE Chemistry/2014/s/Paper 32/Q6

(c) name or formula of strong acid and alkali (1)

reacts with or neutralises both acid and base or alkali (then amphoteric) (1)

it dissolves/soluble in both(acid and alkali) or form solutions in both (1) [3]

MS Topic Chem 9 **Q# 92/** iGCSE Chemistry/2015/w/Paper 33/Q6

6(a)	Na/sodium **and** Li/lithium;	1
6(f)	*physical properties* any three from: hard; strong; high density; malleable; ductile; sonorous; shiny; high melting point/high boiling point; (good) conductor (of heat/electricity); forms coloured compounds/coloured ions/coloured salts; *chemical properties* any two: catalytic behaviour; more than one or different or variable oxidation state or oxidation number or valency/variable charges/many differently charged ions; forms complex (ions); forms coloured compounds/coloured ions/coloured salts; amphoteric oxide/amphoteric/basic oxide/alkaline oxides/acidic oxide; (other metallic reactions) with acids/water/steam; reducing agent/electron donor/reacts with non-metal to form ionic compound/forms positive ions;	5

Topic Chem 9 **Q# 93/** iGCSE Chemistry/2015/w/Paper 33/Q2

2(d)	argon/Ar;	1

Topic Chem 9 **Q# 94/** iGCSE Chemistry/2015/m/Paper 32/Q1

(d) argon [1]

(f) sodium [1]

Topic Chem 9 **Q# 95/** iGCSE Chemistry/2014/w/Paper 33/Q3

(iii) Any **two** from: [2]
potassium oxide
potassium hydroxide
potassium carbonate
potassium hydrogencarbonate (bicarbonate)

Topic Chem 9 **Q# 96/** iGCSE Chemistry/2014/w/Paper 33/Q1

1 **(a)** **Bromine**
Physical: reddish-brown liquid **or** brown liquid **or** volatile liquid/low boiling point liquid **or** poor/non-conductor (of electricity) **or** soluble in water **or** soluble in organic/non-polar solvents [1]

Chemical: Reacts with water **or** reacts with iodides (in solution) **or** displaces iodine **or** reacts with alkenes/named alkene/unsaturated hydrocarbons **or** reacts with alkane in UV/named alkane in UV **or** valency/oxidation state(–)1 **or** forms Br^- **or** gains or shares 1 electron **or** combines or reacts with metals/named metal **or** combines or reacts with non-metals/named non-metal **or** oxidising agent **or** bleaches litmus paper/indicator paper **or** corrosive **or** forms acidic oxides [1]

(c) **Manganese**

Physical: (good) conductor (of heat/electricity) **or** high melting point/high boiling point **or** forms coloured compounds/coloured ions **or** hard **or** strong **or** high density **or** malleable **or** ductile **or** sonorous **or** shiny [1]

Chemical: Variable or different valency/oxidation state/oxidation number **or** catalytic activity **or** forms coloured compounds/coloured ions **or** forms complex ions/complexes **or** reacts with acids **or** reducing agent **or** reacts with non-metals [1]

Topic Chem 9 **Q# 97/** iGCSE Chemistry/2014/s/Paper 33/Q1

(c) krypton (1) [1]

(e) fluorine (1) [1]

Topic Chem 9 **Q# 98/** iGCSE Chemistry/2014/s/Paper 32/Q6

6 (a) any **three** from:

(it would have) more than one or variable valency / oxidation state / oxidation number (1)

(metal / element / titanium / it has a) high density (1)

coloured compounds / ions / solutions (1)

form complex (ions) (1)

(element/compound act as) catalyst (1) [3]

Topic Chem 9 **Q# 99/** iGCSE Chemistry/2014/s/Paper 32/Q1

1 (a) A and E **need both** (1) [1]

(c) C (1) [1]

(f) E (1) [1]

MS Topic Chem 10 **Q# 100/** iGCSE Chemistry/2015/w/Paper 33/Q6

6(b)	Cu / copper **and** Rh / rhodium;	1
6(c)	$Fe_2(SO_4)_3$;	1
6(d)	Mg^{2+};	1
6(e)	copper sulfate (solution); add manganese / Mn to solution; copper displaced or forms / blue colour changes; **or** (a solution of) an iron salt or a zinc salt; add copper and manganese to each; only manganese reacts / displaces; **or** (a solution of a) manganese salt and a copper salt; add, e.g. iron / zinc; copper (displaced) and manganese not; **or** to a (dilute) acid / any named acid / water / steam; add Mn and Cu / both metals to the liquid; rate faster or shorter time or more bubbles or more hydrogen or more gas with Mn or with the more reactive metal / reaction only with Mn or with the more reactive metal; **or** copper oxide; add manganese and heat; evidence of reaction; **or** burn manganese and copper / both elements; in air / oxygen; Mn or more reactive metal burns brighter / only Mn or more reactive metal burns / evidence that manganese reacts faster; **or** add carbon; to both metal oxides and heat; evidence that reaction occurs with copper oxide more readily / least reactive metal oxide;	3

	or both metal nitrates or carbonates; heat; evidence that manganese compound is most stable/most reactive compound is most stable; **or** (electrochemical) cell/use of voltmeter/electrolyte; copper and manganese (as electrodes); manganese is the negative terminal;	

Topic Chem 10 **Q# 101/** iGCSE Chemistry/2015/w/Paper 32/Q5

5(a)	as a reducing agent; source of heat/energy;	**2**
5(b)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ species; balancing;	**2**
5(c)	silica reacts with limestone or calcium oxide; to form a slag or calcium silicate or $CaSiO_3$; (liquid) slag floats (above molten iron);	**3**
5(d)	blow or pass oxygen through (molten) iron; $C + O_2 \rightarrow CO_2$; carbon dioxide escapes or carbon dioxide is a gas;	**3**

Topic Chem 10 **Q# 102/** iGCSE Chemistry/2015/w/Paper 32/Q3

3(a)	zinc blende is burnt/roasted/heated in air; zinc sulfide + oxygen → zinc oxide + sulfur dioxide;	**2**
3(b)	zinc oxide + carbon → zinc + carbon dioxide/monoxide;	**1**
3(d)(i)	copper;	**1**
3(d)(ii)	any two from: • hard(er)/less malleable; • strong(er); • (better) appearance; • (more) resistant to corrosion;	**2**
3(e)(i)	steel (or iron) is exposed to oxygen **and** water;	**1**
3(e)(ii)	Zn more reactive than Fe (allow steel); Zn loses/transfers electrons (more readily) **and** forms (+ve) ions (in preference to Fe); Fe (allow steel) is more reactive than Cu; Fe loses/transfers electrons (more readily) **and** forms (+ve) ions (in preference to Cu);	**4**

Topic Chem 10 **Q# 103/** iGCSE Chemistry/2015/w/Paper 32/Q3

3(e)(i)	steel (or iron) is exposed to oxygen **and** water;	**1**

Topic Chem 10 **Q# 104/** iGCSE Chemistry/2015/s/Paper 33/Q6

6(a)(i)	$Al^{3+} + 3e \rightarrow Al$ formula of Al^{3+} ion; rest correct;	**2**	**A** multiples **I** state symbols **A** – 3e on right
6(a)(ii)	$2O^{2-} \rightarrow O_2 + 4e$ species; balancing;	**2**	**A** multiples **I** state symbols **A** – 4e on left
6(a)(iii)	endothermic **AND** (electrical) energy supplied;	**1**	**A** energy required to break bonds
6(b)(i)	exothermic **AND** (electrical) energy release;	**1**	**I** heat energy
6(b)(ii)	magnesium forms ions (in solution) **OR** magnesium loses electrons **OR** magnesium is oxidised; copper is deposited (on the electrode) **OR** copper ions become copper atoms **OR** copper ions gain electrons **OR** copper ions are reduced;	**2**	**A** magnesium dissolves/goes into solution **A** equation (balanced or unbalanced) **A** equation (balanced or unbalanced) **I** use of terms anode or cathode
6(b)(iii)	M1 set up a magnesium/manganese cell; M2 the negative electrode (is the more reactive) **OR** the electrode that loses mass (is more reactive); **OR** M1 replace magnesium with manganese; M2 if voltage less (positive) manganese is less reactive **OR** if voltage is more (positive) manganese is more reactive;	**2**	**A** replace Cu with Mn **A** converse

Topic Chem 10 **Q# 105/** iGCSE Chemistry/2015/s/Paper 33/Q5

5(a)	($CuCO_3 \rightarrow$) $CuO + CO_2$; ($Cu(OH)_2 \rightarrow$) $CuO + H_2O$; ($2Cu(NO_3)_2 \rightarrow$) $2CuO + (4NO_2) + O_2$ species; balancing;	**4**	**A** multiples **I** state symbols

5(b)(i)	(black to) pink / brown / orange;	1	**I** red
5(b)(ii)	(hot) copper reacts / is oxidised; with oxygen / air;	2	**A** forms copper oxide for 2 marks
5(b)(iii)	carbon monoxide / ammonia / methane;	1	
5(b)(iv)	carbon / graphite or any metal more reactive than copper;	1	

Topic Chem 10 **Q# 106/** iGCSE Chemistry/2015/s/Paper 32/Q6

6(b)(i)	$2NaNO_3 \rightarrow 2NaNO_2 + O_2$ species; balancing;	2	**A** multiples **I** state symbols / word equation
6(b)(iii)	the more reactive the metal the lower rate of decomposition / more difficult the decomposition / more stable the nitrate / more energy needed to decompose / decomposes at higher temperature ora;	1	**A** less (extent the) decomposition **A** reactive metals produce nitrates difficult to decompose ora i.e. comparatives not essential **A** the more reactive the metal the less it decomposes is acceptable because we can assume that *it* refers to the nitrate BOD **A** inverse relationship with further qualification **A** group 1 / reactive metals produce nitrite (and oxygen) **and** less reactive metals produce oxide (+ NO_2 + O_2) (both required for mark) **I** less products (unqualified) **R** less products / metals decompose
6(c)(i)	(changes from) blue solid / blue crystals; black solid formed; brown gas / brown vapour / (pungent) smell;	3	**R** precipitate **A** one mark out of the first two for changes from blue to black (without solid or crystals) **I** red / melt **I** water / steam / condensation given off **I** reference to glowing / burning splints / colourless gas / effervescence **I** names / formulae

Topic Chem 10 **Q# 107/** iGCSE Chemistry/2015/m/Paper 32/Q6

(d) (i) $Cu(OH)_2(s) \rightarrow CuO(s) + H_2O(g)$

Equation [1]

State symbols of correct chemical equation [1]

(ii) carbon / hydrogen [1]

Topic Chem 10 **Q# 108/** iGCSE Chemistry/2015/m/Paper 32/Q5

5 (a) Bauxite [1]

(b) carbon / graphite [1]

(c) improves conductivity / better conductor [1]

Lower (operating) temperature / save energy / saves electricity / saves heat [1]

(d) anode: $2O^{2-} \rightarrow O_2 + 4e^-$ / $2O^{2-} - 4e^- \rightarrow O_2$ [1]

cathode: $Al^{3+} + 3e^- \rightarrow Al$ / $Al^{3+} \rightarrow Al - 3e^-$ [1]

(e) (i) Iron carbon aluminium / Fe, C, Al [1]

(ii) Aluminium oxide is not reduced by carbon but iron(III) oxide is [1]

(f) haematite / hematite [1]

(g) **Allow:** multiples in **(i)** to **(iv)**

(i) $C + O_2 \rightarrow CO_2$ [1]

(ii) $CO_2 + C \rightarrow 2CO$ [1]

(iii) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ / $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$ / $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$ [1]

(iv) $CaO + SiO_2 \rightarrow CaSiO_3$ / $CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$ [1]

Topic Chem 10 **Q# 109/** iGCSE Chemistry/2014/w/Paper 33/Q6

(ii) $SrCO_3 \rightarrow SrO + CO_2$ [1]

(c) (i) rubidium nitrite or nitrate(III) [1]

(ii) $2Sr(NO_3)_2 \rightarrow 2SrO + 4NO_2 + O_2$ [2]
Species (1) Balancing (1)

Topic Chem 10 **Q# 110/** iGCSE Chemistry/2014/w/Paper 33/Q2

(iv) not horizontal **or** line slopes **or** line is lower [1]

Topic Chem 10 **Q# 111/** iGCSE Chemistry/2014/w/Paper 33/Q1

(b) Graphite

Chemical: reducing agent **or** reduces metal oxides/named metal oxide **or** reacts with/burns in air/oxygen **or** forms an acidic oxide (CO_2) **or** valency/oxidation state of 2 or 4 [1]

Topic Chem 10 **Q# 112/** iGCSE Chemistry/2014/w/Paper 32/Q6

(ii) $2KNO_3 = 2KNO_2 + O_2$ [2]
Species (1)
Balance (1)

Topic Chem 10 **Q# 113/** iGCSE Chemistry/2014/w/Paper 32/Q4

4 (a) M1 brass [1]

M2 copper **COND** on M1 [1]

(b) (i) $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$ [2]
species (1) balancing (1)

Topic Chem 10 **Q# 114/** iGCSE Chemistry/2014/w/Paper 32/Q2

2 (a) $Al^{3+} + 3e^- \rightarrow Al$ [2]
species (1) balancing (1)

(b) (i) $AlCl_3 + 3Na \rightarrow 3NaCl + Al$ [2]
species (1) balancing (1)

(c) (i) bauxite [1]

(ii) M1 aluminium oxide / amphoteric oxide dissolves OR iron(III) oxide / basic oxide does not [1]

M2 Filter **COND** on M1 [1]

(iii) Any **two** from:
Lowers (working) temperature or lowers mpt (of mixture)
increases conductivity
reduces cost OR energy need [2]

(d) (i) Has an impervious **or** non-porous **or** passive **or** unreactive **or** protective oxide layer [1]

(ii) Any **two** from:
good conductor of heat
high melting point
Unreactive towards foods [2]

Topic Chem 10 **Q# 115/** iGCSE Chemistry/2014/s/Paper 33/Q7

7 (a) bauxite (1) [1]

(c) (i) food containers / window frames / cooking foil / cars / bikes / drink cans (1) [1]

Topic Chem 10 **Q# 116/** iGCSE Chemistry/2014/s/Paper 33/Q4

(ii) any **two** of the oxides, C, S, P and Si, mentioned (1)
carbon dioxide and sulfur dioxide escape / are gases (1)

phosphorus oxide **or** silicon(IV) oxide react with calcium oxide /
phosphorus oxide **or** silicon(IV) oxide are acidic and calcium oxide is basic (1)

to form a slag **or** calcium silicate **or** calcium phosphate (1)

must have correct equation for one of the above reactions (1) [5]

(iii) carbon particles / atoms different size (1)
prevents movement of rows, etc. (1) [2]

MS Topic Chem 11 **Q# 117/** iGCSE Chemistry/2015/w/Paper 33/Q1

1(c)	any two from: • filtration / sedimentation / sieving / screening / (pass through) gravel (beds) / flocculation / decantation / clarification / coagulation / flotation / settling tank / add aluminium sulfate; • (add) carbon; • chlorination / (add) chlorine / add Cl_2; • fluoridation / add fluoride; • ozone dosing; • desalination; • aeration; • distillation;	2
1(d)	any two from: making steel; making paper; textiles; generating electricity / energy / power / turbines; HEP; water mills; steam power (e.g. steam engines); geothermal power; agriculture; livestock; irrigation; hydration of alkenes / manufacture of ethanol / alcohols; manufacture of sulfuric acid / Contact process; manufacture of hydrogen; solvent / dissolving; coolant / cooling; cleaning / washing; (supply of) drinking (water); central heating; production of slaked lime; cooking;	2

Topic Chem 11 **Q# 118/** iGCSE Chemistry/2015/w/Paper 32/Q2

2(a)(i)	combustion / burning of a motor vehicle fuel or a named fuel which can act as a motor vehicle fuel; incomplete combustion would produce CO; complete combustion would produce CO_2;	3
2(a)(ii)	*carbon dioxide*: climate change / global warming / greenhouse effect; *carbon monoxide*: poisonous / toxic;	2
2(a)(iii)	nitrogen and oxygen react or combine; at high temperatures or in presence of spark;	2
2(a)(iv)	it reacts or combines with oxygen / $NO + \frac{1}{2}O_2 \rightarrow NO_2$;	1
2(b)	any two from: • acid rain is formed; • lowers pH or acidifies lakes / rivers or kills fish / aquatic animals; • changes composition of soils or reduces fertility of soil or reduces crop yields / deforestation or kills crops or trees or plants or leaves / lowers pH of soil or increases acidity of soil; • attacks (limestone) buildings or statues; attacks metal (structures) / bridges;	2
2(c)	use of a catalytic converter; $2NO + 2CO \rightarrow 2CO_2 + N_2$ species; balancing;	3

Topic Chem 11 **Q# 119/** iGCSE Chemistry/2015/s/Paper 33/Q4

4(b)(i)	oxygen/air and sulfur (from fuel) react; (forms) sulfur (di)oxide; (sulfur dioxide) reacts with oxygen/air and water (to form sulfuric acid) **OR** sulfur trioxide reacts with water (to form sulfuric acid) **OR** sulfurous acid reacts with oxygen (to form sulfuric acid);	**3**	**A** correct formulae throughout **A** sulfurous acid if sulfur reacts with oxygen and water
4(b)(ii)	oxygen and nitrogen react; making oxides of nitrogen; (oxides of nitrogen) react with water (making nitric acid);	**3**	**A** nitrogen combust **R** if oxygen or nitrogen originate from the fuel **A** named oxide of nitrogen **A** correct formulae **A** NO_x
4(b)(iii)	add sodium hydroxide (solution) and aluminium; (warm) and ammonia made;	**2**	**A** zinc or Devarda's **A** description of smell of ammonia or test for ammonia

Topic Chem 11 **Q# 120/** iGCSE Chemistry/2015/s/Paper 32/Q7

7(a)(i)	living/organism or named example e.g. yeast/cells/plants/animals/part of animal or plant e.g. muscle/humans/micro-organisms; produces/releases or gain or obtain energy/exothermic/heat; from food/named foodstuff/carbohydrate/named carbohydrate/sugar/named sugar/glucose/nutrients;	**3**	**A** 'we/us' for 'humans' **I** products/breathing/oxygen/anaerobic/aerobic
7(a)(ii)	***Any 2 from 3:*** carbon dioxide/CO_2; water/H_2O; adenosine triphosphate/ATP;	**1**	 **I** energy

Topic Chem 11 **Q# 121/** iGCSE Chemistry/2015/s/Paper 32/Q6

6(a)(i)	(Haber process makes) ammonia/NH_3; (ammonia converted into) fertilisers/nitrates/ammonium salts or names or formulae of examples e.g. ammonium nitrate/NH_4NO_3/ammonium sulfate/$(NH_4)_2SO_4$/calcium nitrate/$Ca(NO_3)_2$/urea/$CO(NH_2)_2$;	**2**	**A** 2 marks for 'ammonia is a fertiliser' **A** ammonia is used to make sodium nitrate Haber process used to make fertilisers gets second mark only
6(a)(ii)	it (refers to sodium nitrate)/sodium nitrate would dissolve (in rain)/soluble (in water)/wash away/leach/drain off;	**1**	**A** reacts with water **I** reference to fertiliser **R** sodium reacts/dissolves **A** because they are not dissolved by rainfall (implication is in desert)
6(a)(iii)	potassium (is required by plants as well as nitrogen)/NPK;	**1**	**R** comments about pH/better for soil/%N higher/reactivity of potassium **I** comments about what K does for plants e.g. combat disease

Topic Chem 11 **Q# 122/** iGCSE Chemistry/2015/s/Paper 32/Q4

4(a)	large surface area/large area of contact/large surface; more (successful) collisions (between catalyst and gases or between reacting gases) **OR** more active sites **OR** faster reaction/increase rate/increase speed;	**2**	**I** activation energy Second mark must be comparative
4(b)	decrease temperature/temperature below 450 °C/quoted temperature below 450 °C; increase pressure/pressure above 200 atm/quoted pressure above 200 atm;	**2**	**I** comments about concentration **I** low temperature and high pressure. Both answers must be comparative **I** explanations
4(c)	decreased temperature would reduce rate/reaction slower/too slow; increased pressure expensive/uneconomic/safety risks/leaks/explosions/yield **or** rate good enough at lower pressure/strong pipes needed/thick pipes needed/sturdy pipes needed/requires a lot of energy;	**2**	**A** takes longer **I** slow (unqualified) **I** answers that do not refer to decreased temperature and increased pressure e.g. it is too expensive unless this is linked with pressure

Topic Chem 11 **Q# 123/** iGCSE Chemistry/2015/m/Paper 32/Q3

3 **(a)** (making) fertilisers / nitric acid / nylon / explosives / urea
(for) cleaning products (allow oven cleaner) / refrigeration [1]

(b) equilibrium / reversible [1]

(c) (nitrogen)air / atmosphere [1]

(hydrogen) methane / water / steam / alkane / named alkane / hydrocarbon / crude oil or petroleum / natural gas [1]

(d) iron [1]

(e) **(i)** rate increases / faster [1]

More (effective) collisions [1]

(ii) yield decreases [1]

(forward reaction) exothermic / reverse reaction endothermic / high temp favours endothermic reaction [1]

(f) **(i)** yield increases [1]

less / fewer molecules or moles or volume on RHS ORA / high pressure favours reaction which produces fewer molecules or moles or volume [1]

(ii) particles / molecules closer / more particles per unit area or volume / more molecules per unit area or volume / more concentration / particles have less space between them **and** more collisions [1]

(iii) safety issues / higher cost [1]

Topic Chem 11 **Q# 124/** iGCSE Chemistry/2015/m/Paper 32/Q1

(b) chlorine [1]

Topic Chem 11 **Q# 125/** iGCSE Chemistry/2014/s/Paper 33/Q5

5 **(a)** faster reaction rate (1)
higher collision rate (1)
greater yield **or** favour RHS (1)
pressure favours products because it has lower volume / fewer product molecules (1) [4]

(b) higher temperature favour endothermic reaction (1)
this is the back reaction / left hand side / reactants (1)
reduce yield (1) [3]

(c) **(i)** greater surface area (1) [1]

(ii) increase reaction rate (1)
can use a lower temperature to have an economic rate (1)
and not decrease yield (by increasing temperature). [2]

(d) lower the temperature (1)
only ammonia will liquefy (1)
OR
add water (1)
only ammonia will dissolve (1)
OR
increase pressure (1)
only ammonia will liquefy (1) [2]

Topic Chem 11 **Q# 126/** iGCSE Chemistry/2014/s/Paper 33/Q4
fractional distillation (1)
liquid air (1)

Topic Chem 11 **Q# 127/** iGCSE Chemistry/2014/s/Paper 33/Q1

1 **(a)** carbon dioxide (1) [1]

Topic Chem 11 **Q# 128/** iGCSE Chemistry/2014/s/Paper 33/Q1

(d) nitrogen (1) [1]

Topic Chem 11 **Q# 129/** iGCSE Chemistry/2014/s/Paper 32/Q5

5 **(a)** **(i)** incomplete combustion **or** limited oxygen/less oxygen/not enough oxygen (1) [1]

Topic Chem 11 **Q# 130/** iGCSE Chemistry/2014/s/Paper 32/Q3

3 **(a)** **(i)** pressure 150–300 atmospheres/atm (1)

temperature **accept** in range 370 to 470 °C (1)

iron (catalyst) (1)

balanced equation $N_2 + 3H_2 \rightleftharpoons 2NH_3$ (1)

equilibrium/reversible (1) [5]

(ii) potassium/K (1)

phosphorus/P (1) [2]

(b) **(i)** burn fossil fuels/burn fuels containing sulfur/burn compounds containing sulfur/burn ores containing sulfur/roast metal sulfides/burn metal sulfides (1)

sulfur dioxide/SO_2 (formed) (1)

(form) sulfuric/H_2SO_4/sulfurous acid/H_2SO_3 (1)

OR

nitrogen and oxygen (in air) react at high temperatures/in jet engines/car engines/lightning. (1)

(form) oxides of nitrogen (1)

(form) nitric acid/HNO_3/nitrous acid/HNO_2 (1) [3]

Topic Chem 11 **Q# 131/** iGCSE Chemistry/2014/s/Paper 32/Q2

(ii) any **two** from:

limited or finite resource / non-renewable / will run out / depleted (1)

greenhouse effect / gas(es) / climate change / (cause) global warming (1)

acid rain (1)

production of poisonous / toxic gases (1) [2]

MS Topic Chem 12 **Q# 132/** iGCSE Chemistry/2015/w/Paper 33/Q2

2(a)	sulfur dioxide / SO_2;	1

Topic Chem 12 **Q# 133/** iGCSE Chemistry/2015/s/Paper 33/Q2

2(c)	sulfur dioxide;	1	**A** SO_2

Topic Chem 12 **Q# 134/** iGCSE Chemistry/2014/w/Paper 32/Q6

6 (a) making fertilisers or pickling metals or making fibres or making phosphoric acid/phosphates making dyes or making paints/pigments/dyes or making paper making plastics or making detergents or tanning leather or battery acid. [1]

(ii) M1 Sulfur trioxide reacts with water to make sulfuric acid or equation [1]

M2 sulfur dioxide reacts with oxygen to form sulfur trioxide or equation [1]

Topic Chem 12 **Q# 135/** iGCSE Chemistry/2014/w/Paper 32/Q4

(c) (i) sulfuric acid [1]

Topic Chem 12 **Q# 136/** iGCSE Chemistry/2014/s/Paper 33/Q1

(f) sulfur dioxide (1) [1]

MS Topic Chem 13 **Q# 137/** iGCSE Chemistry/2015/s/Paper 33/Q3

3(b)	$CaO + H_2O \rightarrow Ca(OH)_2$ reactants; product;	2	One mark for each side correct **A** multiples **I** state symbols
3(c)	M1 number of moles of $CaCO_3$ = (12.5 / 100 =) 0.125 **or** 125000 **OR** 56 / 100 = 0.56; M2 mass calcium oxide = (0.125 × 56) = 7 (tonnes) **OR** 0.56 × 12.5 = 7;	2	Correct answer scores both marks **A** answers in g or kg
3(d)(i)	*Any **two** from:* does not wash away / insoluble / lasts a long time; does not increase pH above 7 / neutral / has pH 7; naturally occurring / does not need to be processed;	2	**A** does not leach out
3(d)(ii)	*Any **three** from:* (flue gas contains) sulfur dioxide; flue gas / sulfur dioxide is acidic; calcium carbonate reacts with sulfur dioxide; to make a salt / calcium sulfite **OR** neutralisation;	3	**A** $CaCO_3$ is a base
3(d)(iii)	making steel or iron / in a blast furnace / toothpaste / (making) glass / building / (making) cement / treating acidic river or lakes / chalk;	1	

Topic Chem 13 **Q# 138/** iGCSE Chemistry/2014/s/Paper 33/Q4

4 (a) (i) heat limestone / calcium carbonate (1)

Topic Chem 13 **Q# 139/** iGCSE Chemistry/2014/s/Paper 32/Q3

(ii) any **two** from:

calcium oxide / lime / quicklime / CaO (1)

calcium hydroxide / $Ca(OH)_2$ / lime / slaked lime / limewater (1)

calcium carbonate / $CaCO_3$ / limestone / chalk / marble (1) [2]

guidance: 'lime' can only be credited once.

MS Topic Chem 14 **Q# 140/** iGCSE Chemistry/2015/w/Paper 33/Q4

4(a)(i)	any three from: • (same) general (molecular) formula; • (consecutive members) differ by CH_2; • same functional group; • common (allow similar) methods of preparation; • same / similar chemical properties / (chemical) reactions;	3
4(a)(ii)	C_nH_{2n} alkene; C_nH_{2n+2} alkane;	1 1
4(a)(iii)	alkanes all or only (C–C) single bonds / no double bonds / no multiple bonds; alkenes (at least one) C=C / double bond / multiple bond;	1 1
4(b)(i)	heat / high temperature / temperature between 450 °C and 800 °C; catalyst / named catalyst, e.g. zeolites or alumina or aluminium oxide or aluminosilicates or silica or oxides of chromium; **or** high pressure / pressure in range of 2–70 atm; **or** steam; absence of air / oxygen;	2
4(b)(ii)	any correct equation producing an alkane and an alkene adding up to seven carbon atoms in the products;	1
4(b)(iii)	any correct equation producing two alkenes and hydrogen, e.g. → C_2H_4 + C_3H_{10} + H_2 / C_3H_6 + C_4H_8 + H_2;	1
4(b)(iv)	**alkenes:** more useful than alkanes / used to make polymers or plastics / used to make chemicals / petrochemicals; **or** **alkanes:** (balance the demand for different) fuels / increase petrol (fraction) or hydrogen / produce lighter fractions from heavier fractions or suitable example, e.g. naphtha to gasoline / more useful smaller molecules or more demand for smaller molecules or more demand for smaller fractions / used as fuel / used to make ammonia / used in Haber process / used in hydrogenation of vegetable oils / used to make HC*l*;	1 1

Topic Chem 14 **Q# 141/** iGCSE Chemistry/2015/w/Paper 33/Q2

2(c)	ethene / C_2H_4;	1
2(f)	methane / CH_4;	1

Topic Chem 14 **Q# 142/** iGCSE Chemistry/2015/w/Paper 32/Q4

4(a)(ii)	$CH_3CHClCH_3$;	1
4(a)(iii)	(both have) same molecular formula; different structural formula or structure;	2
4(c)(i)	$CH_3CH_2CH_2Cl$ + NaOH → $CH_3CH_2CH_2Cl$ + NaC*l* NaC*l* as product; rest of equation;	2
4(c)(ii)	propene; CH_2=$CHCH_3$;	2
4(c)(iii)	propanoic acid;	1

Topic Chem 14 **Q# 143/** iGCSE Chemistry/2015/s/Paper 33/Q7

7(a)(i)	alkenes have a (carbon to carbon) double bond;	1	**A** "they" for alkenes **A** alkanes do not have a (carbon to carbon) double bond
7(a)(ii)	alkene; C_nH_{2n} **or** twice as many hydrogen atoms as carbon atoms;	2	**A** fits general formula for alkenes
7(a)(iii)	add bromine (water); remains brown / orange / yellow / no change; becomes colourless / decolourised;	3	**I** red **A** M2 and M3 only available if M1 correct or close (such as bromide or bromination) **I** clear
7(b)(i)	 correct structure with at least two carbons and single C-C bond; continuation bonds with at least 2 carbon atoms in chain; two or more correct repeat units (with correct use of n, if used) **OR** correct use of n;	3	**I** incorrect additional units **R** any incorrect units or non-integral number of repeat units
7(b)(ii)	CH_3-CH=CH-CH_3;	2	**A** award 1 mark for any monomer with C=C as long as both carbons have the correct valency **I** names

7(b)(iii)	*one from:* addition polymerisation polymer only product; addition polymerisation same functional group in all monomers **or** C=C in monomers; addition polymer has same empirical formula as monomer; *one from:* condensation makes (polymer and) simple/small molecule **OR** water **OR** hydrogen chloride; condensation polymerisation monomers have two (different) functional groups;	2	**A** only one monomer **A** (normally two) different monomers
7(b)(iv)	polyester/ polyamide;	1	**A** protein/polysaccharide/ polypeptide/ complex carbohydrate **I** names

Topic Chem 14 **Q# 144/** iGCSE Chemistry/2015/s/Paper 33/Q6

6(d)(i)	(light from the) sun/sunlight;	1	**A** uv
6(d)(ii)	carbon dioxide + water → glucose + oxygen;	1	**A** starch/sugar/(named)carbohydrate **I** energy or light on LHS

Topic Chem 14 **Q# 145/** iGCSE Chemistry/2015/s/Paper 33/Q4

4(a)(i)	*Any **one** fossil fuel from:* crude oil/petroleum/natural gas/ methane/petrol/gasoline/kerosene/ paraffin/diesel (oil)/gas oil/fuel oil/refinery gas/LPG/propane/butane;	1	**I** ethane/ oil/ naphtha/coal/gas **R** coke/ bitumen/lubricating oil/wood
4(a)(ii)	(burn to) release energy; take a long time to form (from organic material);	2	If time stated 1000 years or more

Topic Chem 14 **Q# 146/** iGCSE Chemistry/2015/s/Paper 32/Q7

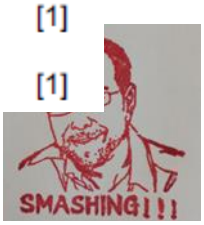
7(c)	***Any two from:*** fuel; **OR** petrol additive; **OR** solvent/tinctures; **OR** (making) perfumes; **OR** varnishes; **OR** preserving biological specimens/preserving food; **OR** essence/flavourings; **OR** antiseptic/kill bacteria (in medicine)/sterilizer; **OR** antitussive agent; **OR** (in) disinfectant/hand sanitizer; **OR** to make esters/ esterification; **OR** to make ether(s); **OR** to make amines; **OR** to make carboxylic acid(s)/vinegar/ethanoic acid; **OR** thermometers; **OR** alcohol lamp/spirit burners; **OR** any other suitable use;	2	**I** medicine (unqualified)/chemical feedstock
7(d)	cracking/ crack; (hexane to obtain) ethene/ C_2H_4 ; $C_6H_{14} \rightarrow C_2H_4 + C_4H_{10}$; hydration (of ethene)/ hydrate/hydrated **or** add(ition of) water/ add(ition of) steam/ addition; $C_2H_4 + H_2O \rightarrow C_2H_5OH$;	5	**I** fractional distillation/ distillation wherever mentioned **I** catalytic/ thermal + other conditions Ethene/ C_2H_4 can be given in either equation whether the equation is otherwise correct or not **I** state symbols **A** multiples/ other equations e.g. $C_6H_{14} \rightarrow 3C_2H_4 + H_2$ $C_6H_{14} \rightarrow 2C_2H_4 + C_2H_6$ $C_6H_{14} \rightarrow C_2H_4 + C_4H_8 + H_2$ **A** any correct equations in which carbon is produced e.g. $C_6H_{14} \rightarrow 2C_2H_4 + 2C + 3H_2$ **A** additional **I** conditions/react with water **I** C_2H_6O/state symbols **A** multiples

Topic Chem 14 **Q# 147/** iGCSE Chemistry/2015/m/Paper 32/Q7

7 (a) Any **two** from:
yeast/20–40 °C/anaerobic or without oxygen or without air/(aqueous) solution or water or aqueous [2]

(c) (i) Crude oil/petroleum [1]

(ii) $C_2H_4 + H_2O \rightarrow C_2H_5OH$ / CH_3CH_2OH [1]



4 **(a)** **(i)** 82.76/12 and 17.2(4)(/1)
or evaluation: 6.89 / 6.9(0) and 17.2(4) [1]

C_2H_5 [1]

OR
82.76 / 100 × 58 = 48 and 17.24 / 100 × 58 = 10
or evaluation i.e. 48 and 10 [1]

C_2H_5 [1]

(ii) (C_2H_5 =) 29 [1]

(58 / 29 =2) C_4H_{10} [1]

OR:
82.76 / 100 × 58 = 48 and 17.24 / 100 × 58 = 10
or evaluation i.e. 48 and 10 [1]

48 / 12 = 4 10 / 1 = 10 (therefore) C_4H_{10} [1]

(b) **(i)** C_nH_{2n} [1]

(ii) CH_2 [1]

(c) (contains) double bond / triple bond / multiple bond(s) / not all bonds are single [1]

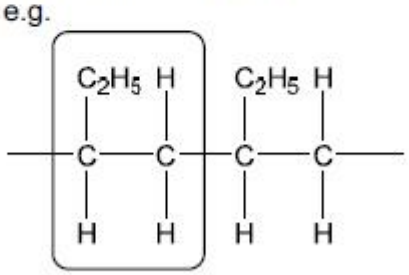
(contains) carbon and hydrogen **only** [1]

(d) bromine / bromine water [1]

no change / stays brown / orange / yellow / red-brown or only changes in UV [1]

(brown / orange / yellow) to colourless / decolourised [1]

(e) **(i)** circle / brackets around any 2 consecutive carbon atoms in the main chain and all attached atoms [1]
e.g.



(ii) $CH_3CH_2CH=CH_2$ / $C_2H_5CH=CH_2$ (double bond must be shown) [1]

butene / but-1-ene [1]

(iii) $(CH_3)_2C=CH_2$ / $CH_3CH=CHCH_3$ / $(CH_2)_2CHCH_3$ / $(CH_2)_4$ [1]

[Total:15]

4 **(a)** **(i)** 82.76/12 and 17.2(4)(/1)
or evaluation: 6.89 / 6.9(0) and 17.2(4) [1]

C_2H_5 [1]

OR
82.76 / 100 × 58 = 48 and 17.24 / 100 × 58 = 10
or evaluation i.e. 48 and 10 [1]

C_2H_5 [1]

(ii) (C_2H_5 =) 29 [1]

(58 / 29 =2) C_4H_{10} [1]

OR:
82.76 / 100 × 58 = 48 and 17.24 / 100 × 58 = 10
or evaluation i.e. 48 and 10 [1]

48 / 12 = 4 10 / 1 = 10 (therefore) C_4H_{10} [1]

(b) **(i)** C_nH_{2n} [1]

(ii) CH_2 [1]

(c) (contains) double bond / triple bond / multiple bond(s) / not all bonds are single [1]

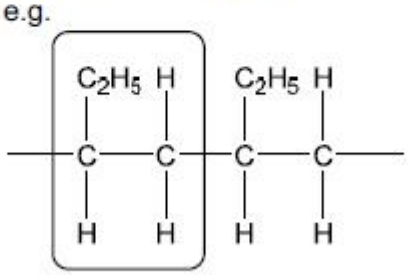
(contains) carbon and hydrogen **only** [1]

(d) bromine / bromine water [1]

no change / stays brown / orange / yellow / red-brown or only changes in UV [1]

(brown / orange / yellow) to colourless / decolourised [1]

(e) **(i)** circle / brackets around any 2 consecutive carbon atoms in the main chain and all attached atoms [1]
e.g.



(ii) $CH_3CH_2CH=CH_2$ / $C_2H_5CH=CH_2$ (double bond must be shown) [1]

butene / but-1-ene [1]

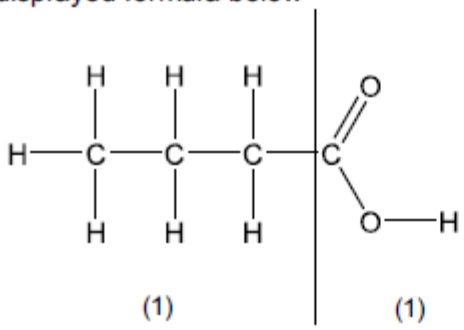
(iii) $(CH_3)_2C=CH_2$ / $CH_3CH=CHCH_3$ / $(CH_2)_2CHCH_3$ / $(CH_2)_4$ [1]

[Total:15]

Topic Chem 14 **Q# 150/** iGCSE Chemistry/2014/w/Paper 33/Q7

7 (a) (i) butanoic acid/butyric acid [1]

displayed formula below [2]



(1) (1)

(ii) any **three** from:
same or similar chemical properties
(same) general (molecular) formula
(consecutive members) differ by CH_2
same functional group
common methods of preparation
physical properties vary in predictable manner/show trends/gradually change
or example of a physical property variation i.e. melting point/boiling point/volatility [3]

(b) (i) methyl propanoate [1]

$CH_3CH_2COOCH_3/CH_3CH_2CO_2CH_3/C_2H_5COOCH_3/C_2H_5CO_2CH_3$ [1]

(ii) methyl ethanoate [1]

(c) (i) $3C_4H_{10} + 5\,½\,O_2 \rightarrow 4C_2H_5COOH + 3\,H_2O$ [1]

(ii) propanol or propan-1-ol or propanal [1]

[Total: 14]

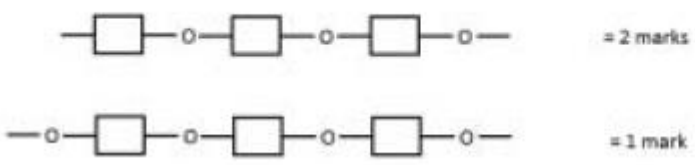
Topic Chem 14 **Q# 151/** iGCSE Chemistry/2014/w/Paper 32/Q5

5 (a) (i) M1 Contain carbon, hydrogen and oxygen (only) [1]

M2 hydrogen and oxygen is in a 2:1 ratio (or in the same ratio as water) [1]

(ii) M1 -O- linkage [1]

M2 3 monomer units with 3 blocks and 3 Oxygen atoms **Cond** [1]



3 (a) (i) C_4H_8 only
CH_2 (Allow C_1H_2) [2]

(ii) Any unambiguous structural formula of methyl cyclopropane or but-1-ene or but-2-ene or methyl propene [1]

(iii) M1 same molecular formula [1]

M2 different structural formulae or different structures
or different arrangement of atoms [1]

(iv) If 'No':
one an alkane, the other an alkene
or
one is saturated / has single bonds, the other is unsaturated / has a double bond
ignore: references to the 'functional group'

If 'yes'
both alkanes **or** both saturated
ignore: references to the 'functional group' [1]

(b) (i) M1 Action of heat or catalyst or thermal decomposition (on an alkane) [1]
Ignore steam. Ignore pressure.

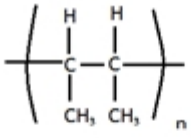
M2 Long-chained molecules or alkanes form smaller molecules (not smaller fraction) or forms smaller alkenes (or alkanes) [1]

(ii) $C_{10}H_{22}$ [1]

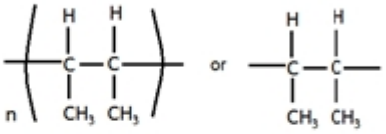
(c) (i) M1 Correct structure of one repeat unit [1]

M2 Continuation bonds **COND** on M1 [1]

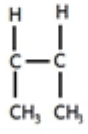
M3 use of brackets and subscript 'n' **COND** on M1 and M2 [1]



= 3 marks



= 2 marks



= 1 mark

(ii) dibromoethane or 1,2-dibromoethane [1]

Topic Chem 14 **Q# 153/** iGCSE Chemistry/2014/s/Paper 33/Q6

6 (a) (i) C and H only (1) [1]

(ii) only single bonds (1) [1]

(b) (i) C_nH_{2n+2} (1) [1]

(ii) $C_{14}H_{30}$ (1)
$(14 \times 12) + 30 = 198$ (g) (1) [2]

(c) (i) $C_9H_{20} + 14\ O_2 \rightarrow 9CO_2 + 10H_2O$ (2) [2]

(ii) Volume ratio

$C_xH_y(g)$ +	$O_2(g)$ →	$CO_2(g)$ +	$H_2O(l)$
20	160	100	all in cm^3
1	8	5	mole ratio

$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$
For evidence of method (1)
for equation as above (2) [3]

(d) (i) alkanes in petrol/fuel/solvent (1)
alkenes to make alcohols/plastics/polymers/solvents (1)
hydrogen to make ammonia/fuel/fuel cells, etc. (1) [3]

(ii) a correct equation for example:
$C_{10}H_{22} \rightarrow C_8H_{16} + C_2H_4 + H_2$ (1) [1]

(e) (i) light **or** lead tetraethyl/catalyst/high temperature (1) [1]

(ii) $CH_3–CHCl–CH_3$ (1) [1]

[Total: 16]

Topic Chem 14 **Q# 154/** iGCSE Chemistry/2014/s/Paper 33/Q3

(b) correct linkage (1)
rest of molecule correct **and** continuation shown (1)
(other product is) water (1) [3]

Topic Chem 14 **Q# 155/** iGCSE Chemistry/2014/s/Paper 33/Q1

(b) propene (1) [1]

Topic Chem 14 **Q# 156/** iGCSE Chemistry/2014/s/Paper 32/Q4

4 (a) (i) butanoic/butyric acid (1)

$CH_3CH_2CH_2COOH$ / $C_2H_5CH_2COOH$ (1) [2]

(ii) any **three** from:

(same) general formula (1)

(consecutive members) differ by CH_2 (1)

same functional group (1)

common methods of preparation (1)

physical properties vary in predictable manner/show trends/gradually change
or example of a physical property variation i.e. melting point/boiling point/volatility (1) [3]

(b) (i) displayed formula of propan-1-ol, all bonds shown separately (1) [1]

(ii) acidified (1)

potassium manganate(VII)/potassium permanganate/$KMnO_4$ **or** potassium dichromate(VI)/$K_2Cr_2O_7$/potassium dichromate (1) [2]

(c) (i) zinc + propanoic acid → zinc propanoate (+ hydrogen) (1) [1]

(ii) calcium oxide + propanoic acid → calcium propanoate + water (1) [1]

(iii) $LiOH + CH_3CH_2COOH \rightarrow CH_3CH_2COOLi + H_2O$ (1) [1]

Topic Chem 14 **Q# 157/** iGCSE Chemistry/2014/s/Paper 32/Q2

2 (a) (i) substance/material/compound/element/mixture (burnt) to produce/release energy **or** heat (1) [1]

(ii) Any **two** from:
coal
coke
peat
petroleum/ crude oil
refinery gas/LPG
gasoline/petrol
naptha
kerosene/paraffin
diesel (oil)/gas oil
fuel oil
propane
butane [2]

(iii) wood/charcoal/animal dung/biomass/Uranium/U/plutonium/Pu (1) [1]

(b) (i) any **two** from:
water/steam/water vapour/H_2O (1)
carbon dioxide/CO_2 (1)
carbon monoxide/CO (1) [2]

8. Acids, bases and salts	
8.1 The characteristic properties of acids and bases **Core** • Describe the characteristic properties of acids as reactions with metals, bases, carbonates and effect on litmus and methyl orange • Describe the characteristic properties of bases as reactions with acids and with ammonium salts and effect on litmus and methyl orange • Describe neutrality and relative acidity and alkalinity in terms of pH measured using Universal Indicator paper (whole numbers only) • Describe and explain the importance of controlling acidity in soil	**Supplement** • Define *acids* and *bases* in terms of proton transfer, limited to aqueous solutions • Describe the meaning of weak and strong acids and bases
8.2 Types of oxides **Core** • Classify oxides as either acidic or basic, related to metallic and non-metallic character	**Supplement** • Further classify other oxides as neutral or amphoteric
8.3 Preparation of salts **Core** • Demonstrate knowledge and understanding of preparation, separation and purification of salts as examples of some of the techniques specified in section 2.2.2 and the reactions specified in section 8.1	**Supplement** • Demonstrating knowledge and understanding of the preparation of insoluble salts by precipitation • Suggest a method of making a given salt from a suitable starting material, given appropriate information
8.4 Identification of ions and gases **Core** • Describe the following tests to identify: *aqueous cations:* aluminium, ammonium, calcium, chromium(III), copper(II), iron(II), iron(III) and zinc (using aqueous sodium hydroxide and aqueous ammonia as appropriate) (Formulae of complex ions are **not** required.) *cations:* use of the flame test to identify lithium, sodium, potassium and copper(II) *anions:* carbonate (by reaction with dilute acid and then limewater), chloride, bromide and iodide (by reaction under acidic conditions with aqueous silver nitrate), nitrate (by reduction with aluminium), sulfate (by reaction under acidic conditions with aqueous barium ions) and sulfite (by reaction with dilute acids and then aqueous potassium manganate(VII)) *gases:* ammonia (using damp red litmus paper), carbon dioxide (using limewater), chlorine (using damp litmus paper), hydrogen (using lighted splint), oxygen (using a glowing splint), and sulfur dioxide (using aqueous potassium manganate(VII))	

Tests for ions (Topic 8)

Tests for anions

anion	test	test result
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide (Br^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify, then add aqueous barium nitrate	white ppt.
sulfite (SO_3^{2-})	add dilute hydrochloric acid, warm gently and test for the presence of sulfur dioxide	sulfur dioxide produced will turn acidified aqueous potassium manganate(VII) from purple to colourless

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium (Al^{3+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt. or very slight white ppt.
chromium(III) (Cr^{3+})	green ppt., soluble in excess	grey-green ppt., insoluble in excess
copper (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

gas	test and test result
ammonia (NH_3)	turns damp, red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	'pops' with a lighted splint
oxygen (O_2)	relights a glowing splint
sulfur dioxide (SO_2)	turns acidified aqueous potassium manganate(VII) from purple to colourless

Flame tests for metal ions

metal ion	flame colour
lithium (Li^+)	red
sodium (Na^+)	yellow
potassium (K^+)	lilac
copper(II) (Cu^{2+})	blue-green

Q# 1/ iGCSE Chemistry/2015/w/Paper 31/

2 Describe how to separate the following. In each example, give a description of the procedure used and explain why this method works.

(d) Magnesium hydroxide from a mixture of magnesium hydroxide and zinc hydroxide.

procedure .....

.....

explanation .....

.....

[3]

Q# 2/ iGCSE Chemistry/2015/s/Paper 31/

6 Acid-base reactions are examples of proton transfer.

(a) Ethylamine is a weak base and sodium hydroxide is a strong base.

(i) In terms of proton transfer, explain what is meant by the term *weak base*.

.....

..... [2]

(ii) Given aqueous solutions of both bases, describe how you could show that sodium hydroxide is the stronger base. How could you ensure a 'fair' comparison between the two solutions?

.....

.....

.....

..... [3]

(b) Ethylamine reacts with acids to form salts.

$$CH_3CH_2NH_2 + HCl \rightarrow \underset{\text{ethylammonium chloride}}{CH_3CH_2NH_3Cl}$$

(i) Complete the equation for the reaction between sulfuric acid and ethylamine. Name the salt formed.

$$\text{.....}CH_3CH_2NH_2 + \text{.....} \rightarrow \text{.....}$$

name of salt ..... [3]

(ii) Amines and their salts have similar chemical properties to ammonia and ammonium salts.

Suggest a reagent that could be used to displace the weak base, ethylamine, from its salt ethylammonium chloride.

..... [1]

Q# 3/ iGCSE Chemistry/2014/w/Paper 31/

1 **(a)** Match the following pH values to the solutions given below.

1 3 7 10 13

The solutions all have the same concentration.

solution	**pH**
aqueous ammonia, a weak base	.....
dilute hydrochloric acid, a strong acid	.....
aqueous sodium hydroxide, a strong base	.....
aqueous sodium chloride, a salt	.....
dilute ethanoic acid, a weak acid	.....

[5]

(b) Explain why solutions of hydrochloric acid and ethanoic acid with the same concentration, in mol/dm^3, have a different pH.

.....

.....

..... [2]

(c) Measuring pH is one way of distinguishing between a strong acid and a weak acid. Describe another method.

method .....

.....

results .....

.....

[2]

Q# 4/ iGCSE Chemistry/2014/s/Paper 31/ Q4

(b) Across a period, the elements change from metallic to non-metallic.

(i) Describe how the type of oxide changes across this period.

.....

..... [2]

Q# 5/ iGCSE Chemistry/2013/s/Paper 31/

6 Ammonia is a compound which only contains the elements nitrogen and hydrogen. It is a weak base.

(a) (i) Define the term *base*.

..... [1]

(ii) Given aqueous solutions of ammonia and sodium hydroxide, both having a concentration of 0.1 mol/dm^3, how could you show that ammonia is the weaker base?

.....

.....

..... [2]

Q# 6/ iGCSE Chemistry/2013/s/Paper 31/

2 An element, **M**, has the electron distribution 2 + 8 + 18 + 3.

(e) The hydroxide of **M** is a white powder which is insoluble in water.
Describe how you could show that this hydroxide is amphoteric.

.....

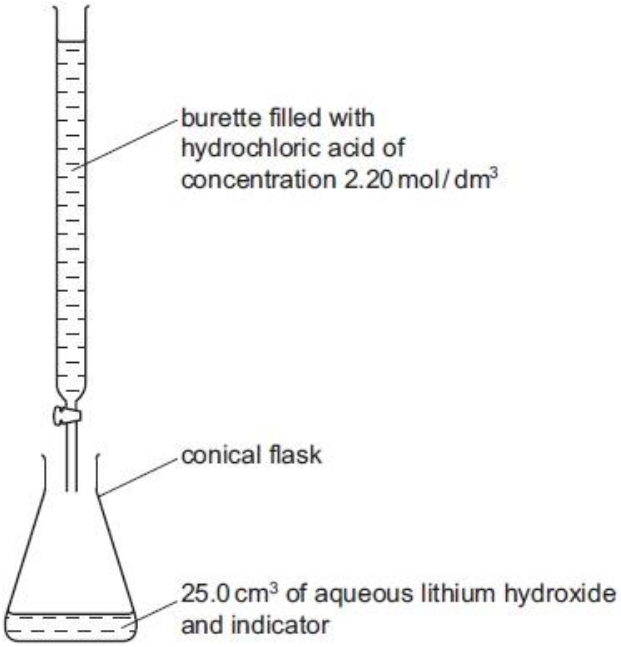
.....

..... [2]

Q# 7/ iGCSE Chemistry/2013/s/Paper 31/

7 The hydroxides of the Group I metals are soluble in water. Most other metal hydroxides are insoluble in water.

(a) (i) Crystals of lithium chloride can be prepared from lithium hydroxide by titration.



25.0 cm^3 of aqueous lithium hydroxide is pipetted into the conical flask.
A few drops of an indicator are added. Dilute hydrochloric acid is added slowly to the alkali until the indicator just changes colour. The volume of acid needed to neutralise the lithium hydroxide is noted.

A neutral solution of lithium chloride, which still contains the indicator, is left. Describe how you could obtain a neutral solution of lithium chloride which does **not** contain an indicator.

.....

..... [2]

(ii) You cannot prepare a neutral solution of magnesium chloride by the same method. Describe how you could prepare a neutral solution of magnesium chloride.

.....

.....

..... [3]

(b) The concentration of the hydrochloric acid was 2.20 mol / dm^3. The volume of acid needed to neutralise the 25.0 cm^3 of lithium hydroxide was 20.0 cm^3. Calculate the concentration of the aqueous lithium hydroxide.

$$LiOH + HCl \rightarrow LiCl + H_2O$$

.....

.....

..... [2]

(c) Lithium chloride forms three hydrates. They are $LiCl.H_2O$, $LiCl.2H_2O$ and $LiCl.3H_2O$. Which **one** of these three hydrates contains 45.9 % of water?
Show how you arrived at your answer.

.....

.....

..... [3]

Q# 8/ iGCSE Chemistry/2012/w/Paper 31/ Q7

(b) Strontium chloride-6-water can be made from the insoluble compound, strontium carbonate, by the following reactions.

$$SrCO_3(s) + 2HCl(aq) \rightarrow SrCl_2(aq) + CO_2(g) + H_2O(l)$$

$$SrCl_2(aq) + 6H_2O(l) \rightarrow SrCl_2.6H_2O(s)$$

The following method was used to prepare the crystals.

1 Add excess strontium carbonate to hot hydrochloric acid.
2 Filter the resulting mixture.
3 Partially evaporate the filtrate and allow to cool.
4 Filter off the crystals of $SrCl_2.6H_2O$.
5 Dry the crystals between filter papers.

(i) How would you know when excess strontium carbonate had been added in step 1?

.....

..... [1]

(ii) Why is it necessary to filter the mixture in step 2?

..... [1]

(iii) In step 3, why partially evaporate the filtrate rather than evaporate to dryness?

..... [1]

Q# 9/ iGCSE Chemistry/2012/w/Paper 31/

4 Silicon(IV) oxide, SiO_2, and zirconium(IV) oxide, ZrO_2, are both macromolecules. They have similar physical properties but silicon(IV) oxide is acidic and zirconium(IV) oxide is amphoteric.

(c) (i) Name a reagent that reacts with the oxides of both elements.

..... [1]

(ii) Name a reagent that reacts with only one of the oxides.

reagent .....

oxide which reacts ..... [2]

Q# 10/ iGCSE Chemistry/2012/s/Paper 31/

2 Three ways of making salts are

- titration using a soluble base or carbonate
- neutralisation using an insoluble base or carbonate
- precipitation.

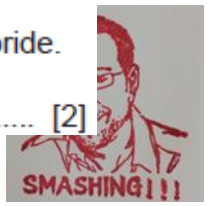
(a) Complete the following table of salt preparations.

method	reagent 1	reagent 2	salt
titration	....	....	sodium nitrate
neutralisation	nitric acid	....	copper(II) nitrate
precipitation	....	....	silver(I) chloride
neutralisation	sulfuric acid	zinc(II) carbonate	....

[6]

(b) (i) Write an ionic equation with state symbols for the preparation of silver(I) chloride.

..... [2]



(ii) Complete the following equation.

$$ZnCO_3 + H_2SO_4 \rightarrow \ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots + \ldots\ldots\ldots\ldots$$

[2]

Q# 11/ iGCSE Chemistry/2011/w/Paper 31/ Q5

(c) Describe how you could test the solution to find out which ion, Fe^{2+} or Fe^{3+}, is present.

.....

.....

..... [3]

Q# 12/ iGCSE Chemistry/2011/w/Paper 31/

1 This question is concerned with the following oxides.

sulfur dioxide
carbon monoxide
lithium oxide
aluminium oxide
nitrogen dioxide
strontium oxide

(a) (i) Which of the above oxides will react with hydrochloric acid but not with aqueous sodium hydroxide?

..... [1]

(ii) Which of the above oxides will react with aqueous sodium hydroxide but not with hydrochloric acid?

..... [1]

(iii) Which of the above oxides will react with both hydrochloric acid and aqueous sodium hydroxide?

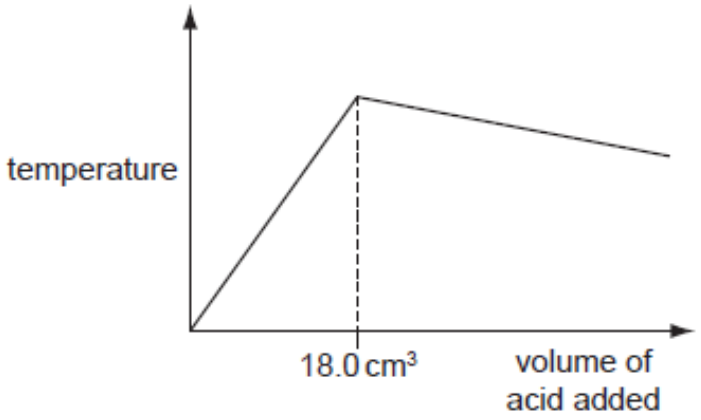
..... [1]

(iv) Which of the above oxides will not react with hydrochloric acid or with aqueous sodium hydroxide?

..... [1]

Q# 13/ iGCSE Chemistry/2011/s/Paper 31/ Q5

(d) 20.0 cm^3 of aqueous sodium hydroxide, 2.00 mol / dm^3, was placed in a beaker. The temperature of the alkali was measured and 1.0 cm^3 portions of hydriodic acid were added. After each addition, the temperature of the mixture was measured. Typical results are shown on the graph.



$$NaOH(aq) + HI(aq) \rightarrow NaI(aq) + H_2O(l)$$

(iii) In another experiment, it was shown that 15.0 cm^3 of the acid neutralised 20.0 cm^3 of aqueous sodium hydroxide, 1.00 mol/dm^3. Calculate the concentration of the acid.

.....

..... [2]

Q# 14/ iGCSE Chemistry/2011/s/Paper 31/ Q2

(c) The selenide ion reacts with water.

$$Se^{2-} + H_2O \rightarrow HSe^- + OH^-$$

What type of reagent is the selenide ion in this reaction? Give a reason for your choice.

.....

..... [3]

Q# 15/ iGCSE Chemistry/2011/s/Paper 31/ NOT w/ith Q5(a)

5 (a) (i) $2Li + 2HI \rightarrow 2LiI + H_2$

(ii) zinc carbonate + hydriodic acid → zinc iodide + carbon dioxide + water

(iii) $MgO + 2HI \rightarrow MgI_2 + H_2O$

(b) Two of the reactions in **(a)** are acid/base and one is redox. Which one is redox? Explain your choice.

.....

.....

..... [2]

Q# 16/ iGCSE Chemistry/2011/s/Paper 31/

5 Hydriodic acid, HI(aq), is a strong acid. Its salts are iodides.

(a) It has the reactions of a typical strong acid. Complete the following equations.

(i) .....Li + ...HI → ..... + ... [1]

(ii) zinc carbonate + hydriodic acid → ..... + ... + ...

[1]

(iii) MgO + ...HI → ..... + ...

[1]

Q# 17/ iGCSE Chemistry/2010/w/Paper 31/ Q6

(b) Beryllium hydroxide, a white solid, is an amphoteric hydroxide.

(i) Name another metal which has an amphoteric hydroxide.

..... [1]

(ii) Suggest what you would observe when an excess of aqueous sodium hydroxide is added gradually to aqueous beryllium sulfate.

.....

..... [2]

Q# 18/ iGCSE Chemistry/2010/w/Paper 31/

8 Soluble salts can be made using a base and an acid.

(a) Complete this method of preparing dry crystals of the soluble salt cobalt(II) chloride-6-water from the insoluble base cobalt(II) carbonate.

Step 1

Add an excess of cobalt(II) carbonate to hot dilute hydrochloric acid.

Step 2

.....

.....

Step 3

.....

.....

Step 4

.....

..... [4]

Q# 19/ iGCSE Chemistry/2009/w/Paper 3/

2 Oxides are classified as acidic, basic, neutral and amphoteric.

(a) Complete the table.

type of oxide	pH of solution of oxide	example
acidic		
basic		
neutral		

[6]

(b) (i) Explain the term *amphoteric*.

.....

..... [1]

(ii) Name two reagents that are needed to show that an oxide is amphoteric.

.....

..... [2]

Q# 20/ iGCSE Chemistry/2009/s/Paper 31/ Q7

(b) They react with water to form acidic solutions.

$$HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$$

$$HF + H_2O \rightleftharpoons H_3O^+ + F^-$$

(i) Explain why water behaves as a base in both of these reactions.

.....

..... [2]

(ii) At equilibrium, only 1% of the hydrogen chloride exists as molecules, the rest has formed ions. In the other equilibrium, 97% of the hydrogen fluoride exists as molecules, only 3% has formed ions.

What does this tell you about the strength of each acid?

.....

..... [2]

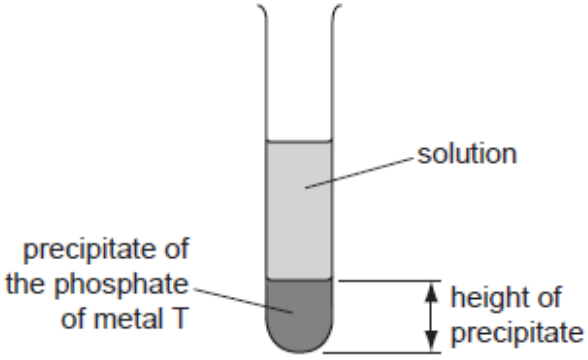
(iii) How would the pH of these two solutions differ?

..... [1]

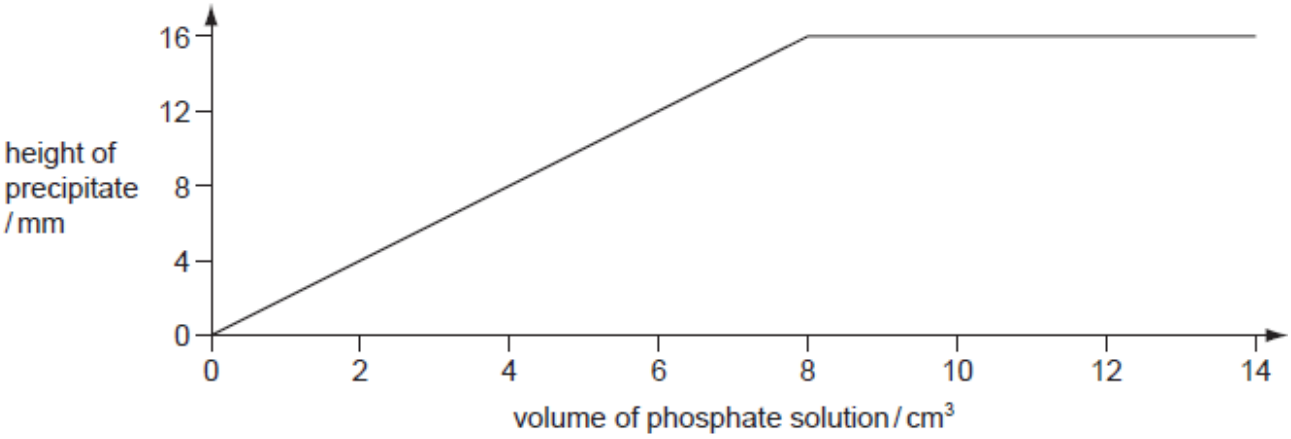
Q# 21/ iGCSE Chemistry/2009/s/Paper 31/ Q5

(b) The formulae of insoluble compounds can be found by precipitation reactions.

To 12.0 cm^3 of an aqueous solution of the nitrate of metal T was added 2.0 cm^3 of aqueous sodium phosphate, Na_3PO_4. The concentration of both solutions was 1.00 mol / dm^3. When the precipitate had settled, its height was measured.



The experiment was repeated using different volumes of the phosphate solution. The results are shown on the following graph.



What is the formula of the phosphate of metal T? Give your reasoning.

.....

.....

.....

..... [3]

Q# 22/ iGCSE Chemistry/2009/s/Paper 31/

5 Insoluble salts are made by precipitation.

(a) A preparation of the insoluble salt calcium fluoride is described below.

To 15 cm^3 of aqueous calcium chloride, 30 cm^3 of aqueous sodium fluoride is added. The concentration of both solutions is 1.00 mol / dm^3. The mixture is filtered and the precipitate washed with distilled water. Finally, the precipitate is heated in an oven.

(i) Complete the equation.

Ca^{2+} + ...F^- ⟶ ..... [2]

(ii) Why is the volume of sodium fluoride solution double that of the calcium chloride solution?

.....

..... [1]

(iii) Why is the mixture washed with distilled water?

.....

..... [1]

(iv) Why is the solid heated?

.....

..... [1]

Q# 23/ iGCSE Chemistry/2008/w/Paper 31/

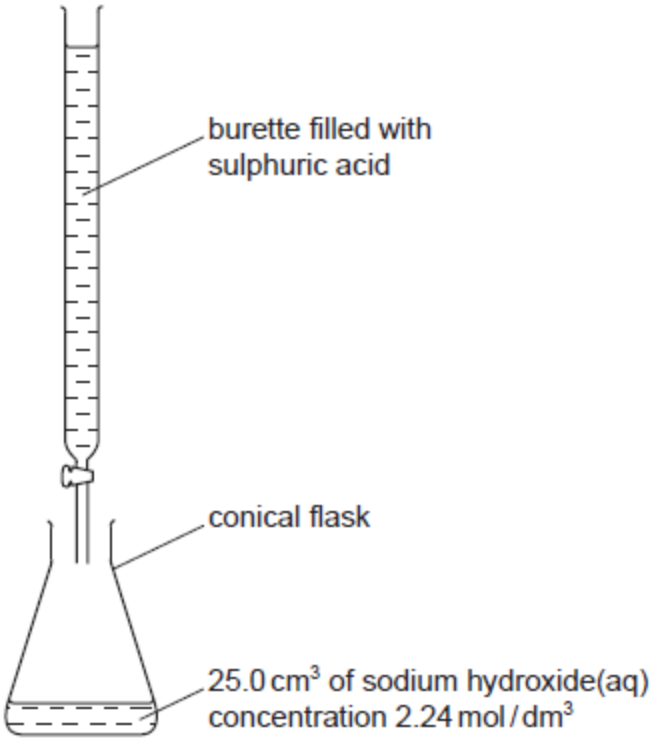
1 Complete the following table.

gas	test for gas
ammonia	
	bleaches damp litmus paper
hydrogen	
	relights a glowing splint
	turns limewater milky

[Total: 5]

Q# 24/ iGCSE Chemistry/2008/s/Paper 31/

7 Crystals of sodium sulphate-10-water, $Na_2SO_4.10H_2O$, are prepared by titration.



(a) 25.0 cm^3 of aqueous sodium hydroxide is pipetted into a conical flask.
A few drops of an indicator are added. Using a burette, dilute sulphuric acid is slowly added until the indicator just changes colour. The volume of acid needed to neutralise the alkali is noted.

Suggest how you would continue the experiment to obtain pure, dry crystals of sodium sulphate-10-water.

.....

.....

.....

..... [4]

Q# 25/ iGCSE Chemistry/2008/s/Paper 31/

5 Carbonyl chloride, $COCl_2$, is a colourless gas. It is made by the following reaction.

$$CO(g) + Cl_2(g) \underset{\text{heat}}{\overset{\text{cool}}{\rightleftharpoons}} COCl_2(g)$$

(c) Carbonyl chloride reacts with water to form two acidic compounds.
Suggest which acidic compounds are formed.

1. .....

2. ..... [2]

Q# 26/ iGCSE Chemistry/2008/s/Paper 31/

4 Sulphuric acid is a typical strong acid.

(a) Change the equations given into a different format.

(i) $Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2$
Change into a word equation.

..... [1]

(ii) lithium oxide + sulphuric acid ⟶ lithium sulphate + water
Change into a symbol equation.

..... [2]

(iii) $CuO + 2H^+ \longrightarrow Cu^{2+} + H_2O$
Change the ionic equation into a symbol equation.

..... [2]

(iv) $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + CO_2 + H_2O$
Change into a word equation.

..... [1]

(b) When sulphuric acid dissolves in water, the following reaction occurs.
$H_2SO_4 + H_2O \longrightarrow HSO_4^- + H_3O^+$
Explain why water is behaving as a base in this reaction.

..... [2]

(c) Sulphuric acid is a strong acid, ethanoic acid is a weak acid.
Explain the difference between a strong acid and a weak acid.

.....

..... [2]

Q# 27/ iGCSE Chemistry/2007/w/Paper 3/

5 Methylamine, CH_3NH_2, is a weak base. Its properties are similar to those of ammonia.

(a) When methylamine is dissolved in water, the following equilibrium is set up.

$$\underset{\text{base}}{CH_3NH_2} + \underset{\text{acid}}{H_2O} \rightleftharpoons CH_3NH_3^+ + OH^-$$

(i) Suggest why the arrows are not the same length.

..... [1]

(ii) Explain why water is stated to behave as an acid and methylamine as a base.

.....

..... [2]

(b) An aqueous solution of the strong base, sodium hydroxide, is pH 12. Predict the pH of an aqueous solution of methylamine which has the same concentration. Give a reason for your choice of pH.

.....

..... [2]

(c) Methylamine is a weak base like ammonia.

(i) Methylamine can neutralise acids.

$$2CH_3NH_2 + H_2SO_4 \rightarrow (CH_3NH_3)_2\,SO_4$$
methylammonium sulphate

Write the equation for the reaction between methylamine and hydrochloric acid. Name the salt formed.

.....

..... [2]

(ii) When aqueous methylamine is added to aqueous iron(II) sulphate, a green precipitate is formed. What would you see if iron(III) chloride solution had been used instead of iron(II) sulphate?

..... [1]

(iii) Suggest the name of a reagent that will displace methylamine from one of its salts, for example methylammonium sulphate.

..... [1]

Q# 28/ iGCSE Chemistry/2007/s/Paper 3/

3 There are three methods of preparing salts.

Method **A** – use a burette and an indicator.

Method **B** – mix two solutions and obtain the salt by precipitation.

Method **C** – add an excess of base or a metal to a dilute acid and remove the excess by filtration.

For each of the following salt preparations, choose one of the methods **A**, **B** or **C**, name any additional reagent needed and then write or complete the equation.

(i) the soluble salt, zinc sulphate, from the insoluble base, zinc oxide

method .....

reagent .....

word equation ..... [3]

(ii) the soluble salt, potassium chloride, from the soluble base, potassium hydroxide

method .....

reagent .....

equation ..... + ... → $KCl + H_2O$ [3]

(iii) the insoluble salt, lead(II) iodide, from the soluble salt, lead(II) nitrate

method .....

reagent .....

equation Pb^{2+} + ... → ..... [4]

[Total: 10]

Q# 29/ iGCSE Chemistry/2006/s/Paper 3/ Q3

(d) This question is concerned with the following oxides.

aluminium oxide	Al_2O_3
calcium oxide	CaO
carbon dioxide	CO_2
carbon monoxide	CO
magnesium oxide	MgO
sulphur dioxide	SO_2

(i) Which of the above oxides will react with hydrochloric acid but not with aqueous sodium hydroxide?

..... [1]

(ii) Which of the above oxides will react with aqueous sodium hydroxide but not with hydrochloric acid?

..... [1]

(iii) Which of the above oxides will react both with hydrochloric acid and with aqueous sodium hydroxide?

..... [1]

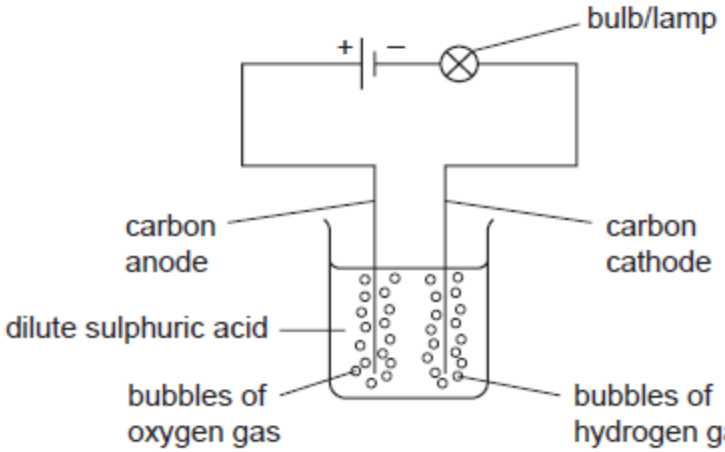
(iv) Which of the above oxides will react neither with hydrochloric acid nor with aqueous sodium hydroxide?

.....

[1]

Q# 30/ iGCSE Chemistry/2006/s/Paper 3/ Q3

(b) The following apparatus was set up to investigate the electrical conductivity of dilute acids.



Dilute sulphuric acid is a strong acid. If it was replaced by a weak acid, what **two** differences in the observations would you expect to make?

.....

.....

.....

[2]

Q# 31/ iGCSE Chemistry/2006/s/Paper 3/ Q2

(c) The equation for the reaction of **X** with cold water is given below.

$$2\mathbf{X}(s) + 2H_2O(l) \longrightarrow 2\mathbf{X}OH(aq) + H_2(g)$$

(i) Describe the test you would use to show that the gas evolved is hydrogen.

.....

.....

[1]

(ii) How could you show that the water contained a compound of the type **X**OH?

.....

.....

[2]

(iii) In which group of the Periodic Table does metal **X** belong?

.....

[1]

(iv) The ore of **X** is its chloride. Suggest how metal **X** could be extracted from its chloride.

.....

[2]

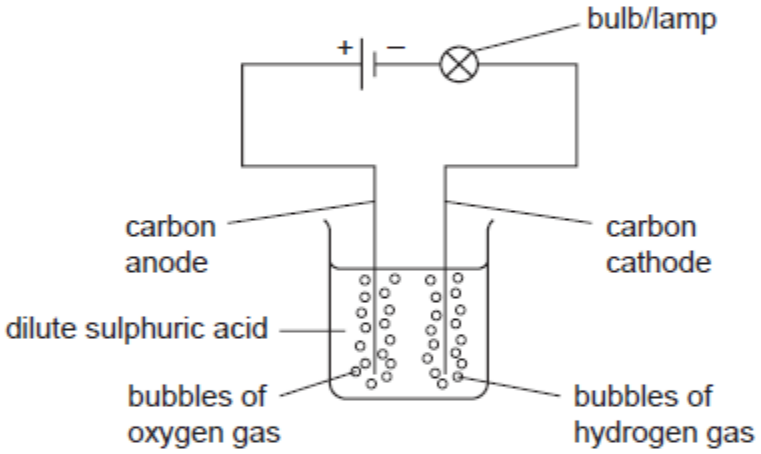
3 **(a)** Four bottles were known to contain aqueous ammonia, dilute hydrochloric acid, sodium hydroxide solution and vinegar, which is dilute ethanoic acid. The bottles had lost their labels. The pH values of the four solutions were 1, 4, 10 and 13.

Complete the table.

solution	pH
aqueous ammonia	
dilute hydrochloric acid	
sodium hydroxide solution	
vinegar	

[2]

(b) The following apparatus was set up to investigate the electrical conductivity of dilute acids.



Dilute sulphuric acid is a strong acid. If it was replaced by a weak acid, what **two** differences in the observations would you expect to make?

.....

.....

..... [2]

(c) When nitric acid is added to water the following reaction occurs.

$$HNO_3 + H_2O \longrightarrow NO_3^- + H_3O^+$$

Give the name and the formula of the particle which is transferred from nitric acid to water.

name .....

formula ..... [2]

Q# 33/ iGCSE Chemistry/2005/w/Paper 3/ Q6

(b) In the above method, a soluble salt was prepared by neutralising an acid with an insoluble base. Other salts have to be made by different methods.

(i) Give a brief description of how the soluble salt, rubidium sulphate could be made from the soluble base, rubidium hydroxide.

.....

.....

.....

..... [3]

(ii) Suggest a method of making the insoluble salt, calcium fluoride.

.....

.....

.....

..... [3]

Q# 34/ iGCSE Chemistry/2005/w/Paper 3/ Q5

(c) The major ore of strontium is its carbonate, $SrCO_3$. Strontium is extracted by the electrolysis of its molten chloride.

(i) Name the reagent that will react with the carbonate to form the chloride.

..... [1]

Q# 35/ iGCSE Chemistry/2005/s/Paper 3/ Q2

(b) Describe how you could show by adding aqueous sodium hydroxide and aqueous ammonia that a solution contained zinc ions.

result with sodium hydroxide .....

excess sodium hydroxide .....

result with aqueous ammonia .....

excess aqueous ammonia ..... [3]

Q# 36/ iGCSE Chemistry/2005/s/Paper 3/Q3

(d) Propanoic acid is a weak acid.

(i) The following equation represents its reaction with ammonia.

$$CH_3-CH_2-COOH + NH_3 \longrightarrow CH_3-CH_2-COO^- + NH_4^+$$

Explain why propanoic acid behaves as an acid and ammonia as a base.

.....

..... [3]

(ii) Explain the expression *weak acid.*

..... [1]

Q# 37/ iGCSE Chemistry/2005/s/Paper 3/

3 A South Korean chemist has discovered a cure for smelly socks. Small particles of silver are attached to a polymer, poly(propene), and this is woven into the socks.

(b) To show that the polymer contains silver the following test was carried out.

The polymer fibres were chopped into small pieces and warmed with nitric acid. The silver atoms were oxidised to silver(I) ions. The mixture was filtered. Aqueous sodium chloride was added to the filtrate and a white precipitate formed.

(i) Why was the mixture filtered?

..... [1]

(ii) Explain why the change of silver atoms to silver ions is oxidation.

..... [1]

(iii) Give the name of the white precipitate.

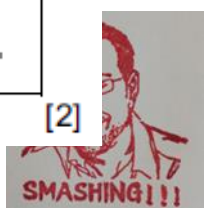
..... [1]

Q# 38/ iGCSE Chemistry/2005/s/Paper 3/Q6

(c) Complete the following table by writing "reaction" or "no reaction" in the spaces provided.

oxide	type of oxide	reaction with acid	reaction with alkali
magnesium	basic	.....	.....
aluminium	amphoteric	.....	.....

[2]



Q# 39/ iGCSE Chemistry/2004/w/Paper 3/ QiGCSE Chemistry/201 (d)

(i) Describe how you could show that the gas collected in this experiment is oxygen.

[1]

Q# 40/ iGCSE Chemistry/2004/w/Paper 3/

2 The salt copper(II) sulphate can be prepared by reacting copper(II) oxide with sulphuric acid.

Complete the list of instructions for making copper(II) sulphate using **six** of the words below.

blue cool dilute filter

saturated sulphate white oxide

Instructions

1 Add excess copper(II) oxide to _____ sulphuric acid in a beaker and boil it.

2 _____ to remove the unreacted copper(II) oxide.

3 Heat the solution until it is _____.

4 _____ the solution to form _____

coloured crystals of copper (II) _____. [6]

Q# 41/ iGCSE Chemistry/2004/s/Paper 3/ Q2 (b)

(iii) Rock phosphate (calcium phosphate) is obtained by mining. It reacts with concentrated sulphuric acid to form the fertiliser, superphosphate. Predict the formula of each of these phosphates.

fertiliser	ions	formula
calcium phosphate	Ca^{2+} and PO_4^{3-}	.....
calcium superphosphate	Ca^{2+} and $H_2PO_4^-$	..... [2]

(iv) The ionic equation for the reaction between the phosphate ion and sulphuric acid is shown below.

$$PO_4^{3-} + 2H_2SO_4 \rightarrow H_2PO_4^- + 2HSO_4^-$$

Explain why the phosphate ion is described as acting as a base in this reaction.

..... [2]

Q# 1/ iGCSE Chemistry/2015/w/Paper 31/

2(d)	add sodium hydroxide solution; filter; zinc hydroxide (is amphoteric it) will react or will dissolve / magnesium hydroxide does not react or does not dissolve;	1 1 1

Q# 2/ iGCSE Chemistry/2015/s/Paper 31/

6(a)(i)	M1 proton acceptor; M2 does not accept (protons) readily **OR** less able to accept protons (than strong bases);	 2	**A** alternative words to 'acceptor' e.g. 'receiver' **I** references to pH **A** 'hydrogen ion' or 'H^+' for proton **I** accepts fewer / less protons
6(a)(ii)	M1 same concentration of both bases; M2 measure their pH; M3 the higher pH is the stronger base;	 3	 **A** suitable method e.g. universal indicator or pH paper or pH meter **I** litmus or methyl orange or phenolphthalein **I** titration methods for M2 and M3 **A** suitable colours of both weak strong bases e.g. ethylamine is (greeny)blue, NaOH is darker blue/purple **A** alternative methods for M2 and M3 e.g. measure conductivity (M2) and higher conductivity is the stronger base (M3) e.g.add aluminium / Al (M2) and stronger base gives faster rate of effervescence / more fizzing / more bubbling (M3)
6(b)(i)	$2CH_3CH_2NH_2 + H_2SO_4 \rightarrow (CH_3CH_2NH_3)_2SO_4$ species; balancing; the salt is ethylammonium sulfate;	 3	**A** multiples **I** state symbols **A** one mark for correct product **A** close spellings **A** diethylammonium sulfate
6(b)(ii)	sodium hydroxide / calcium hydroxide / NaOH / $Ca(OH)_2$;	1	**A** any Group 1 or Group 2 hydroxide or oxide

Q# 3/ iGCSE Chemistry/2014/w/Paper 31/

1 (a) Match the following pH values to the solutions given below.

1 3 7 10 13

The solutions all have the same concentration.

solution	pH
aqueous ammonia, weak base	10
dilute hydrochloric acid, a strong acid	1
aqueous sodium hydroxide, a strong base	13
aqueous sodium chloride, a salt	7
dilute ethanoic acid, a weak acid	3

[5]

(b) Hydrochloric acid strong acid **or** ethanoic acid weak acid [1]
OR: hydrochloric acid completely ionised **or** ethanoic acid partially ionised
hydrochloric acid greater concentration of/more H^+ ions (than ethanoic acid) [1]

(c) Rate of reaction with Ca, Mg, Zn, Fe [1]

Strong (hydrochloric) acid bubbles faster **or** more bubbles **or** dissolves faster [1]

OR: rate of reaction with (metal) carbonate [1]
strong (hydrochloric) acid faster **or** more bubbles **or** dissolves faster (only if carbonate insoluble) [1]

OR: electrical conductivity [1]
strong (hydrochloric) acid better conductor [1]

Q# 4/ iGCSE Chemistry/2014/s/Paper 31/ Q4

(b) (i) Assume change is from L to R unless clearly stated:
basic to amphoteric to acidic (2) [2]

Q# 5/ iGCSE Chemistry/2013/s/Paper 31/

6 (a) (i) proton or H^+ acceptor [1]

(ii) (measure) pH or (use) UI indicator [1]
note: can be implied need not be explicit
sodium hydroxide has higher pH / ammonia(aq) has lower pH [1]
(this sentence would score 2 marks)
or
appropriate colours with UI / appropriate numerical values [1]
ammonia is closer to green, blue-green, turquoise or lighter blue
sodium hydroxide is darker blue / purple / violet [1]
or
measure electrical conductivity [1]
can be implied need not be explicit
ammonia (aq) is the poorer conductor/ sodium hydroxide is the better conductor [1]

Q# 6/ iGCSE Chemistry/2013/s/Paper 31/ Q2

(e) it would react with/dissolves in a named strong acid [1]
it would react with/dissolves in a named alkali [1]
it shows both basic and acid properties =1 [1]
it reacts with both acids and bases/alkalis =1 [1]
[max 2]

Q# 7/ iGCSE Chemistry/2013/s/Paper 31/

7 (a) (i) add carbon / animal charcoal [1]
filter [1]

OR

repeat experiment without indicator [1]
using same quantity / volume of acid [1]

(ii) add magnesium metal / carbonate / oxide / hydroxide
to (hot) (hydrochloric) acid [1]

cond: until in excess **or** no more dissolves **or** reacts [1]

cond: filter (to remove unreacted solid) [1]

(b) number of moles of HC*l* = 0.020 x 2.20 = 0.044 [1]
number of moles of LiOH = 0.044
concentration of LiOH = 0.044/0.025 = 1.769 (mol / dm^3) [1]
accept 1.75 to 1.77 need 2 dp
correct answer scores = 2

(c) (for LiC*l*.$2H_2O$)
mass of one mole = 78.5 [1]
percentage water = 36 / 78.5 x 100 [1]
45.9 so is LiC*l*.$2H_2O$ [1]
only award the marks if you can follow the reasoning and it gives 45.9% of water

note: if correct option given mark this and ignore the rest of the response

allow: max 2 for applying a correct method to another hydrate, [1] for the method and [1] for the correct value, working essential

Q# 8/ iGCSE Chemistry/2012/w/Paper 31/ Q7

(b) (i) strontium carbonate does not dissolve / no effervescence; [1]
note: not just reaction is complete

(ii) to remove excess / unreacted / undissolved strontium carbonate; [1]

(iii) water of crystallisation needed / $6H_2O$ in crystals / would get anhydrous salt / would not get hydrated salt / crystals dehydrate; [1]
not: just to obtain crystals

Q# 9/ iGCSE Chemistry/2012/w/Paper 31/ Q4

(c) (i) sodium hydroxide / any named alkali / reactive metal; [1]

(ii) named acid; [1]
zirconium oxide; [1]

Q# 10/ iGCSE Chemistry/2012/s/Paper 31/

2 (a) nitric acid; [1]
sodium hydroxide / carbonate / hydrogen carbonate; [1]

copper(II) oxide / hydroxide / carbonate; [1]

any named soluble chloride; [1]
accept: *hydrochloric acid / hydrogen chloride*
silver(I) nitrate / ethanoate / sulfate; [1]
must be soluble silver salt **not** *silver oxide / carbonate*

zinc(II) sulfate [1]

(b) (i) $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ [2]
equation correct state symbols missing [1]

(ii) $ZnCO_3 + H_2SO_4 \rightarrow ZnSO_4 + CO_2 + H_2O$ [2]
correct formula for zinc sulfate = 1

[Total: 10]

Q# 11/ iGCSE Chemistry/2011/w/Paper 31/ Q5

(c) add sodium hydroxide solution / ammonia(aq) [1]
Fe^{2+} green precipitate [1]
Fe^{3+} brown precipitate [1]

Q# 12/ iGCSE Chemistry/2011/w/Paper 31/

1 (a) (i) lithium oxide / strontium oxide [1]

(ii) sulfur dioxide / nitrogen dioxide [1]

(iii) aluminium oxide [1]

(iv) carbon monoxide [1]
accept: correct formulae

Q# 13/ iGCSE Chemistry/2011/s/Paper 31/ Q5(d)

(iii) 1.33 / 1.3 / 1.3333 (mol/dm^3) scores both marks [2]
not 1.34
for a correct method – $M_1 V_1$ / moles of NaOH = 0.02
with an incorrect answer **only** [1]

Q# 14/ iGCSE Chemistry/2011/s/Paper 31/ Q2

(c) base [1]
not alkali
accepts a proton [2]
accepts hydrogen ion / H^+ **only** [1]
proton and H^+ [2]

Q# 15/ iGCSE Chemistry/2011/s/Paper 31/ Q5

(b) reaction 1 is redox / Li/2HI reaction [1]
cond reason either oxidation number/state / electron transfer [1]

Q# 16/ iGCSE Chemistry/2011/s/Paper 31/

5 **(a)** **(i)** $2Li + 2HI \rightarrow 2LiI + H_2$ [1]

(ii) zinc carbonate + hydriodic acid $\rightarrow$ zinc iodide + carbon dioxide + water [1]

(iii) $MgO + 2HI \rightarrow MgI_2 + H_2O$ [1]

Q# 17/ iGCSE Chemistry/2010/w/Paper 31/ Q6

(b) **(i)** zinc / aluminium / lead / tin / chromium [1]

(ii) white precipitate [1]
precipitate dissolves / colourless solution forms / forms a clear solution / soluble in excess [1]

Q# 18/ iGCSE Chemistry/2010/w/Paper 31/

8 **(a)** filter / centrifuge / decant [1]
(partially) evaporate / heat / boil [1]
allow to crystallise / cool / let crystals form [1]
dry crystals / dry between filter paper / leave in a warm place to dry [1]
"dry" on its own must be a verb
evaporate to dryness only marks 1 and 2
note if discuss residue only mark 1

Q# 19/ iGCSE Chemistry/2009/w/Paper 3/

2 **(a)** pH < 7 [1]
example [1]

pH > 7 [1]
example [1]
NOT amphoteric oxides Be, A*l*, Zn, Pb, Sn etc

pH = 7 [1]
example H_2O, CO, NO [1]
the two marks are not linked, mark each independently
NOT amphoteric oxides Be, A*l*, Zn, Pb, Sn etc.

(b) **(i)** shows both basic and acidic properties [1]

(ii) a named strong acid [1]
a named alkali [1]

Q# 20/ 7iGCSE Chemistry/2009/s/Paper 31/ Q7

(b) **(i)** because it accepts a proton [2]
accepts hydrogen ion **or** H^+ **ONLY** [1]
proton and H^+ [2]

(ii) hydrogen chloride is a strong acid [1]
hydrogen fluoride is a weak acid [1]
weaker **or** stronger correctly applied for [2]

(iii) hydrogen chloride (aqueous) would have lower pH [1]
OR hydrogen fluoride (aqueous) would have higher pH
If values suggested, not over 7

Q# 21/ iGCSE Chemistry/2009/s/Paper 31/ Q5

(b) $T_3(PO_4)_2$ allow correct example [1]
explain why 8 cm^3 react fully [1]
comment about mole ratio [1]

Q# 22/ iGCSE Chemistry/2009/s/Paper 31/

5 (a) (i) $Ca^{2+} + 2F^- \rightarrow CaF_2$ [2]
Not balanced **ONLY** [1]
Both species must be correct for first mark. Second mark is for correct balancing.

(ii) Mole ratio Ca^{2+}: F^- is 1:2 [1]
Answer must mention moles
accept argument based on charges or number of ions
accept 2 moles of NaF react with 1 mole of $CaCl_2$
NOT just "2" in equation
If fluorine must specify atoms or ions

(iii) to remove traces of solutions **or** to remove soluble impurities **or** to remove a named salt sodium chloride **or** sodium fluoride **or** calcium chloride [1]
To remove impurities is not enough

(iv) to dry (precipitate) **or** to remove water **or** to evaporate water [1]
NOT to evaporate some of water **NOT** to crystallise salt

Q# 23/ iGCSE Chemistry/2008/w/Paper 31/

1 red litmus paper blue [1]
OR white fumes/smoke with HCl (g) **or** (aq)

chlorine [1]

"pop" with a lighted splint **or** burn with a pop **or** goes pop and extinguishes flame [1]
NOT glowing splint

oxygen [1]

carbon dioxide [1]
ACCEPT correct formulae

[Total: 5]

Q# 24/ iGCSE Chemistry/2008/s/Paper 31/

7 (a) repeat experiment without indicator **or** use carbon to remove indicator [1]
(partially) evaporate **or** boil **or** heat [1]
allow to cool **or** crystallise **or** crystals [1]
dry crystals [1]
MUST be in correct order
NB evaporate to dryness, marks one and two **ONLY**

Q# 25/ iGCSE Chemistry/2008/s/Paper 31/

5

(c) hydrogen chloride **or** hydrochloric acid [1]
carbon dioxide **or** carbonic acid **or** hydrogen carbonate [1]

Q# 26/ iGCSE Chemistry/2008/s/Paper 31/

4 (a) (i) magnesium + sulphuric acid = magnesium sulphate + hydrogen [1]
ACCEPT hydrogen sulphate

(ii) $Li_2O + H_2SO_4 \rightarrow Li_2SO_4 + H_2O$ [2]
formulae correct but not balanced [1]

(iii) $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$ [2]
OR $CuO + 2HCl \rightarrow CuCl_2 + H_2O$
OR $CuO + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2O$
formulae correct but not balanced [1]

(iv) sodium carbonate + sulphuric acid → sodium sulphate + carbon dioxide + water [1]

(b) it accepts a proton [2]
it accepts a hydrogen ion [1] **ONLY**

(c) sulphuric acid is completely ionised [1]
or few molecules and many ions
ethanoic acid is partially ionised [1]
or many molecules and few ions

Q# 27/ iGCSE Chemistry/2007/w/Paper 3/

5 (a) (i) equilibrium to left **or** many molecules and few ions **or**
partially ionised **or** reverse reaction favoured [1]

(ii) Water donates proton [1]
methylamine accepts a proton [1]
NOTE If hydrogen ion then **ONLY** [1] provided both are correct

(b) less than 12 more than 7 [1]
smaller concentration of hydroxide ions **or** partially dissociated **or**
poor proton acceptor **or** poor H^+ acceptor [1]
NOT it is a weak base

(c) (i) $CH_3NH_2 + HCl = CH_3NH_3Cl$ [1]
methylammonium chloride [1]
NOTE the equation must be as written, the equation with sulphuric acid has been given as guidance.

(ii) brown precipitate [1]
ACCEPT orange **or** red/brown **or** brick red **or** brown/red

(iii) sodium hydroxide **or** any named strong base [1]

Q# 28/ iGCSE Chemistry/2008/s/Paper 31/

3 (i) method C [1]
sulphuric acid (allow if given in equation) [1]
zinc oxide + sulphuric acid = zinc sulphate + water [1]

(ii) method A [1]
hydrochloric acid [1]
$KOH + HCl = KCl + H_2O$ [1]

(iii) method B [1]
potassium iodide **or** any soluble iodide [1]
$Pb^{2+} + 2I^- = PbI_2$ accept a correct equation even if soluble iodide is wrong [2]
Not balanced - $Pb^{2+} + I^- = PbI_2$ ONLY [1]

Q# 29/ iGCSE Chemistry/2006/s/Paper 3/ Q3

(d) (i) CaO and MgO **[1]**

(ii) CO_2 and SO_2 **[1]**

(iii) Al_2O_3 **[1]**

(iv) CO **[1]**

Q# 30/ iGCSE Chemistry/2006/s/Paper 3/ Q3

(b) With strong acid bulb brighter **[1]**
faster rate of bubbles **[1]**
OR corresponding comments for weak acid

Q# 31/ iGCSE Chemistry/2006/s/Paper 3/ Q2

(c) (i) goes "pop" with burning splint **[1]**
or mixed with air and ignited goes pop
NOT glowing splint

(ii) test and observable result **[1]**
universal indicator goes blue
or pH paper goes blue
or high pH, accept 13, 14
or ammonium ion gives off ammonia
or with metallic cations forms a precipitate **[1]**
NOT litmus
ONLY accept - neutralises acids with an observable result,
e.g. becomes warm.

(iii) Group 1 **[1]**

(iv) electrolysis **[1]**
COND molten **[1]**

Q# 32/ iGCSE Chemistry/2006/s/Paper 3/

3 (a) ammonia 10
hydrochloric acid 1
sodium hydroxide 13
ethanoic acid 4
All correct **[2]**
Two correct [1]

(b) With strong acid bulb brighter **[1]**
faster rate of bubbles **[1]**
OR corresponding comments for weak acid

(c) proton **NOT** hydrogen ion **[1]**
H^+ not conditional on proton **[1]**
Only way for [2] is proton and H^+

Q# 33/ iGCSE Chemistry/2005/w/Paper 3/ Q6

(b)(i) sulphuric acid
COND description of titration
repeat without indicator **or** with carbon
evaporation
any **TWO** **[3]**

(ii) suitable reactants calcium chloride and sodium fluoride **[1]**
COND upon correct reagents
filter **[1]**
wash and dry precipitate **[1]**

OR Accept synthesis
calcium **[1]**
fluorine **[1]**
burn **or** heat **[1]** **[3]**

Q# 34/ iGCSE Chemistry/2005/w/Paper 3/ Q5

(c)(i) hydrochloric acid **[1]**

Q# 35/ iGCSE Chemistry/2005/s/Paper 3/ Q2

(b) for zinc and sodium hydroxide white precipitate **[1]**
dissolves in excess (only if precipitate mentioned) **[1]**

for zinc and ammonia same results **[1]**
Mark either first (sodium hydroxide **or** aqueous ammonia), if completely correct, then an additional [1] can be awarded for stating that the other has the same results.

Q# 36/ iGCSE Chemistry/2005/s/Paper 3/
3

(d) (i) acid loses a proton **[2]**
base accepts a proton **[1]**

OR same explanation but acid loses a hydrogen ion (1)
and base gains hydrogen ion (1)

(ii) only partially ionised **or** poor hydrogen ion donor **or** poor proton donor **[1]**
NOT does not form many hydrogen ions in water **or** low concentration of hydrogen ions
NOT pH

Q# 37/ iGCSE Chemistry/2005/s/Paper 3/
3

(b) (i) to remove fibres **or** remove solid
NOT precipitate, **NOT** impurities, **NOT** to obtain a filtrate **[1]**

(ii) because silver atoms have lost electrons **[1]**
OR oxidation number increased

(iii) silver chloride **[1]**

Q# 38/ iGCSE Chemistry/2005/s/Paper 3/

(c) reaction no reaction **[1]**
reaction reaction **[1]**

Q# 39/ iGCSE Chemistry/2004/w/Paper 3/ QiGCSE Chemistry/201

(d) (i) glowing splint burst into flame or rekindled **[1]**
Must have glowing or equivalent idea
OR any similar description that includes the two points glowing and relights.

Q# 40/ iGCSE Chemistry/2004/w/Paper 3/

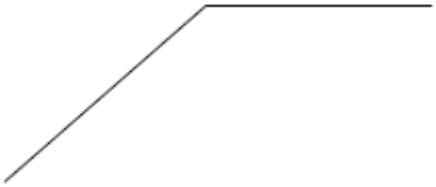
2	dilute filter saturated cool blue sulphate	[6]

Q# 41/ iGCSE Chemistry/2004/s/Paper 3/ Q2 (b)

(iii)	$Ca_3(PO_4)_2$	[1]
	$Ca(H_2PO_4)_2$	[1]
(iv)	only acceptable responses are: accepts a proton accepts H^+ **[1]** only	[2]

Q# 42/ iGCSE Chemistry/2004/s/Paper 3/

4	(a)	(i)	Named soluble zinc salt corresponding sodium salt If hydroxide **or** oxide then 0/2	[1] [1]
		(ii)	Correct equation not balanced **[1]** only	[2]
		(iii)	Correct equation	[2]
	(b)	(i)	$Fe^{3+} + 3OH^- = Fe(OH)_3$	[1]
		(ii)	Max at $8cm^3$ Same shape of graph	[1]

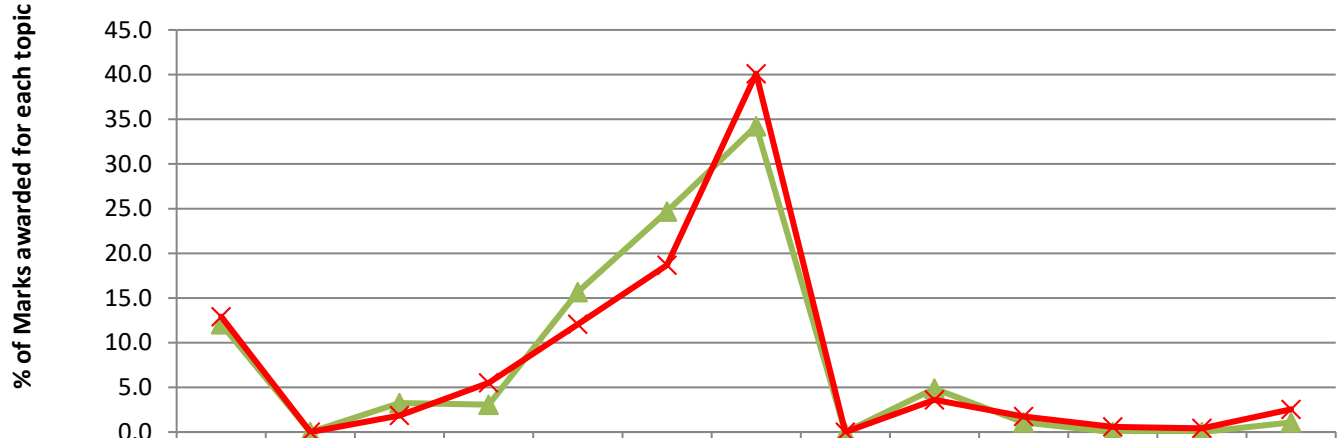


Just the above shape, the height of the precipitate and the volume of sodium hydroxide are irrelevant [1]

(iii)	Maximum then height of precipitate decreases **or** graph slopes down to x axis **or** comes to zero	[1]
	hydroxide dissolves in excess **or** it is amphoteric	[1]

PAPER 6

Percentage of all marks awarded for each topic from w2001 to w2015 (red crosses) and from m2016 to w2017 (green triangles)

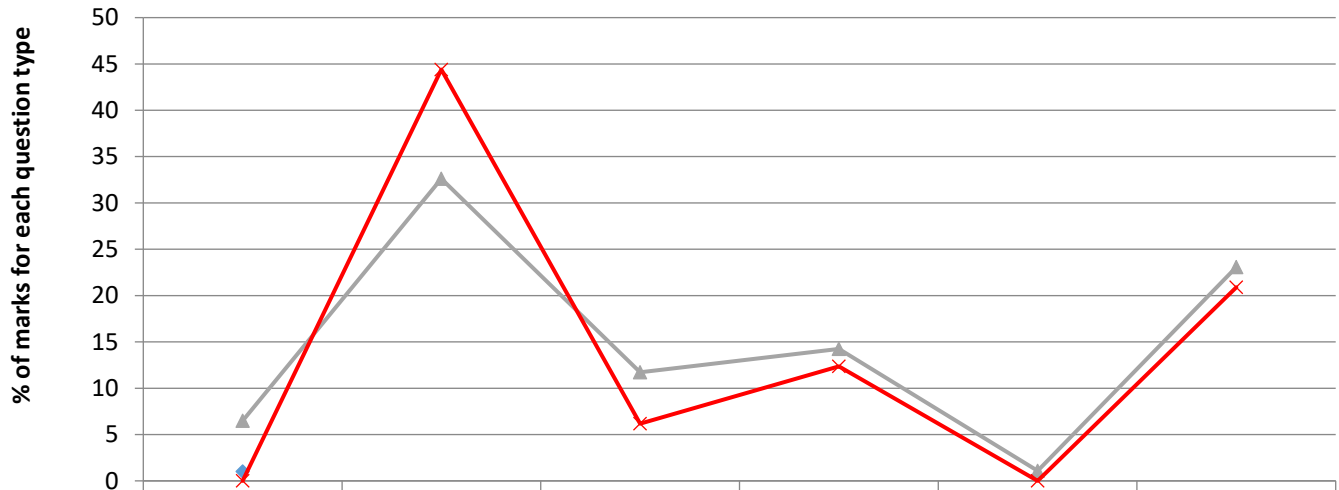


	1	3	4	5	6	7	8	9	10	11	12	13	14
P6 2016-17	12.1	0.0	3.2	3.1	15.7	24.7	34.2	0.0	4.9	1.1	0.0	0.0	1.1
P6 2001-15	12.9	0.0	1.9	5.5	12.1	18.7	40.1	0.0	3.6	1.7	0.6	0.4	2.5

Paper 6 Topic Number

PAPER 6 - Question types

Percentage of all marks awarded for each question type from w2001 to w2015 (red crosses) and from m2016 to w2017 (green triangles)



	Misc	Graph	Labelling Equipment	Essay	Gas test	Ions test
2016-17	1					
2016-17	6.5	32.6	11.7	14.2	1.1	23.1
2001-15	0.0	44.4	6.2	12.4	0.0	20.9

Paper 6 Question type

3 Two solutions, **Y** and **Z**, were analysed.
Solution **Y** was aqueous chromium(III) nitrate.
Tests were carried out on both solutions.

tests on solution Y

Complete the expected observations.

The solution was divided into two equal portions in two test-tubes.

(a) (i) A few drops of aqueous sodium hydroxide were added to the first portion of solution **Y** and the test-tube shaken to mix the solutions.

observations ..... [2]

(ii) An excess of aqueous sodium hydroxide was then added to the mixture.

observations ..... [1]

(iii) The mixture from **(a)(ii)** was poured into a boiling tube and a small piece of aluminium foil was added.
The mixture was heated and the gas produced was tested.

observations .....

..... [3]

(b) Identify the gas produced in **(a)(iii)**.

..... [1]

tests on solution Z

Tests were carried out and the following observations made.

tests on solution **Z**	observations
Solution **Z** was divided into three equal portions in three test-tubes. **test 1** The pH of the first portion of solution **Z** was tested.	pH 10
test 2 A few drops of aqueous copper(II) sulfate were added to the second portion of solution **Z**. An excess of aqueous copper(II) sulfate was then added to the mixture.	dark blue solution formed light blue precipitate formed

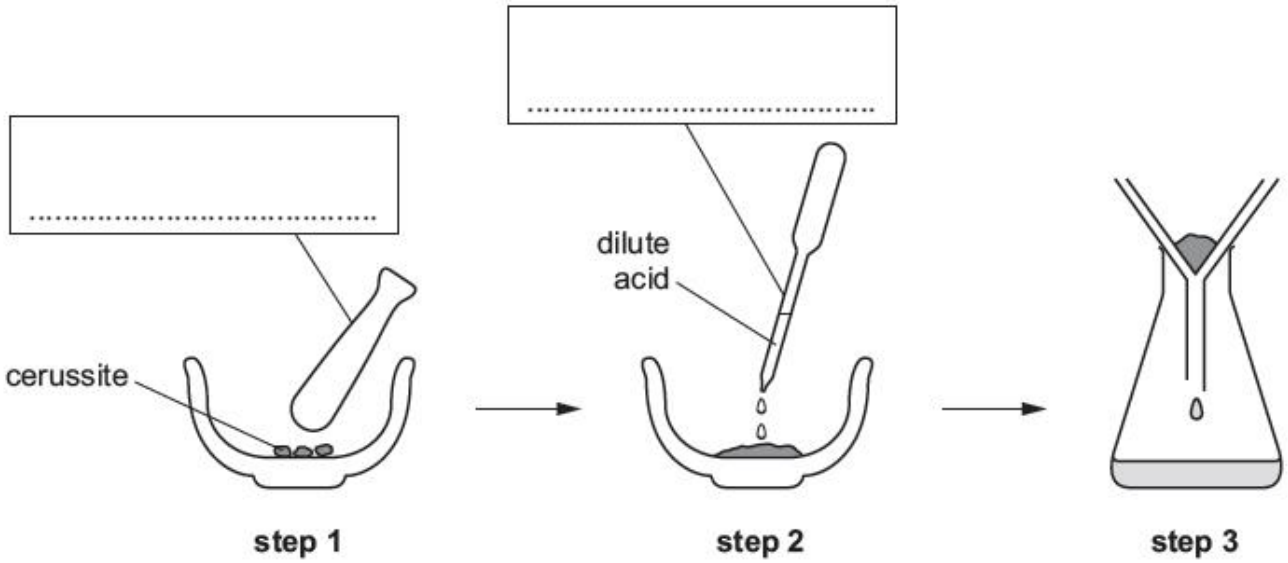
test 3 The second portion of solution **Y** was added to the third portion of solution **Z**.	grey-green precipitate formed

(c) Identify solution **Z**.

..... [1]

Q# 2/ iGCSE Chemistry/Paper 6/2017/w/ Time Zone 3/

1 Cerussite is a lead ore which contains lead(II) carbonate. A student obtained a solution of lead(II) nitrate from cerussite using the apparatus shown.



(c) Name the dilute acid used in **step 2**.

..... [1]

Q# 3/ iGCSE Chemistry/Paper 6/2017/w/ Time Zone 2/

(ii) State the effect of a lighted splint on the hydrogen produced.

..... [1]

Q# 4/ iGCSE Chemistry/Paper 6/2017/w/ Time Zone 2/

3 Two solid salts, **U** and **W**, were analysed. Solid **U** was sodium carbonate.
Tests were carried out on each solid.

tests on solid U

Complete the expected observations.

(a) Describe the appearance of solid **U**.

..... [1]

About half of solid **U** was dissolved in distilled water to produce solution **U**. Solution **U** was divided into two equal portions in two test-tubes.

(b) Dilute hydrochloric acid was added to the first portion of solution **U**.
The gas produced was tested.

observations .....

..... [3]

(c) Name the gas produced in **(b)**.

..... [1]

(d) A flame test was carried out on solid **U**.

observations ..... [1]

tests on solid W

Tests were carried out and the following observations made.

tests on solid **W**	observations
Appearance of solid **W**.	white crystals
Solid **W** was dissolved in distilled water to produce solution **W**. The solution was divided into two equal portions in two test-tubes. **test 1** Dilute nitric acid and aqueous silver nitrate were added to the first portion of solution **W**.	white precipitate formed
test 2 The second portion of solution **U** was added to the second portion of solution **W**.	white precipitate formed
An excess of dilute hydrochloric acid was then added to the mixture.	rapid effervescence white precipitate dissolved

(e) What conclusions can you draw about solid **W**?

..... [2]

Q# 5/ iGCSE Chemistry/Paper 6/2017/w/ Time Zone 1/

3 Two solid salts, **F** and **G**, were analysed. Solid **F** was iron(III) nitrate.
Tests were carried out on each solid.

tests on solid F

Complete the expected observations.

Solid **F** was dissolved in distilled water to produce solution **F**. Solution **F** was divided into three equal portions in three test-tubes.

(a) (i) A few drops of aqueous sodium hydroxide were added to the first portion of solution **F** until a change was seen.

observations ..... [2]

(ii) An excess of aqueous sodium hydroxide was then added to the mixture from **(a)(i)**.

observations ..... [1]

(b) An excess of aqueous ammonia was added to the second portion of solution **F** until a change was seen.

observations ..... [1]

(c) Aluminium foil and aqueous sodium hydroxide were added to the third portion of solution **F**. The mixture was heated and the gas which was produced was tested.

test for gas .....

test result .....

[2]

(d) Identify the gas produced in **(c)**.

..... [1]

tests on solid G

Tests were carried out and the following observations made.

tests on solid **G**	observations
test 1 A flame test was carried out on solid **G**.	red colour
test 2 Dilute nitric acid was added to solid **G**. The gas produced was passed through limewater.	rapid effervescence limewater turned milky

(e) Identify solid **G**.

..... [2]

Q# 6/ iGCSE Chemistry/Paper 6/2017/s/ Time Zone 3/

3 Two substances, solid **J** and solution **K**, were analysed. Solution **K** was hydrogen peroxide. Tests on each substance were carried out. The observations are shown.

tests	observations
tests on solid J Appearance of solid **J**.	black solid
test 1 Dilute hydrochloric acid was added to solid **J**. The mixture was heated and the gas given off was tested with damp litmus paper.	blue litmus turned white

tests on solution K Solution **K** was divided into two equal portions in two test-tubes. **test 2** Iron(II) sulfate crystals were added to the first portion of the solution. The mixture was shaken and aqueous sodium hydroxide was added to the mixture.	red-brown precipitate formed
test 3 Solid **J** was added to the second portion of the solution. The gas given off was tested with a splint.	glowing splint relit solid **J** was unchanged

(a) Name the gas given off in **test 1**.

..... [1]

(b) (i) Name the precipitate formed in **test 2**.

..... [2]

(ii) A new **test 2** was carried out. Iron(II) sulfate crystals were added to **water**, the mixture was shaken and then aqueous sodium hydroxide was added.

What would be observed?

..... [2]

Q# 7/ iGCSE Chemistry/Paper 6/2017/s/ Time Zone 1/

3 Two solids, **E** and **F**, were analysed. Solid **F** was potassium iodide. Tests were carried out on each solid. Some of the observations on solid **E** are shown.

tests on solid **E**	observations
Appearance of solid **E**.	green solid
test 1 Solid **E** was heated gently then strongly.	the solid turned black
test 2 Dilute sulfuric acid was added to solid **E**. The gas given off was tested. Excess aqueous ammonia was then added to the mixture in the test-tube.	rapid effervescence limewater turned milky a pale blue precipitate formed, which then dissolved to form a dark blue solution

test 3 A flame test was carried out on solid **E**.	blue-green colour

(a) **Test 1** states that the solid should be heated gently then strongly.

In terms of safety, explain why it is necessary to heat gently at first.

.....

..... [1]

(b) Identify the gas given off in **test 2**.

..... [1]

(c) Identify solid **E**.

..... [2]

tests on solid F

Complete the expected observations.

(d) Describe the appearance of solid **F**.

..... [1]

Distilled water was added to solid **F** in a test-tube and shaken to dissolve solid **F**.

(e) **(i)** To the first portion of the solution, an excess of aqueous sodium hydroxide was added.

observations ..... [1]

(ii) To the second portion of the solution, dilute nitric acid and aqueous silver nitrate were added.

observations ..... [2]

(f) A flame test was carried out on solid **F**.

observations ..... [1]

(g) Describe how you would carry out a flame test.

.....

.....

..... [2]

Q# 8/ iGCSE Chemistry/Paper 6/2017/s/ Time Zone 1/

4 A sample of furniture cleaner contains aqueous sodium chloride, aqueous ammonia and sand.

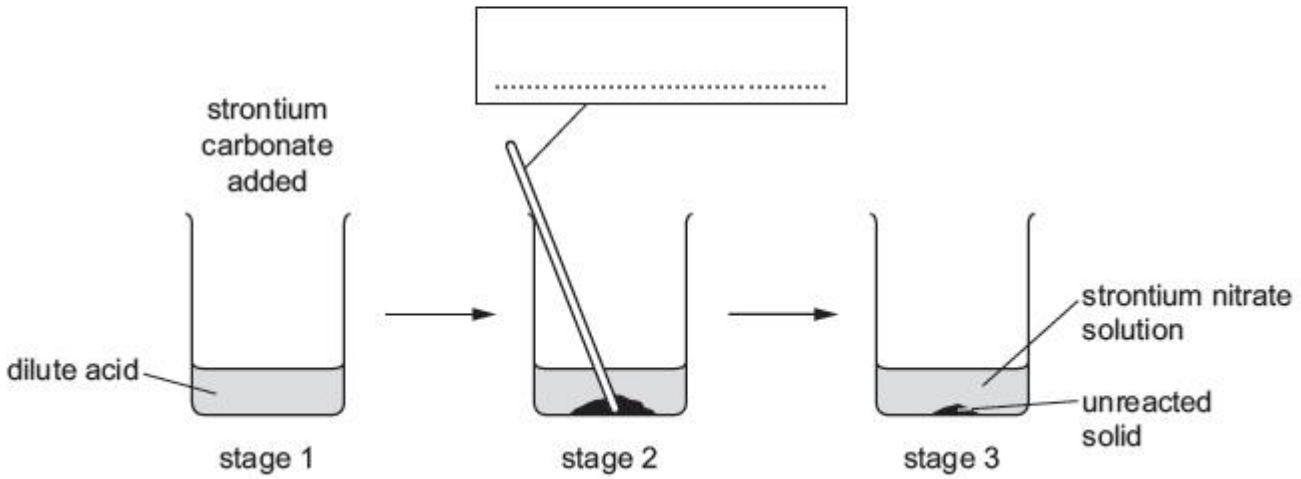
(a) Give a test to show the presence of ammonia in the mixture.

..... [1]

Q# 9/ iGCSE Chemistry/Paper 6/2017/s/ Time Zone 1/

1 A student prepared strontium nitrate crystals.

The diagram shows some of the stages in this preparation.



(a)

(iii) Name the dilute acid used.

..... [1]

(iv) Give **one** expected observation in stage 2.

..... [1]

(b) Why is heat **not** necessary in stage 2?

..... [1]

(c) Which of the reactants is in excess? Explain your answer.

.....

..... [2]

(d) Describe how crystals of strontium nitrate could be obtained from the mixture in stage 3.

.....

.....

..... [3]

Q# 10/ iGCSE Chemistry/Paper 6/2017/m/ Time Zone 2/Q1

(c) Give a test for oxygen.

test .....

result .....

[1]

(d) The gas collected at the positive side turned limewater milky.

(i) Based on this observation, what gas was present?

..... [1]

Q# 11/ iGCSE Chemistry/Paper 6/2017/m/ Time Zone 2/

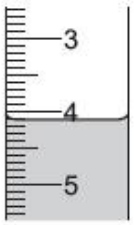
2 A student investigated the reaction between dilute hydrochloric acid and two different aqueous solutions of sodium hydroxide labelled solution **O** and solution **P**.

Two experiments were carried out.

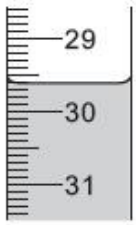
Experiment 1

- A burette was filled with dilute hydrochloric acid. The initial burette reading was recorded.
- Using a measuring cylinder, 20 cm^3 of solution **O** were poured into a conical flask.
- Thymolphthalein indicator was added to the conical flask.
- The dilute hydrochloric acid was added from the burette, while swirling the flask, until the solution just changed colour. The final burette reading was recorded.

(a) Use the burette diagrams to record the readings in the table and complete the table.



initial reading



final reading

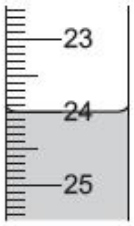
final burette reading / cm^3	
initial burette reading / cm^3	
difference / cm^3	

[2]

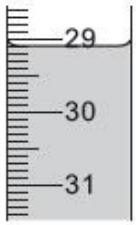
Experiment 2

- The conical flask was emptied and rinsed with distilled water.
- Experiment 1 was repeated using solution **P** instead of solution **O**.

(b) Use the burette diagrams to record the readings in the table and complete the table.



initial reading



final reading

final burette reading / cm^3	
initial burette reading / cm^3	
difference / cm^3	

[2]

(c) What type of chemical reaction occurs when dilute hydrochloric acid reacts with sodium hydroxide solution?

..... [1]

(d) **(i)** Which solution of sodium hydroxide, solution **O** or solution **P**, is the more concentrated? Explain your answer.

.....

..... [2]

(ii) How many times more concentrated is this solution of sodium hydroxide than the other solution of sodium hydroxide?

..... [1]

(e) If Experiment 2 were repeated using 10 cm^3 of solution **P**, what volume of dilute hydrochloric acid would be needed?

..... [2]

(f) What would be the effect, if any, on the volume of dilute hydrochloric acid used in Experiment 1 if the solution of sodium hydroxide were **warmed** before adding the dilute hydrochloric acid? Give a reason for your answer.

effect on volume .....

reason .....

[2]

(g) **(i)** What would be a more accurate method of measuring the volume of the aqueous sodium hydroxide solution?

..... [1]

(ii) Suggest how the reliability of the results could be checked.

..... [1]

(h) Aqueous sodium hydroxide reacts with aqueous calcium chloride to form a precipitate of calcium hydroxide.

Use this information to suggest a **different** method of finding out which of the solutions of sodium hydroxide is the more concentrated.

.....

.....

.....

..... [3]

Q# 12/ iGCSE Chemistry/Paper 6/2017/m/ Time Zone 2/

4 When solid barium hydroxide is added to solid ammonium chloride a reaction takes place.

(b) How could you show whether or not the final mixture contains ammonium ions?

.....

.....

.....

..... [2]

Q# 13/ iGCSE Chemistry/Paper 6/2017/m/ Time Zone 2/

3 Two solids, **Q** and **R**, which are both salts, were analysed. Solid **Q** was zinc bromide.
Tests were carried out on each solid.

tests on solid Q

Solid **Q** was dissolved in distilled water.
The solution was divided into three equal portions in three test-tubes, and the following tests were carried out.

Complete the expected observations.

(a) (i) Drops of aqueous sodium hydroxide were added to the first portion of the solution until a change was seen.

observations ..... [2]

(ii) Excess aqueous sodium hydroxide was then added to the mixture.

observations ..... [1]

(b) (i) Drops of aqueous ammonia were added to the second portion of the solution until a change was seen.

observations ..... [1]

(ii) Excess aqueous ammonia was then added to the mixture.

observations ..... [1]

(c) Dilute nitric acid and aqueous silver nitrate were added to the third portion of the solution.

observations ..... [2]

tests on solid R

Tests were carried out and the following observations made.

tests on solid **R**	observations
test 1 A flame test was carried out on solid **R**.	yellow colour

Solid **R** was dissolved in distilled water. The solution was divided into two equal portions in two test-tubes. **test 2** Dilute nitric acid and aqueous barium nitrate were added to the first portion of the solution.	no change
test 3 Dilute nitric acid and aqueous silver nitrate were added to the second portion of the solution.	yellow precipitate formed

(d) Identify solid **R**.

..... [2]

Q# 14/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 3/

3 Two solutions, solution **Q** and solution **R**, were analysed. Solution **Q** was aqueous sulfuric acid.

tests on solution Q

(a) Solution **Q** was divided into four equal portions in four test-tubes. The following tests were carried out.

Complete the observations for **tests 1–4**.

(i) test 1

The pH of the first portion of solution **Q** was measured.

pH ..... [1]

(ii) test 2

Magnesium ribbon was added to the second portion of solution **Q**. The gas given off was tested.

observations .....

..... [3]

(iii) test 3

Sodium carbonate was added to the third portion of solution **Q**. The gas given off was tested.

observations .....

..... [3]

(iv) test 4

Dilute nitric acid and aqueous barium nitrate were added to the fourth portion of solution **Q**.

observations ..... [1]

tests on solution R

Solution **R** was divided into three equal portions in three test-tubes.
The following tests were carried out.

tests	observations
test 5 The pH of the first portion of solution **R** was measured.	pH = 10
test 6 Drops of aqueous sodium hydroxide were added to the second portion of solution **R** and the test-tube shaken. Excess aqueous sodium hydroxide was then added to the test-tube.	white precipitate no visible change
test 7 Aqueous iron(II) sulfate was added to the third portion of solution **R** and the mixture shaken.	green precipitate formed

(b) Identify solution **R**.

.....

..... [2]

Q# 15/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 2/Q3

3 Two solutions, solution **S** and solution **T**, were analysed. Solution **S** was dilute hydrochloric acid. The tests on solution **S** and solution **T**, and some of the observations, are shown.

tests on solution S

(a) Solution **S** was divided into four equal portions in four test-tubes. The following tests were carried out.

Complete the observations for **tests 1–4**.

(i) test 1

The pH of the first portion of solution **S** was tested.

pH ..... [1]

(ii) test 2

Copper(II) oxide was added to the second portion of the solution. The mixture was heated.

observations .....

.....

..... [2]

(iii) test 3

Solid sodium carbonate was added to the third portion of the solution. The gas given off was tested.

observations .....

..... [3]

(iv) test 4

Dilute nitric acid and aqueous silver nitrate were added to the fourth portion of the solution.

observations ..... [1]

tests on solution T

(b) Tests were carried out on solution **T** and the following observations made.

tests	observations
Solution **T** was divided into three equal portions in three test-tubes. Appearance of the solution.	 yellow solution
Drops of aqueous sodium hydroxide were added to the second portion of the solution and the test-tube shaken. Excess aqueous sodium hydroxide was then added to the test-tube.	red-brown precipitate no visible change
Aqueous sodium hydroxide and aluminium foil were added to the third portion of the solution and the mixture heated. The gas given off was tested with pH indicator paper.	pungent gas formed, pH 10

Identify solution **T**.

.....

..... [2]

3 Solid **P**, which is an aluminium salt, was analysed.
The tests on solid **P**, and some of the observations, are shown.

tests on solid P

(a) test 1

Solid **P** was divided into three portions. The first portion of solid **P** was heated.

observations *condensation formed on the sides of the test-tube*

Any gases given off were tested with cobalt(II) chloride paper.

observations *cobalt(II) chloride paper turned from blue to pink*

What does **test 1** tell you about solid **P**?

..... [1]

(b) test 2

A flame test was carried out on the second portion of solid **P**.

observations ..... [1]

tests on a solution of P

Distilled water was added to the rest of solid **P** in a test-tube and shaken to dissolve.

(c) The solution was divided into four equal portions in four test-tubes. The following tests were carried out.

(i) test 3

Several drops of aqueous sodium hydroxide were added to the first portion of the solution.

Excess aqueous sodium hydroxide was then added to the mixture.

observations .....

.....

..... [3]

(ii) test 4

Several drops of aqueous ammonia were added to the second portion of the solution.

Excess aqueous ammonia was then added to the mixture.

observations .....

..... [2]

Two further tests were carried out and the following observations made.

tests on a solution of **P**	observations
test 5 Dilute nitric acid and aqueous silver nitrate were added to the third portion of the solution.	no visible reaction
test 6 Dilute nitric acid and aqueous barium nitrate were added to the fourth portion of the solution.	white precipitate formed

(d) What does **test 5** tell you about solid **P**?

..... [1]

(e) Identify solid **P**.

..... [1]

(f) Describe the appearance of solid **P**.

..... [1]

Q# 17/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 1/Q1

(d) Give **one** test to distinguish between oxygen and hydrogen.

test .....

result with oxygen .....

result with hydrogen .....

[2]

Q# 18/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 1/

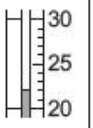
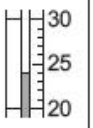
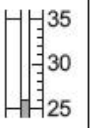
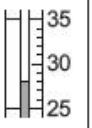
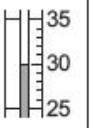
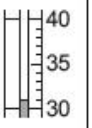
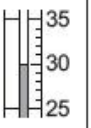
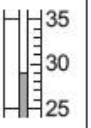
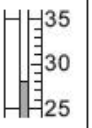
2 A student investigated what happened when dilute nitric acid reacted with aqueous solutions of two different alkalis, solution **N** and solution **O**.

Two experiments were carried out.

(a) *Experiment 1*

A measuring cylinder was used to pour 50 cm^3 of solution **N** into a polystyrene cup. The initial temperature of the solution was measured.
A burette was filled with nitric acid to the 0.0 cm^3 mark.
5.0 cm^3 of nitric acid were added to solution **N** in the polystyrene cup and the solution stirred. The maximum temperature of the solution was measured.
A further 5.0 cm^3 of nitric acid were added to the polystyrene cup and the solution stirred. The maximum temperature of the solution was measured.
The student continued to add 5.0 cm^3 portions of nitric acid to the polystyrene cup, until a total volume of 40 cm^3 of nitric acid had been added. After each addition, the solution was stirred and the maximum temperature measured.

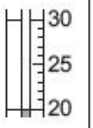
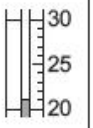
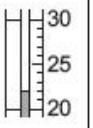
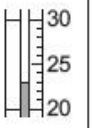
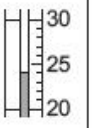
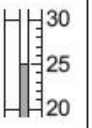
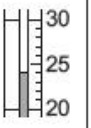
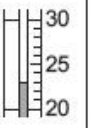
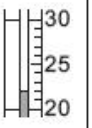
Use the thermometer diagrams to record the maximum temperatures in the table.

volume of nitric acid added / cm^3	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0
thermometer diagram									
maximum temperature of the solution in the polystyrene cup / °C									

[2]

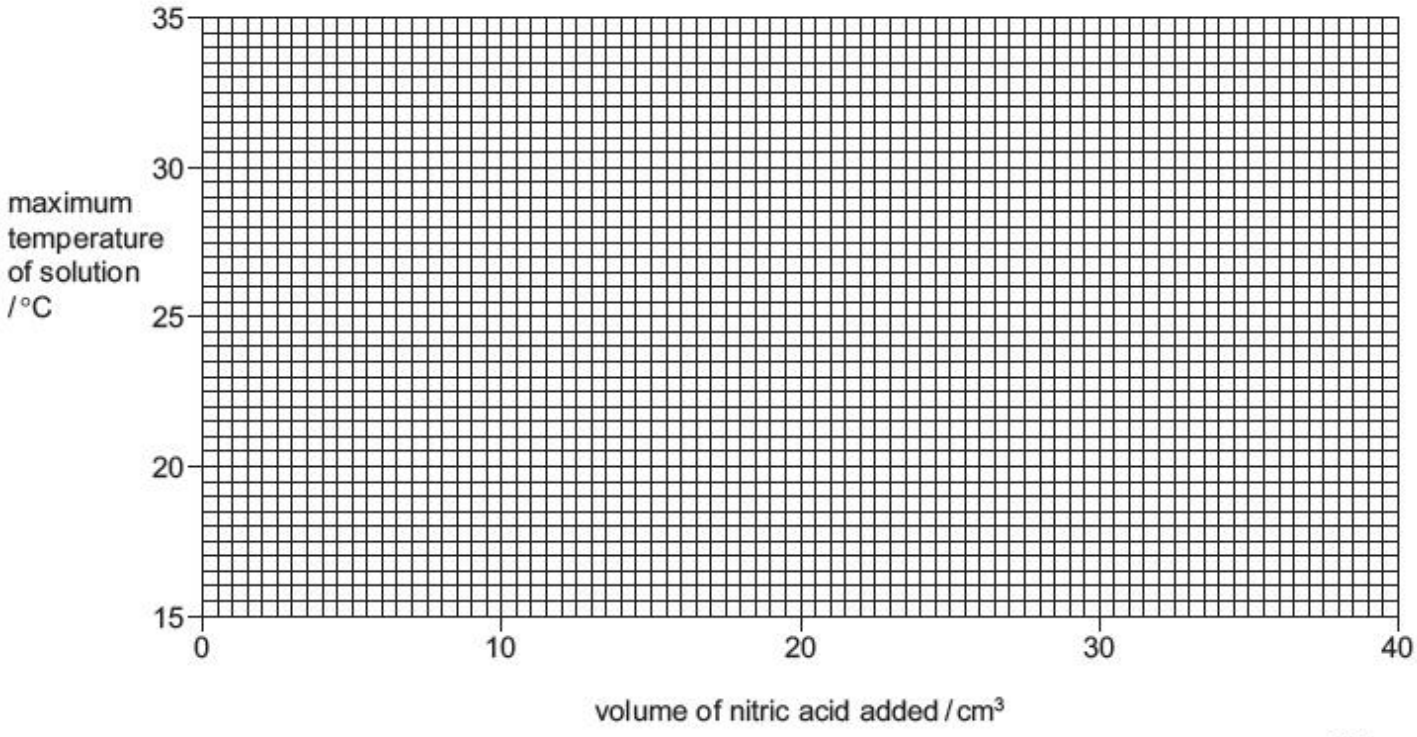
(b) *Experiment 2*

Experiment 1 was repeated using solution **O** instead of solution **N**.
Use the thermometer diagrams to record the maximum temperatures in the table.

volume of nitric acid added / cm^3	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0
thermometer diagram									
maximum temperature of the solution in the polystyrene cup / °C									

[2]

(c) Plot the results for Experiments 1 and 2 on the grid and draw **two** smooth line graphs.
Clearly label your graphs.



[4]

(d) **Use your graph** to estimate the maximum temperature of the solution when 13 cm^3 of nitric acid were added to 50 cm^3 of solution **N** in Experiment 1.
Show clearly **on the grid** how you worked out your answer.

..... °C [2]

(e) Name a suitable indicator that could be used in Experiment 1.

..... [1]

(f) Solution **N** and solution **O** were the same concentration.

In which experiment is the temperature change greater? Suggest why the temperature change is greater in this experiment.

.....

..... [2]

(g) How would the results differ in Experiment 1 if 100 cm^3 of solution **N** were used?

.....

..... [1]

(h) Suggest why a polystyrene cup was used in these experiments and **not** a copper can.

..... [1]

(i) State **one** source of error in the experiments. Suggest an improvement to reduce this source of error.

source of error .....

improvement .....
[2]

Q# 19/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 1/

4 Agri Limes are mixtures of calcium carbonate and calcium oxide. Farmers use Agri Limes on fields to neutralise acidity.

Plan an investigation to find out which of **two** different Agri Limes, **Q** or **R**, will neutralise more acid.
You are provided with common laboratory apparatus and chemicals, including dilute nitric acid.

.....

.....

.....

.....

.....

.....

.....

..... [6]

Q# 20/ iGCSE Chemistry/Paper 6/2016/s/ Time Zone 3/Q2

(b) The gas produced in experiment 3 was tested with a lighted splint and the result recorded below.

test ...lighted splint.....

result ...popped.....

Name the gas given off in experiment 3.

..... [1]

Q# 21/ iGCSE Chemistry/Paper 6/2016/s/ Time Zone 3/

3 A mixture of two solids, **G** and **H**, was analysed. Solid **G** was zinc nitrate, which is water soluble, and solid **H** is insoluble in water.
The tests on the mixture, and some of the observations, are shown.

Distilled water was added to the mixture in a boiling tube and shaken. The contents of the boiling tube were filtered keeping the filtrate and the residue.

tests on filtrate

(a) The filtrate was divided into four test-tubes and the following tests carried out.

(i) Drops of aqueous sodium hydroxide were added to the first portion of the solution. Excess aqueous sodium hydroxide was then added to the test-tube.

observations .....

.....

..... [3]

(ii) Using the second portion of the solution, the test in **(a)(i)** was repeated using aqueous ammonia instead of aqueous sodium hydroxide.

observations .....

..... [2]

(iii) Dilute nitric acid was added to the third portion of the solution followed by aqueous silver nitrate.

observations ..... [1]

(iv) Aqueous sodium hydroxide and aluminium foil were added to the fourth portion of the solution.
The mixture was warmed and the gas given off was tested.

observations .....

.....

..... [3]

tests on residue

Two tests are carried out and the following observations made.

tests	observations
A spatula was used to transfer some of the residue into a test-tube. Dilute hydrochloric acid was added to the residue. The gas given off was tested.	rapid effervescence, limewater turned milky
A flame test was carried out on the residue.	red flame colour

(b) Identify solid **H**.

.....

..... [2]

Q# 22/ iGCSE Chemistry/Paper 6/2016/s/ Time Zone 2/

4 Potassium sulfate is the salt produced when sulfuric acid is neutralised by potassium hydroxide solution.
The correct amount of potassium hydroxide solution must be added to neutralise all of the sulfuric acid.
Plan an experiment to obtain pure crystals of potassium sulfate from sulfuric acid and potassium hydroxide solution.
You are provided with common laboratory apparatus.

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

Q# 23/ iGCSE Chemistry/Paper 6/2016/s/ Time Zone 2/

3 Two solids, **E** and **F**, were analysed. Solid **E** was sodium sulfite. Both solids were found to be water soluble.
The tests on the solids, and some of the observations, are shown below.

tests on solid E

(a) Describe the appearance of the solid.

..... [1]

(b) Distilled water was added to solid **E** in a test-tube and shaken to dissolve.

The solution was divided into two portions in two test-tubes and the following tests carried out.

(i) Aqueous sodium hydroxide was added to the first portion of the solution.

observations ..... [1]

(ii) Dilute hydrochloric acid was added to the second portion of the solution. The mixture was warmed. The gas given off was tested with a piece of filter paper soaked in aqueous acidified potassium manganate(VII) solution.

observations .....

..... [2]

(c) A flame test was carried out on solid **E**.

observations ..... [1]

tests on solid F

tests	observations
The solid was heated. The gas given off was tested with damp, red litmus paper.	pungent gas evolved red litmus paper turned blue
Aqueous sodium hydroxide was added to solid **F** and the mixture heated. The gas given off was tested.	pungent gas evolved Universal Indicator paper showed pH 10

(d) Identify the gas given off in the tests on solid **F**.

..... [1]

(e) Identify **one** of the ions in solid **F**.

..... [1]

Mark Scheme iG Chem 8 EQ P6 Tests for Ions

Q# 1/ iGCSE Chemistry/Paper 6/2017/w/ Time Zone 3/

3(a)(i)	green	1
	precipitate	1
3(a)(ii)	green solution / precipitate dissolves	1
3(a)(iii)	bubbles / fizzing / effervescence	1
	(red) litmus paper / Universal Indicator paper	1
	(red litmus paper) turns blue / (Universal Indicator paper) turns purple	1
3(b)	ammonia / NH_3	1
3(c)	(aqueous) ammonia / NH_3	1

Q# 2/ iGCSE Chemistry/Paper 6/2017/w/ Time Zone 3/

1(c)	nitric (acid)	1

Q# 3/ iGCSE Chemistry/Paper 6/2017/w/ Time Zone 2/

1(d)(ii)	'pops'	1

Q# 4/ iGCSE Chemistry/Paper 6/2017/w/ Time Zone 2/

3(a)	white (crystals)	1
3(b)	bubbles / fizz	1
	limewater	1
	(turns) milky	1
3(c)	carbon dioxide	1
3(d)	yellow	1
3(e)	non-transition metal / Group II metal / barium / calcium / magnesium	1
3(e)	chloride	1

Q# 5/ iGCSE Chemistry/Paper 6/2017/w/ Time Zone 1/

3(a)(i)	red-brown	1
	precipitate	1
3(a)(ii)	insoluble / no change	1
3(b)	red-brown precipitate	1
3(c)	(red) litmus paper	1
	turns blue	1
3(d)	ammonia	1
3(e)	lithium	1
	carbonate	1

Q# 6/ iGCSE Chemistry/Paper 6/2017/s/ Time Zone 3/

3(a)	chlorine	1
3(b)(i)	iron(III)	1
	hydroxide	1
3(b)(ii)	green	1
	precipitate	1
3(c)	oxygen	1
3(d)	catalyst	1
	transition element compound / manganese oxide	1

Q# 7/ iGCSE Chemistry/Paper 6/2017/s/ Time Zone 1/

3(a)	solid spits out of the tube / the tube might crack	1
3(b)	carbon dioxide	1
3(c)	copper / Cu^{2+}	1
	carbonate / CO_3^{2-}	1
3(d)	white	1
3(e)(i)	no reaction / change	1
3(e)(ii)	yellow	1
	precipitate	1
3(f)	lilac	1

Q# 8/ iGCSE Chemistry/Paper 6/2017/s/ Time Zone 1/

4(a)	(red) litmus turns blue	1

Q# 9/ iGCSE Chemistry/Paper 6/2017/s/ Time Zone 1/

1(a)(iii)	nitric (acid)	1
1(a)(iv)	bubbles / fizz / effervescence	1
1(b)	the reaction is (fast) at room temperature	1

1(c)	strontium carbonate	1
	solid is left behind	1
1(d)	filter	1
	heat / evaporate	1
	to crystallising point / glass rod test / until saturation point	1

Q# 10/ iGCSE Chemistry/Paper 6/2017/m/ Time Zone 2/

1(c)	test: glowing splint result: relights	1
1(d)(i)	carbon dioxide	1

Q# 11/ iGCSE Chemistry/Paper 6/2017/m/ Time Zone 2/

2(a)	initial and final readings completed correctly: 29.6; 4.1	1
	difference completed correctly: 25.5	1
2(b)	initial and final readings and difference completed correctly: 29.1; 24.0; 5.1	1
	all readings to 1 d.p.	1
2(c)	neutralisation	1
2(d)(i)	solution **O**	1
	greater volume of acid was used in the titration	1
2(d)(ii)	five times as concentrated	1
2(e)	2.5–2.6	1
	unit: cm^3	1
2(f)	effect on volume: no effect	1
	reason: temperature would only affect the rate	1
2(g)(i)	use a pipette / burette	1
2(g)(ii)	repeat experiments (and compare / average)	1
2(h)	**M1** *fair test* to equal volumes of each sodium hydroxide solution / solutions **O** and **P** add an equal volume / measured volumes of aqueous calcium chloride	1
	M2 *dependent variable measured* measure mass / height of precipitate formed / volume of calcium chloride used	1
	M3 *conclusion* the more concentrated sodium hydroxide solution would form the most precipitate (mass / height) / would require a smaller volume of calcium chloride	1

Q# 12/ iGCSE Chemistry/Paper 6/2017/m/ Time Zone 2/

4(b)	**M1** add (aqueous) sodium hydroxide (and warm)	1
	M2 gas produced turns (red) litmus blue	1

Q# 13/ iGCSE Chemistry/Paper 6/2017/m/ Time Zone 2/

3(a)(i)	white	1
	precipitate	1
3(a)(ii)	(white precipitate) dissolves	1
3(b)(i)	white precipitate	1
3(b)(ii)	(white precipitate) dissolves	1
3(c)	cream	1
	precipitate	1
3(d)	sodium	1
	iodide	1

Q# 14/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 3/

3(a)(i)	pH 1–3	1
3(a)(ii)	effervescence / fizzing / bubbling / solid disappears / dissolves lighted splint 'pops'	1 1 1

3(a)(iii)	effervescence / fizzing / bubbling / solid disappears / dissolves limewater milky	1 1 1
3(a)(iv)	white precipitate	1
3(b)	calcium / Ca^{2+} hydroxide / OH^-	1 1

Q# 15/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 2/

3(a)(i)	pH 1–3	1
3(a)(ii)	solid disappears / dissolves blue / green colour	1 1
3(a)(iii)	solid dissolves limewater turns milky	1 1 1
3(a)(iv)	white precipitate	1
3(b)	iron(III) nitrate	1 1

Q# 16/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 1/

3(a)	water present / hydrated	1
3(b)	no change / colour	1
3(c)(i)	white precipitate dissolves	1 1 1
3(c)(ii)	white precipitate no change	1 1
3(d)	not a halide	1
3(e)	(aluminium) sulfate	1
3(f)	white (crystals)	1

Q# 17/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 1/

1(d)	*lighted splint* no effect / brighter light for oxygen 'pops' for hydrogen **OR** *glowing splint* relights for oxygen no effect for hydrogen	 1 1 1 1

Q# 18/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 1/

2(a)	table of results for Experiment 1 all temperature boxes completed correctly 22, 24, 26, 28, 30, 31, 30, 29, 28	2
2(b)	table of results for Experiment 2 initial and other temperature boxes completed correctly 20, 21, 22, 23, 24, 25, 24, 23, 22	2
2(c)	all points correctly plotted best-fit smooth line graphs labels	2 1 1
2(d)	value from graph (27 °C) shown clearly	1 1
2(e)	phenolphthalein / litmus / suitable named indicator	1
2(f)	Experiment 1 / solution **N** solution **N** is a stronger acid / has a higher pH	1 1
2(g)	measured results / temperature changes / results would be smaller **OR** larger / double volume needed to reach same temperature changes	1
2(h)	polystyrene is an insulator / copper is a (good) conductor	1

2(i)	source of error: heat losses / using a measuring cylinder improvement: lag or insulate / use burette	1 1

Q# 19/ iGCSE Chemistry/Paper 6/2016/w/ Time Zone 1/

4	**method adding Agri Lime to acid** add weighed amount / known mass of Agri Lime **Q** to a known volume of acid with a named indicator added to the acid until the indicator changes colour note the mass of Agri Lime **Q** added repeat with Agri Lime **R** conclusion, e.g. 'the experiment using the smaller amount of Agri Lime is better' **OR** **method adding acid to Agri Lime** use weighed amount / known mass of Agri Lime **Q** add acid to it gradually / from a burette with a named indicator added to the acid until the indicator changes colour note volume of acid added repeat with Agri Lime **R** conclusion, e.g. 'the experiment using the larger volume of acid is better'	6

Q# 20/ iGCSE Chemistry/Paper 6/2016/s/ Time Zone 3/

2(b)	hydrogen;	1

Q# 21/ iGCSE Chemistry/Paper 6/2016/s/ Time Zone 3/

3(a)(i)	white; precipitate; dissolves;	3 1 1 1
3(a)(ii)	white precipitate; dissolves;	2 1 1
3(a)(iii)	no reaction / change / precipitate;	1
3(a)(iv)	any 3 from: effervescence / fizz / bubbles; red litmus / pH paper; blue / pH > 7; pungent smell;	3
3(b)	lithium; carbonate;	2 1 1

Q# 22/ iGCSE Chemistry/Paper 6/2016/s/ Time Zone 2/

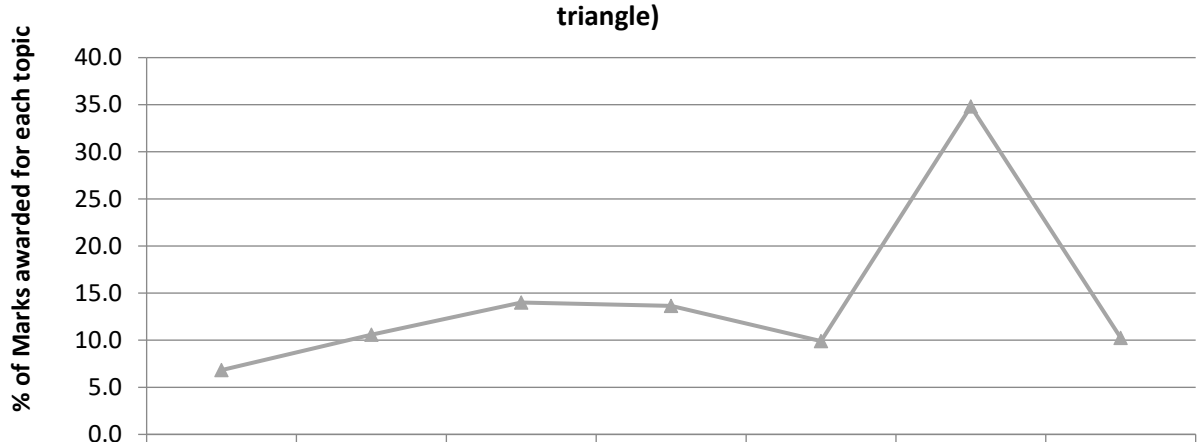
4	**making the salt** any 4 from: • known volume sulfuric acid; • add named indicator; • add potassium hydroxide solution to the acid until the indicator changes colour / is neutralised; • note / measure the volume of potassium hydroxide solution added; • repeat without indicator **OR** add (decolourising) charcoal; **obtaining crystals** any 2 from: • heat / evaporate solution to crystallising point until half evaporated **OR** until crystals (start to) form **OR** until saturated; • leave to cool; • filter to get crystals; • dry crystals (on filter paper) / leave to dry;	6

Q# 23/ iGCSE Chemistry/Paper 6/2016/s/ Time Zone 2/

3(a)	white (solid / crystals / powder);	1
3(b)(i)	no change;	1
3(b)(ii)	turns from purple / pink; to colourless / white;	2 1 1
3(c)	yellow / orange (flame);	1
3(d)	ammonia / NH_3;	1
3(e)	ammonium / NH_4^+;	1

PAPER 4 Topic 10 (Metals) (pre2016 called Paper 3)

Percentage of all marks awarded for each subtopic from s2001 to w2015 green triangle)



	Alloys	Aluminium extraction	Blast furnace	Thermal decomposition	Properties and uses of metals	Reactivity	Zinc extraction
P3 2001-15	6.8	10.6	14.0	13.7	9.9	34.8	10.2

Paper 3 Topic Number

10 Metals

10.1 Properties of metals

Core

- List the general physical properties of metals
- Describe the general chemical properties of metals, e.g. reaction with dilute acids and reaction with oxygen
- Explain in terms of their properties why alloys are used instead of pure metals
- Identify representations of alloys from diagrams of structure

10.2 Reactivity series

Core

- Place in order of reactivity: potassium, sodium, calcium, magnesium, zinc, iron, (hydrogen) and copper, by reference to the reactions, if any, of the metals with:
  - water or steam
  - dilute hydrochloric acid

  and the reduction of their oxides with carbon
- Deduce an order of reactivity from a given set of experimental results

Supplement

- Describe the reactivity series as related to the tendency of a metal to form its positive ion, illustrated by its reaction, if any, with:
  - the aqueous ions
  - the oxides

  of the other listed metals
- Describe and explain the action of heat on the hydroxides, carbonates and nitrates of the listed metals
- Account for the apparent unreactivity of aluminium in terms of the oxide layer which adheres to the metal

10.3 Extraction of metals

Core	Supplement
• Describe the ease in obtaining metals from their ores by relating the elements to the reactivity series	• Describe in outline, the extraction of zinc from zinc blende
• Describe and state the essential reactions in the extraction of iron from hematite	
• Describe the conversion of iron into steel using basic oxides and oxygen	
• Know that aluminium is extracted from the ore bauxite by electrolysis	
• Discuss the advantages and disadvantages of recycling metals, limited to iron/steel and aluminium	• Describe in outline, the extraction of aluminium from bauxite including the role of cryolite and the reactions at the electrodes

10.4 Uses of metals

Core	Supplement
• Name the uses of aluminium: – in the manufacture of aircraft because of its strength and low density – in food containers because of its resistance to corrosion	• Explain the uses of zinc for galvanising and for making brass
• Name the uses of copper related to its properties (electrical wiring and in cooking utensils)	
• Name the uses of mild steel (car bodies and machinery) and stainless steel (chemical plant and cutlery)	• Describe the idea of changing the properties of iron by the controlled use of additives to form steel alloys

Topic Chem 10 Subtopic : Alloys **Q# 1/** iGCSE Chemistry/2015/s/Paper 31/

2 Iron from the Blast Furnace is impure. It contains about 5% of impurities, mainly carbon, sulfur, silicon and phosphorus, which have to be removed when this iron is converted into steel.

(b) Mild steel is the most common form of steel. Mild steel contains a maximum of 0.3% of carbon.

High carbon steel contains 2% of carbon. It is less malleable and much harder than mild steel.

(i) Give a use of mild steel.

..... [1]

(ii) Suggest a use of high carbon steel.

..... [1]

(iii) Explain why metals are malleable.

.....

.....

.....

..... [3]

(iv) Suggest an explanation why high carbon steel is less malleable and harder than mild steel.

.....

.....

..... [2]

Topic Chem 10 Subtopic : Alloys **Q# 2/** iGCSE Chemistry/2011/s/Paper 31/Q3

(b) (i) Why are steel alloys used in preference to iron?

..... [1]

(ii) State a use of the following alloys.

mild steel .....

stainless steel ..... [2]

Topic Chem 10 Subtopic : Alloys **Q# 3/** iGCSE Chemistry/2006/w/Paper 3/ Q6

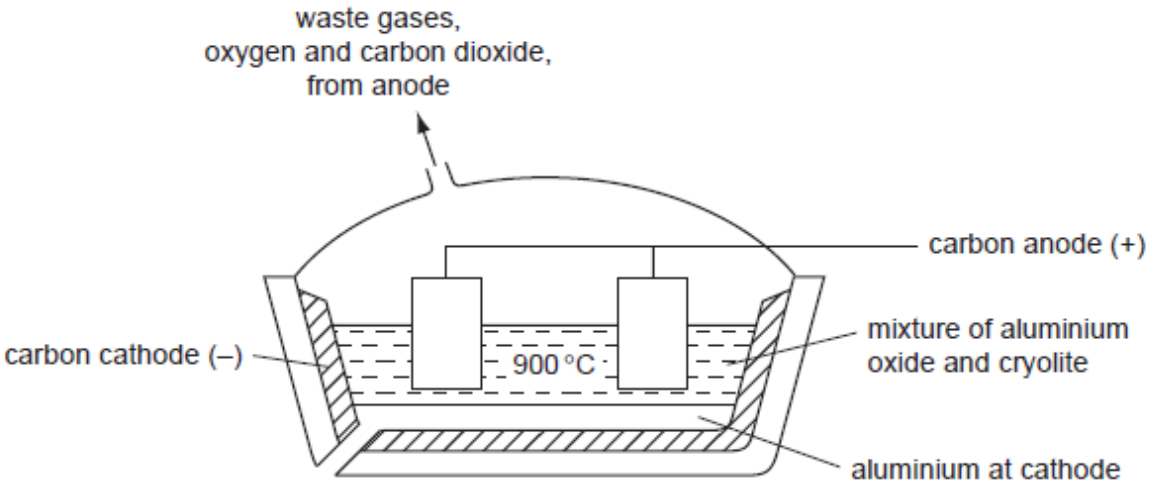
(b) Impure copper is extracted from the ore. This copper is refined by electrolysis.

(iii) One use of this pure copper is electrical conductors, another is to make alloys. Name the metal that is alloyed with copper to make brass.

..... [1]

Topic Chem 10 Subtopic : Aluminium extraction **Q# 4/** iGCSE Chemistry/2011/w/Paper 31/

3 Aluminium is extracted by the electrolysis of a molten mixture of alumina, which is aluminium oxide, and cryolite.



(a) (i) Alumina is obtained from the main ore of aluminium.
Name this ore.

..... [1]

(ii) Explain why it is necessary to use a mixture, alumina and cryolite, rather than just alumina.

.....

..... [2]

(iii) Copper can be extracted by the electrolysis of an aqueous solution.
Suggest why the electrolysis of an aqueous solution cannot be used to extract aluminium.

.....

.....

..... [2]

(b) The ions which are involved in the electrolysis are Al^{3+} and O^{2-}. The products of this electrolysis are given on the diagram.
Explain how they are formed. Use equations where appropriate.

.....

.....

.....

..... [4]

Topic Chem 10 Subtopic : Aluminium extraction **Q# 5/** iGCSE Chemistry/2007/s/Paper 3/

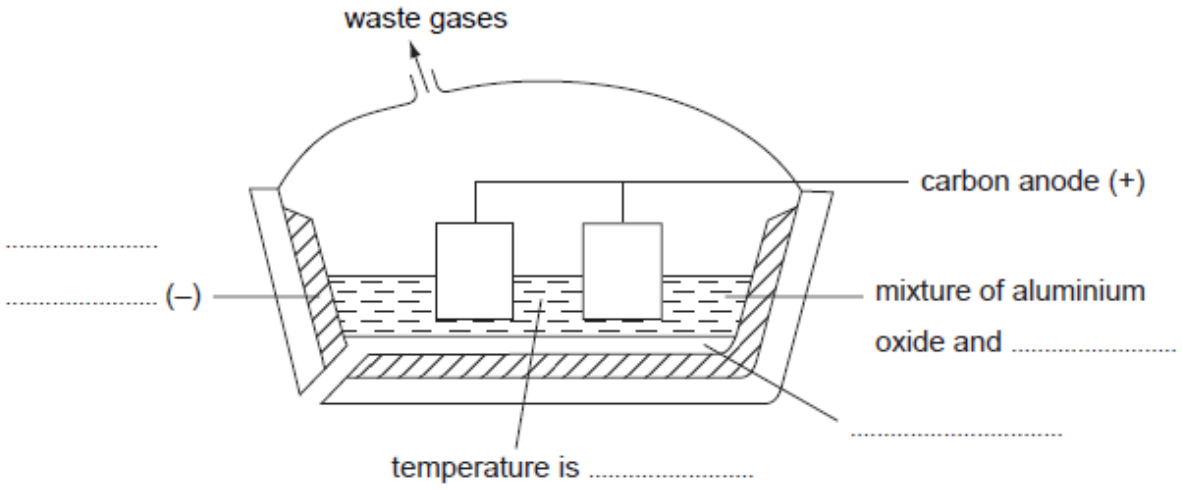
6 Aluminium is extracted by the electrolysis of a molten mixture that contains alumina, which is aluminium oxide, Al_2O_3.

(a) The ore of aluminium is bauxite. This contains alumina, which is amphoteric, and iron(III) oxide, which is basic. The ore is heated with aqueous sodium hydroxide.
Complete the following sentences.

The ..... dissolves to give a solution of .....

The ..... does not dissolve and can be removed by ..... [4]

(b) Complete the labelling of the diagram.



[4]

(c) The ions that are involved in the electrolysis are Al^{3+} and O^{2-}.

(i) Write an equation for the reaction at the cathode.

..... [2]

(ii) Explain how carbon dioxide is formed at the anode.

.....

..... [2]

Topic Chem 10 Subtopic : Blast furnace **Q# 6/** iGCSE Chemistry/2015/s/Paper 31/

2 Iron from the Blast Furnace is impure. It contains about 5% of impurities, mainly carbon, sulfur, silicon and phosphorus, which have to be removed when this iron is converted into steel.

(a) Explain how the addition of oxygen and calcium oxide removes these impurities. Include an equation for a reaction of oxygen and a word equation for a reaction of calcium oxide in this process.

.....

.....

.....

.....

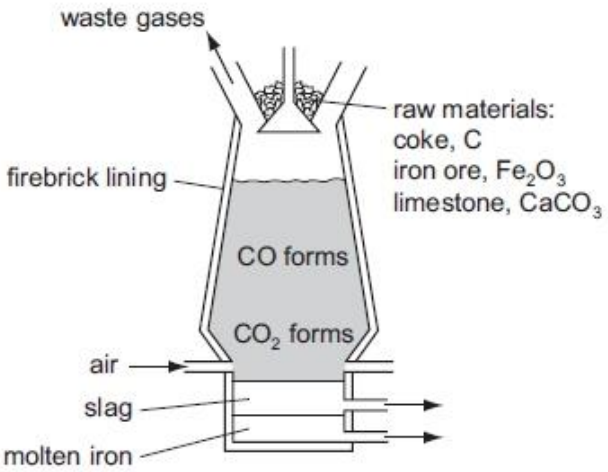
.....

.....

[5]

Topic Chem 10 Subtopic : Blast furnace **Q# 7/** iGCSE Chemistry/2014/w/Paper 31/

4 Iron is extracted from the ore hematite in the Blast Furnace.



(a) The coke reacts with the oxygen in the air to form carbon dioxide.

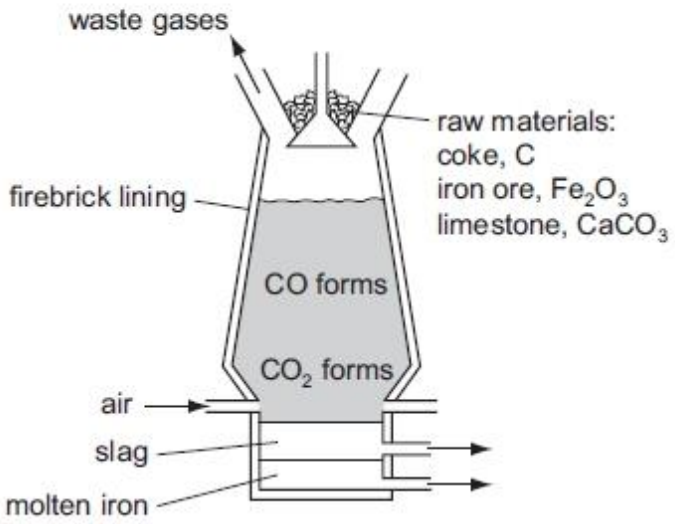
$$C + O_2 \rightarrow CO_2$$

(i) Explain why carbon monoxide is formed higher in the Blast Furnace.

.....

..... [2]

4 Iron is extracted from the ore hematite in the Blast Furnace.



(a) The coke reacts with the oxygen in the air to form carbon dioxide.

$$C + O_2 \rightarrow CO_2$$

(i) Explain why carbon monoxide is formed higher in the Blast Furnace.

.....

..... [2]

(ii) Write an equation for the reduction of hematite, Fe_2O_3, by carbon monoxide.

..... [2]

(b) (i) Limestone decomposes to form two products, one of which is calcium oxide.
Name the other product.

..... [1]

(ii) Calcium oxide reacts with silicon(IV) oxide, an acidic impurity in the iron ore, to form slag.
Write an equation for this reaction.

..... [2]

(iii) Explain why the molten iron and the molten slag form two layers and why molten iron is the lower layer.

.....

..... [2]

(iv) Suggest why the molten iron does **not** react with the air.

..... [1]

Topic Chem 10 Subtopic : Blast furnace **Q# 8/** iGCSE Chemistry/2011/s/Paper 31/

3 Iron from the blast furnace is impure. It contains about 4 % carbon and 0.5 % silicon. Most of this impure iron is used to make mild steel, an alloy of iron containing less then 0.25 % carbon.

(a) A jet of oxygen is blown through the molten iron in the presence of a base, usually calcium oxide. Explain how the percentage of carbon is reduced and how the silicon is removed.

.....

.....

.....

..... [4]

Topic Chem 10 Subtopic : Blast furnace **Q# 9/** iGCSE Chemistry/2008/w/Paper 31/ Q3

(b) (i) Name a reagent that can reduce iron(III) oxide to iron.

..... [1]

(ii) Write a symbol equation for the reduction of iron(III) oxide, Fe_2O_3, to iron.

..... [2]

Topic Chem 10 Subtopic : Blast furnace **Q# 10/** iGCSE Chemistry/2008/w/Paper 31/ Q3

(d) Iron from the blast furnace is impure. Two of the impurities are carbon and silicon. These are removed by blowing oxygen through the molten iron and adding calcium oxide.

(i) Explain how the addition of oxygen removes carbon.

.....

..... [1]

(ii) Explain how the addition of oxygen and calcium oxide removes silicon.

.....

..... [2]

Topic Chem 10 Subtopic : Blast furnace **Q# 11/** iGCSE Chemistry/2006/s/Paper 3/ Q1

(c) Iron is extracted in a blast furnace. The list below gives some of the substances used or formed in the extraction.

carbon monoxide **coke** **iron ore** **limestone** **slag**

(i) Which substance is a mineral containing largely calcium carbonate?

..... [1]

Topic Chem 10 Subtopic : Blast furnace **Q# 12/** iGCSE Chemistry/2006/s/Paper 3/ Q1

(d) State **two** functions of the coke used in the blast furnace.

.....

..... [2]

Topic Chem 10 Subtopic : Properties and uses of metals **Q# 13/** iGCSE Chemistry/2014/s/Paper 31/Q5

(b) State **two** major uses of zinc.

.....

..... [2]

Topic Chem 10 Subtopic : Properties and uses of metals **Q# 14/** iGCSE Chemistry/2013/w/Paper 31/

2 **(a)** Give **three** differences in physical properties between the Group I metal, potassium, and the transition element, iron.

1. .....

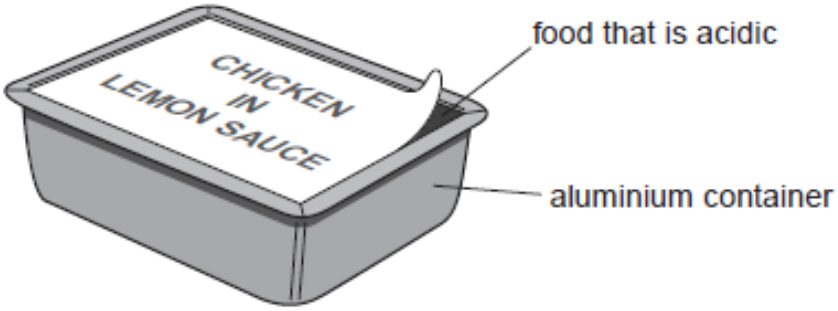
2. .....

3. ..... [3]

Topic Chem 10 Subtopic : Properties and uses of metals **Q# 15/** iGCSE Chemistry/2011/w/Paper 31/ Q3

(c) The uses of a metal are determined by its properties.

(i) Foods which are acidic can be supplied in aluminium containers.

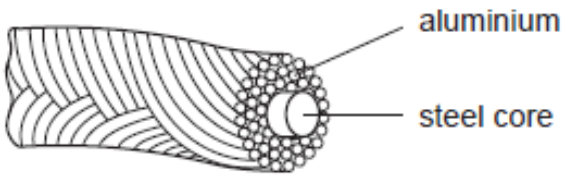


Explain why the acid in the food does not react with the aluminium.

.....

..... [1]

(ii) Explain why overhead electrical power cables are made from aluminium with a steel core.



.....

.....

..... [3]

Topic Chem 10 Subtopic : Properties and uses of metals **Q# 16/** iGCSE Chemistry/2010/s/Paper 31/

7 Titanium is a transition element. It is isolated by the following reactions.

titanium ore → titanium(IV) oxide → titanium(IV) chloride → titanium

TiO_2 $TiCl_4$ Ti

(d) Complete the table which shows some of the properties of titanium and its uses. The first line has been completed as an example.

property	related use
soluble in molten steel	making steel titanium alloys
.....	making aircraft and space vehicles
resistant to corrosion, especially in sea water	.....

[2]

Topic Chem 10 Subtopic : Properties and uses of metals **Q# 17/** iGCSE Chemistry/2008/s/Paper 31/ Q3

(c) (i) Give **two** reasons why copper is used,

in electric wiring, ...

..... [2]

in cooking utensils. .....

..... [2]

(ii) Give another use of copper.

..... [1]

Topic Chem 10 Subtopic : Properties and uses of metals **Q# 18/** iGCSE Chemistry/2007/w/Paper 3/ Q4

(d) Give two uses of zinc.

1. .....

2. ..... [2]

Topic Chem 10 Subtopic : Properties and uses of metals **Q# 19/** iGCSE Chemistry/2007/s/Paper 3/Q6

(d) Give an explanation for each of the following.

(i) Aluminium is used extensively in the manufacture of aircraft.

..... [1]

(ii) Aluminium is used to make food containers.

..... [2]

(iii) Aluminium electricity cables have a steel core.

..... [1]

Topic Chem 10 Subtopic : Properties and uses of metals **Q# 20/** iGCSE Chemistry/2006/s/Paper 3/ Q1

(e) Most of the iron is converted into mild steel or stainless steel. Give **one** use for each.

mild steel .....

stainless steel ..... [2]

Topic Chem 10 Subtopic : Reactivity **Q# 21/** iGCSE Chemistry/2015/w/Paper 31/

2 Describe how to separate the following. In each example, give a description of the procedure used and explain why this method works.

(a) Copper powder from a mixture containing copper and zinc powders.

procedure .....

.....

explanation .....

.....

[3]

Topic Chem 10 Subtopic : Reactivity **Q# 22/** iGCSE Chemistry/2014/s/Paper 31/

7 One way of establishing a reactivity series is by displacement reactions.

(a) A series of experiments was carried out using the metals lead, magnesium, zinc and silver. Each metal was added in turn to aqueous solutions of the metal nitrates.

The order of reactivity was found to be:

magnesium	most reactive
zinc	↓
lead	
silver	least reactive

(i) Complete the table.

✓ = reacts
✗ = does not react

	metal			
aqueous solution	lead Pb	magnesium Mg	zinc Zn	silver Ag
lead(II) nitrate		✓	✓	✗
magnesium nitrate				
zinc nitrate				
silver nitrate				

[3]

(ii) Displacement reactions are redox reactions.
On the following equation, draw a **ring** around the reducing agent and an **arrow** to show the change which is oxidation.

$$Zn + Pb^{2+} \rightarrow Zn^{2+} + Pb$$

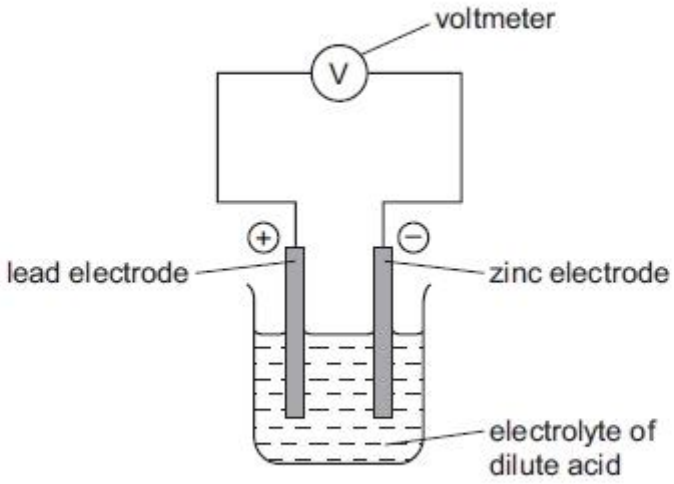
[2]

(iii) Complete the following ionic equation.

$$Zn + 2Ag^{+} \rightarrow \ldots\ldots + \ldots\ldots$$

[1]

(b) Another way of determining the order of reactivity of metals is by measuring the voltage and polarity of simple cells. The polarity of a cell is shown by which metal is the positive electrode and which metal is the negative electrode. An example of a simple cell is shown below.



(i) Mark on the above diagram the direction of the electron flow. [1]

(ii) Explain, in terms of electron transfer, why the more reactive metal is always the negative electrode.

.....

.....

..... [2]

(iii) The following table gives the polarity of cells using the metals zinc, lead, copper and manganese.

cell	electrode 1	polarity	electrode 2	polarity
A	zinc	–	lead	+
B	manganese	–	lead	+
C	copper	+	lead	–

What information about the order of reactivity of these four metals can be deduced from the table?

.....

.....

..... [2]

(iv) What additional information is needed to establish the order of reactivity of these four metals using cells?

..... [1]

Topic Chem 10 Subtopic : Reactivity **Q# 23/** iGCSE Chemistry/2013/w/Paper 31/Q2

(b) The following metals are in order of reactivity.

potassium
zinc
copper

For those metals which react with water or steam, name the products of the reaction, otherwise write 'no reaction'.

potassium .....

.....

zinc .....

.....

copper .....

..... [5]

Topic Chem 10 Subtopic : Reactivity **Q# 24/** iGCSE Chemistry/2013/s/Paper 31/

5 The reactivity series shows the metals in order of reactivity.

(a) The reactivity series can be established using displacement reactions. A piece of zinc is added to aqueous lead nitrate. The zinc becomes coated with a black deposit of lead.

$$Zn + Pb^{2+} \rightarrow Zn^{2+} + Pb$$

Zinc is more reactive than lead.

The reactivity series can be written as a list of ionic equations.

..... → ..... + ... most reactive metal : the best reductant (reducing agent)

$Zn \rightarrow Zn^{2+} + 2e^-$

$Fe \rightarrow Fe^{2+} + 2e^-$

$Pb \rightarrow Pb^{2+} + 2e^-$

$Cu \rightarrow Cu^{2+} + 2e^-$

$Ag \rightarrow Ag^{+} + e^-$

(i) In the space at the top of the list, write an ionic equation for a metal which is more reactive than zinc. [1]

(ii) Write an ionic equation for the reaction between aqueous silver(I) nitrate and zinc.

..... [2]

(iii) Explain why the positive ions are likely to be oxidants (oxidising agents).

..... [1]

(iv) Deduce which ion is the best oxidant (oxidising agent).

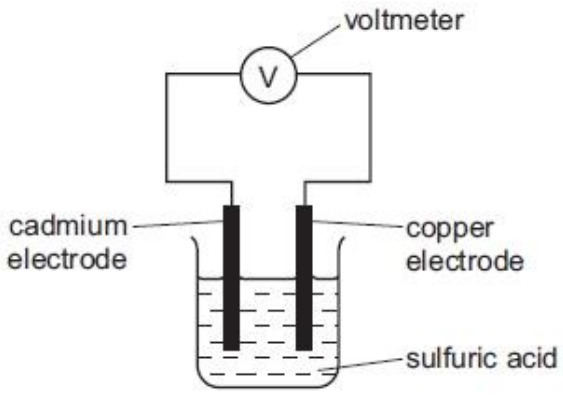
..... [1]

(v) Which ion(s) in the list can oxidise lead metal?

..... [1]

Topic Chem 10 Subtopic : Reactivity **Q# 25/** iGCSE Chemistry/2013/s/Paper 31/

(b) A reactivity series can also be established by measuring the voltage of simple cells. The diagram shows a simple cell.



Results from cells using the metals tin, cadmium, zinc and copper are given in the table below.

cell	electrode 1 positive electrode	electrode 2 negative electrode	voltage / volts
1	copper	cadmium	0.74
2	copper	tin	0.48
3	copper	zinc	1.10

Write the four metals in order of increasing reactivity and explain how you used the data in the table to determine this order.

.....

.....

..... [3]

Topic Chem 10 Subtopic : Reactivity **Q# 26/** iGCSE Chemistry/2012/s/Paper 31/

5 Reactive metals tend to have unreactive compounds. The following is part of the reactivity series.

sodium — most reactive
calcium
zinc
copper
silver — least reactive

(c) Which of the metals in the list on page 5 have oxides which are not reduced by carbon?

..... [1]

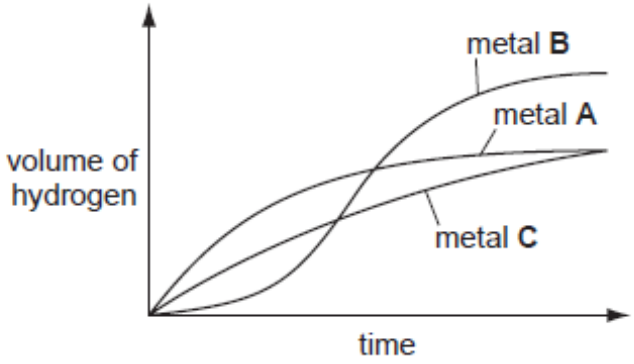
(d) Choose from the list on page 5, metals whose ions would react with zinc.

..... [2]

Topic Chem 10 Subtopic : Reactivity **Q# 27/** iGCSE Chemistry/2011/s/Paper 31/

7 Excess hydrochloric acid was added to powdered zinc. The hydrogen evolved was collected and its volume measured every 20 seconds.

The experiments were repeated at the same temperature using the same number of moles of powdered magnesium and aluminium.



(a) Identify metals **A**, **B** and **C** by choosing from zinc, magnesium and aluminium. Give a reason for each choice.

metal **A** .....

.....

metal **B** .....

.....

metal **C** .....

..... [5]

(b) Using 'moles', explain why two of the metals form the same volume of hydrogen but the third metal forms a larger volume.

.....

.....

..... [3]

Topic Chem 10 Subtopic : Reactivity **Q# 28/** iGCSE Chemistry/2010/w/Paper 31/ Q2

(c) The common ore of tin is tin(IV) oxide and an ore of copper is malachite, $CuCO_3.Cu(OH)_2$.

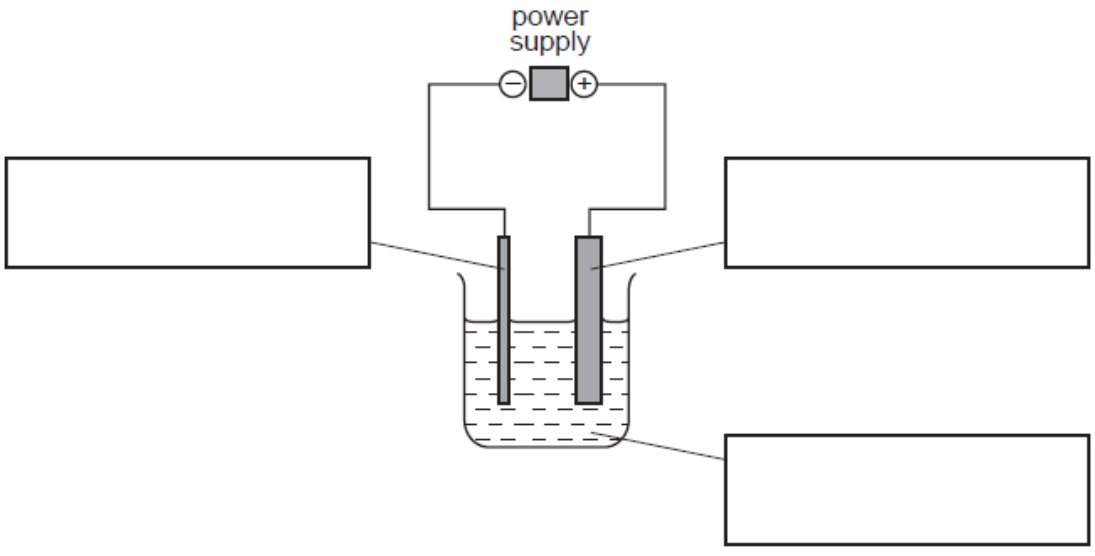
(i) Write a word equation for the reduction of tin(IV) oxide by carbon.

..... [1]

(ii) Malachite is heated to form copper oxide and two other chemicals.
Name these chemicals.

..... and ..... [2]

(iii) Copper oxide is reduced to copper which is then refined by electrolysis.
Label the diagram of the apparatus which could be used to refine copper.



[3]

(iv) Give **one** use of copper, other than making alloys.

..... [1]

Topic Chem 10 Subtopic : Reactivity **Q# 29/** iGCSE Chemistry/2010/s/Paper 31/

7 Titanium is a transition element. It is isolated by the following reactions.

titanium ore → titanium(IV) oxide → titanium(IV) chloride → titanium

TiO_2 $TiCl_4$ Ti

(a) Why is it usually necessary to include a number in the name of the compounds of transition elements?

..... [1]

(b) Titanium(IV) chloride is made by heating the oxide with coke and chlorine.

$$TiO_2 + 2Cl_2 \rightleftharpoons TiCl_4 + O_2$$

$$2C + O_2 \rightleftharpoons 2CO$$

Explain why the presence of coke ensures the maximum yield of the metal chloride.

.....

.....

..... [2]

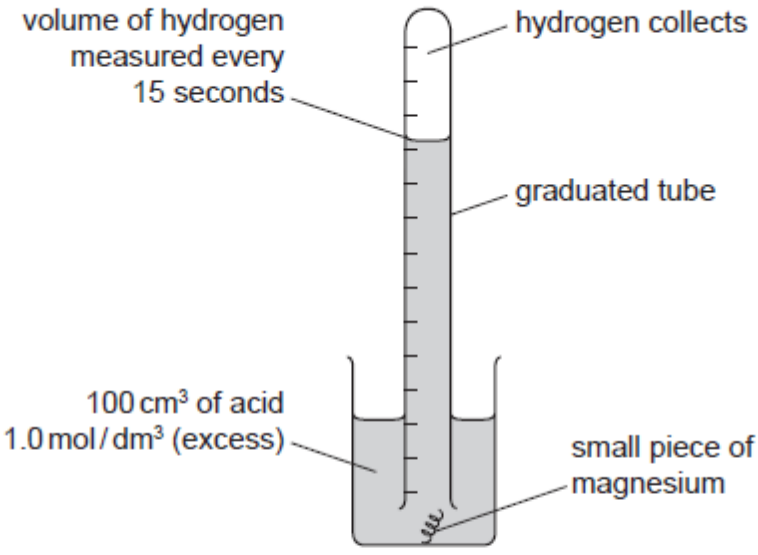
(c) Explain why the change, titanium(IV) chloride to titanium, is reduction.

.....

..... [1]

Topic Chem 10 Subtopic : Reactivity **Q# 30/** iGCSE Chemistry/2010/s/Paper 31/

3 A diagram of the apparatus which could be used to investigate the rate of reaction between magnesium and an excess of an acid is drawn below.



(a) The magnesium kept rising to the surface. In one experiment, this was prevented by twisting the magnesium around a piece of copper. In a second experiment, the magnesium was held down by a plastic net fastened to the beaker.

(i) Suggest a reason why magnesium, which is denser than water, floated to the surface.

.....

..... [1]

(ii) Iron, zinc and copper have similar densities. Why was copper a better choice than iron or zinc to weigh down the magnesium?

.....

..... [1]

Topic Chem 10 Subtopic : Reactivity **Q# 31/** iGCSE Chemistry/2009/s/Paper 31/

4 The reactivity series of metals given below contains both familiar and unfamiliar elements. For most of the unfamiliar elements, which are marked *, their common oxidation states are given.

* barium	Ba
* lanthanum	La (+3)
magnesium	
zinc	
* chromium	Cr (+2), (+3), (+6)
iron	
copper	
* palladium	(+2)

Choose metal(s) from the above list to answer the following questions.

(i) Which **two** metals would not react with dilute hydrochloric acid?

..... [2]

(ii) Which **two** unfamiliar metals (*) would react with cold water?

..... [2]

(iii) What is the oxidation state of barium?

..... [1]

(iv) Name an unfamiliar metal (*) whose oxide cannot be reduced by carbon.

..... [1]

(v) Why should you be able to predict that metals such as iron and chromium have more than one oxidation state?

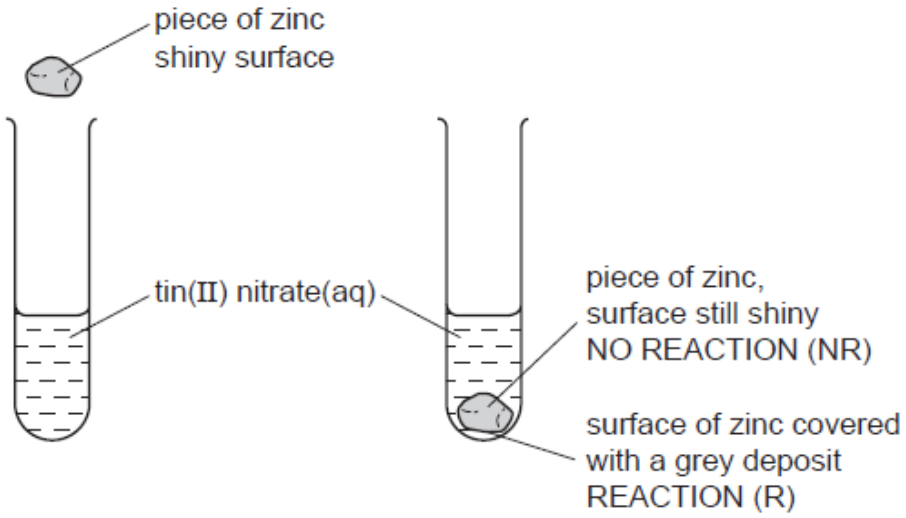
.....

..... [1]

Topic Chem 10 Subtopic : Reactivity **Q# 32/** iGCSE Chemistry/2008/w/Paper 31/

6 The reactivity series lists metals in order of reactivity.

(a) To find out which is the more reactive metal, zinc or tin, the following experiment could be carried out.



This experiment could be carried out with other metals and the results recorded in a table. Then the order of reactivity can be deduced.

(i) The order was found to be:

manganese	most reactive
zinc	
tin	
silver	least reactive

Complete the table of results from which this order was determined.

aqueous solution	**tin Sn**	**manganese Mn**	**silver Ag**	**zinc Zn**
tin(II) nitrate		R	NR	R
manganese(II) nitrate				
silver(I) nitrate				
zinc nitrate				

[3]

(ii) Write the ionic equation for the reaction between tin atoms and silver(I) ions.

.....

[2]

(iii) The following is a redox reaction.

$$Mn + Sn^{2+} \longrightarrow Mn^{2+} + Sn$$

Indicate on the equation the change which is oxidation.
Give a reason for your choice.

..... [2]

(iv) Explain why experiments of this type cannot be used to find the position of aluminium in the reactivity series.

.....

..... [2]

Topic Chem 10 Subtopic : Reactivity **Q# 33/** iGCSE Chemistry/2007/w/Paper 3/ Q4

(c) The remaining zinc oxide reacts with sulphuric acid to give aqueous zinc sulphate. This is electrolysed with inert electrodes (the electrolysis is the same as that of copper(II) sulphate with inert electrodes).
ions present: $Zn^{2+}(aq)$ $SO_4^{2-}(aq)$ $H^+(aq)$ $OH^-(aq)$

(i) Zinc forms at the negative electrode (cathode). Write the equation for this reaction.

..... [1]

(ii) Write the equation for the reaction at the positive electrode (anode).

..... [2]

(iii) The electrolyte changes from aqueous zinc sulphate to

..... [1]

Topic Chem 10 Subtopic : Reactivity **Q# 34/** iGCSE Chemistry/2007/s/Paper 3/

5 **(a)** Titanium is produced by the reduction of its chloride. This is heated with magnesium in an inert atmosphere of argon.

$$TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$$

(i) Explain why it is necessary to use argon rather than air.

..... [1]

(ii) Name another metal that would reduce titanium chloride to titanium.

..... [1]

Topic Chem 10 Subtopic : Thermal decomposition **Q# 35/** iGCSE Chemistry/2012/s/Paper 31/ Q5

(b) All nitrates decompose when heated.

(i) The equation for the thermal decomposition of silver(I) nitrate is given below.

$$2AgNO_3 \rightarrow 2Ag + 2NO_2 + O_2$$

What are the products formed when copper(II) nitrate is heated?

..... [1]

(ii) Complete the equation for the action of heat on sodium nitrate.

.....$NaNO_3$ → ..... + ...

[2]

Topic Chem 10 Subtopic : Thermal decomposition **Q# 36/** iGCSE Chemistry/2011/w/Paper 31/

7 Some hydroxides, nitrates and carbonates decompose when heated.

(a) (i) Name a metal hydroxide which does not decompose when heated.

..... [1]

(ii) Write the equation for the thermal decomposition of copper(II) hydroxide.

..... [2]

(iii) Suggest why these two hydroxides behave differently.

..... [1]

(b) (i) Metal nitrates, except those of the Group 1 metals, form three products when heated. Name the products formed when zinc nitrate is heated.

.....

..... [2]

(ii) Write the equation for the thermal decomposition of potassium nitrate.

..... [2]

Topic Chem 10 Subtopic : Thermal decomposition **Q# 37/** iGCSE Chemistry/2008/w/Paper 31/ Q6 (b)

(ii) Their hydroxides are heated.
If the compound decomposes, complete the word equation.
If it does not decompose, write "no reaction".

Potassium hydroxide → .....

Calcium hydroxide → ..... [2]

(iii) Complete the equations for the decomposition of their nitrates.

$2KNO_3 \rightarrow$ ..... + ...

$2Ca(NO_3)_2 \rightarrow$ ..... + ... + ... [4]

Topic Chem 10 Subtopic : Zinc extraction **Q# 38/** iGCSE Chemistry/2014/s/Paper 31/

5 Zinc is obtained from the ore, zinc blende, ZnS.

(a) Describe the extraction of zinc from its ore, zinc blende. Include at least one balanced equation in your description.

.....

.....

.....

.....

..... [5]

Topic Chem 10 Subtopic : Zinc extraction **Q# 39/** iGCSE Chemistry/2011/s/Paper 31/

4 A major ore of zinc is zinc blende, ZnS. A by-product of the extraction of zinc from this ore is sulfur dioxide which is used to make sulfuric acid.

(a) (i) Zinc blende is heated in air. Zinc oxide and sulfur dioxide are formed. Write the balanced equation for this reaction.

..... [2]

(ii) Zinc oxide is reduced to zinc by heating with carbon. Name **two** other reagents which could reduce zinc oxide.

..... [2]

(iii) The zinc obtained is impure. It is a mixture of metals. Explain **how** fractional distillation could separate this mixture.
zinc bp = 908 °C, cadmium bp = 765 °C, lead bp = 1751 °C

.....

..... [2]

Topic Chem 10 Subtopic : Zinc extraction **Q# 40/** iGCSE Chemistry/2009/w/Paper 3/

3 (a) An important ore of zinc is zinc blende, ZnS.

(i) How is zinc blende changed into zinc oxide?

..... [1]

(ii) Write a balanced equation for the reduction of zinc oxide to zinc by carbon.

..... [2]

(b) Some of the zinc oxide was mixed with an excess of carbon and heated to 1000 °C Zinc distils out of the furnace.

$$2ZnO + C \rightleftharpoons 2Zn + CO_2$$
$$C + CO_2 \rightarrow 2CO$$

(ii) Why is it necessary to use an excess of carbon?

.....

..... [2]

Mark Scheme iG Chem 10 P3 Metals 15w to 06s

Q# 1/ iGCSE Chemistry/2015/s/Paper 31/

2(b)(i)	*Any **one** from:* (making) car (bodies); machinery; chains; pylons; white goods; nails; screws; as a building material; sheds / roofs; reinforcing concrete;	1	**A** bridges **A** tools **I** cutlery
2(b)(ii)	*Any **one** from:* knives; drills; railway tracks; machine/ cutting tools / hammers; razor blades; chisels;	1	**I** cutlery items **I** bridges
2(b)(iii)	M1 atoms or cations or (positive) ions or metal ions; M2 arranged in a lattice or in layers or in rows or in a regular structure; M3 rows or layers slide over one another;	3	**I** (sea of) electrons **R** protons or nuclei for M1 **A** M2 non-directional forces **A** ECF on particle named in M1 for M3 **I** 'atoms' slide over one another
2(b)(iv)	M1 carbon **atoms** or **particles** in structure different size (to cations); M2 so reduce moving or interrupt movement;	2	**R** ions and molecules for M1 **A** M2 for prevents sliding **A** M2 for 'stops' sliding

Q# 2/ iGCSE Chemistry/2011/s/Paper 31/Q3

(b) (i) any sensible suggestion – harder/stronger/can be tailored for a specific use/more resistant to corrosion [1]
not steel does not rust

(ii) mild steel – cars or any vehicle/bicycles/white goods/screws or nails/roof/bridges/tools/ buildings/ships/pipes/machinery etc. [1]

stainless steel – chemical plants/cooking utensils/jewellery/cutlery/surgical equipment/ kitchen sinks/pipes/etc. [1]

Q# 3/ iGCSE Chemistry/2006/w/Paper 3/ Q6 (b)

(iii) Zinc [1]

Q# 4/ iGCSE Chemistry/2011/w/Paper 31/

3 (a) (i) bauxite [1]

(ii) lowers melting point [1]
better conductor / reduces amount of energy needed / reduces cost / more economic / makes process viable / conserves energy [1]

(iii) aluminium more reactive than copper / aluminium higher in reactivity series [1]
hydrogen not aluminium formed at cathode [1]

(b) $Al^{3+} + 3e \rightarrow Al$ [1]
$2O^{2-} \rightarrow O_2 + 4e$ [2]
note: not balanced = 1
oxygen reacts with carbon (anode) to form carbon dioxide / $C + O_2 \rightarrow CO_2$ [1]
note: if mark(s) for an electrode reaction are not awarded then allow aluminium ions accept electrons / are reduced [1]
oxide ion loses electrons / is oxidised [1]
max 4

Q# 5/ iGCSE Chemistry/2008/s/Paper 31/

6 (a) alumina **or** aluminium oxide [1]
sodium aluminate [1]
iron(III) oxide [1]
filtration **or** centrifuge NOT conditional [1]

(b) from left to right:
carbon cathode **or** carbon negative electrode [1]
900 to 1000°C [1]
aluminium [1]
cryolite [1]

(c) (i) $Al^{3+} + 3e = Al$ [2]
not balanced [1]
$Al^{3+}(aq) = 0$

(ii) oxygen is formed **NOT** oxide [1]
reacts with carbon anode [1]

Q# 6/ iGCSE Chemistry/2015/s/Paper 31/

Question	Answer	Marks	Guidance
2(a)	M1 *Forming an oxide* (all) elements or (all) impurities become oxides;		(All) elements or (all) impurities react with oxygen **A** M1 for any one element becoming an oxide
	M2 *Gaseous oxides* carbon dioxide or sulfur (di)oxide escape/are removed as gases;		**A** formulae/carbon monoxide **A** oxides of sulfur/carbon **I** sulfur trioxide
	M3 *Acidic oxides* silicon(IV) oxide or phosphorus(III/V) oxide react/are neutralised by calcium oxide/lime;		**A** silicon (di)oxide for silicon(IV) oxide **A** phosphorus (tri/pent)oxide for phosphorus(III/V) oxide
	M4 *Equation mark* any one of the following equations $S + O_2 \rightarrow SO_2$; $C + O_2 \rightarrow CO_2$ or $2C + O_2 \rightarrow 2CO$; $Si + O_2 \rightarrow SiO_2$; $4P + 5O_2 \rightarrow 2P_2O_5$ or $P_4 + 5O_2 \rightarrow 2P_2O_5$; $4P + 3O_2 \rightarrow 2P_2O_3$ or $P_4 + 3O_2 \rightarrow 2P_2O_3$;		**A** multiples **I** state symbols **I** unbalanced equations **R** other combustion equations with incorrect species
	M5 *Word equation mark* any one of the following word equations calcium oxide + silicon(IV) oxide → calcium silicate; calcium oxide + phosphorus(III/V) oxide → calcium phosphate;	5	**A** calcium oxide + silicon(IV) oxide → slag **A** correct symbol equation for M5 but **R** other equations with incorrect species used as M5

Q# 7/ iGCSE Chemistry/2014/w/Paper 31/

4 (a) (i) insufficient/limited oxygen [1]
or $2C + O_2 \rightarrow 2CO$

coke/carbon reacts with carbon dioxide [1]
or $C + CO_2 \rightarrow 2CO$

(ii) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
species (1) balancing (1) [2]

(b) (i) carbon dioxide [1]

(ii) $CaO + SiO_2 \rightarrow CaSiO_3$ [2]
[1] each side correct

(iii) (molten) iron higher density (than slag) [2]

(iv) No oxygen in contact with iron **or** layer of slag prevents hot iron reacting with oxygen/air **or** (all) oxygen reacts with carbon (so no oxygen left to react with iron) [1]

Q# 8/ iGCSE Chemistry/2011/s/Paper 31/

3 (a) any four max 4
carbon forms carbon dioxide / carbon monoxide [1]
this is a gas it escapes / blown out / diffuses [1]
silicon forms silicon(IV) oxide / silica [1]
/ silicon(IV) oxide present in impure iron
silicon(IV) oxide reacts with calcium oxide to form slag **or** calcium silicate [1]
slag removed from surface [1]
accept skimmed, syphoned, poured off
not tapped max [4]
accept correct formula or equations
not calcium oxide reacts with silicon

Q# 9/ iGCSE Chemistry/2008/w/Paper 31/ Q3

(b) (i) hydrogen **or** carbon **or** carbon monoxide **or** methane
or more reactive metal **NOT** Group I [1]

(ii) any correct equation [2]
only error not balanced [1]

Q# 10/ iGCSE Chemistry/2008/w/Paper 31/ Q3

(d) (i) forms carbon dioxide/carbon monoxide (which escapes) [1]

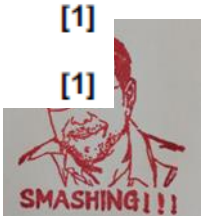
(ii) forms silicon(IV) oxide **or** silicon oxide **or** silica [1]
OR CaO reacts with SiO_2
to form slag **or** calcium silicate [1]
ignore an incorrect formula if a correct name "slag" given
NOT Si + O_2 + CaO form slag, this gains mark for slag only

Q# 11/ iGCSE Chemistry/2006/s/Paper 3/ Q1

(c) (i) limestone **[1]**

(ii) slag **[1]**

(iii) iron ore **[1]**



Q# 12/ iGCSE Chemistry/2006/s/Paper 3/ Q1

(d) to burn **or** provide heat **[1]**
to make carbon monoxide **[1]**

Q# 13/ iGCSE Chemistry/2014/s/Paper 31/

(b) Any **two** from: [2]

- (making) brass **or** alloys (1)
- galvanising (1)
- sacrificial protection (1)
- batteries (1)

Q# 14/ iGCSE Chemistry/2013/w/Paper 31/

2 **(a)** Any three of:
iron is harder
iron has higher density
ACCEPT: heavier **or** potassium lighter
iron has higher mp **or** bp
iron has higher tensile strength **or** stronger
iron has magnetic properties [3]
NOTE: has to be comparison, e.g. iron is hard (0) but iron is harder (1)
NOT: appearance e.g. shiny
ACCEPT: comparative statements relating to potassium

Q# 15/ iGCSE Chemistry/2011/w/Paper 31/ Q3

(c) **(i)** protective oxide layer [1]

(ii) aluminium low density / light [1]
aluminium is a good conductor [1]
strength / prevent sagging / allows greater separation of pylons / core made of steel because it is strong [1]

Q# 16/ iGCSE Chemistry/2010/s/Paper 31/

(d) low density / lightweight / light [1]
propellers / fittings on ships / inert anodes in electrolysis / hip replacements / ship building / chemical plants / cathodic protection / diving equipment [1]

Q# 17/ iGCSE Chemistry/2008/s/Paper 31/ Q3

(c) **(i)** <u>good conductor</u> [1]
malleable **or** ductile [1]

<u>good conductor of heat</u>
high melting point (and high boiling point)
unreactive **or** resists corrosion
appearance
any **TWO** [2]
do not accept malleable **or** ductile if either is given for wiring

(ii) alloys **or** named alloy **or** pipes **or** ornaments **or** jewellery **or** integrated circuit boards **or** electroplating **or** roofs, etc. [1]

Q# 18/ iGCSE Chemistry/2007/w/Paper 3/ Q4

(d) prevent iron from rusting **NOT** with galvanising **or** sacrificial protection
making brass **or** making alloys **NOT** bronze
electroplating **or** as an electrode in electrolysis
cells
roofing
sacrificial protection
coinage
TWO uses [2]

Q# 19/ iGCSE Chemistry/2008/s/Paper 31/Q6

(d) (i) low density **or** light or resistant to corrosion
accept strength/weight ratio **or** alloys are strong
strong on its own is neutral [1]

(ii) not attacked **or** corroded **or** unreactive
oxide layer
easily shaped **or** malleable **or** ductile
any **TWO** [2]

(iii) for strength **or** so it does not break **or** does not sag **or** can have pylons further apart [1]

NOT steel is a better conductor
NOT aluminium protects steel from rusting

Q# 20/ iGCSE Chemistry/2006/s/Paper 3/ Q1

(e) mild steel cars **or** machinery **or** fridges etc. **[1]**
stainless steel cutlery **or** chemical plants etc. **[1]**

Q# 21/ iGCSE Chemistry/2015/w/Paper 31/

Question	Answer	Marks
2(a)	add a (dilute) acid; filter; copper does not react or dissolve / zinc reacts or dissolves or forms a salt;	1 1 1

Q# 22/ iGCSE Chemistry/2014/s/Paper 31/

7 (a) (i)

aqueous solution	lead Pb	magnesium Mg	zinc Zn	silver Ag
lead (II) nitrate		✓	✓	✓
magnesium nitrate	✗		✗	✗
zinc nitrate	✗	✓		✗
silver(I) nitrate	✓	✓	✓	

each horizontal line correct (1) [3]

(ii) Zn (1)

An arrow **from** Zn **to** Zn^{2+} (1) [2]

(iii) $Zn + 2Ag^{+} \rightarrow Zn^{2+} + 2Ag$ (1) [1]

(b) (i) correct direction from zinc to lead (1) [1]

(ii) metals react by **losing electrons** (1)

the more reactive metal / zinc will lose electrons more readily (making the electrode negatively charged). (1) [2]

(iii) manganese **and** zinc are more reactive than lead (and/or copper) (1)

lead is more reactive than copper (1) [2]

(iv) the **polarity** of a Mn/Zn (cell)
or the **voltages** of Zn/Pb **and** Mn/Pb (cells) (1) [1]

Q# 23/ iGCSE Chemistry/2013/w/Paper 31/

(b) potassium hydrogen (1) and potassium hydroxide (1)
zinc hydrogen (1) and zinc oxide (1)
copper no reaction (1) [5]

Q# 24/ iGCSE Chemistry/2013/s/Paper 31/

5 **(a)** **(i)** any metal above zinc
$Mg \rightarrow Mg^{2+} + 2e^-$ [1]

(ii) $Zn + 2Ag^+ \rightarrow Zn^{2+} + 2Ag$ [2]
Note: not balanced only [1]

(iii) because they can accept or gain electrons / change into atoms or can be reduced [1]

(iv) Ag^+ or silver [1]
charge not essential but if given must be correct

(v) Ag^+ and Cu^{2+} **or** silver and copper [1]
charge not essential but if given must be correct

Q# 25/ iGCSE Chemistry/2013/s/Paper 31/

(b) Cu Sn Cd Zn *(i.e. all **4** in correct order)* [1]
relates order to voltage [1]

one relevant comment from: [1]

higher reactivity metals are the negative electrode / copper is least reactive because it is the positive electrode because copper would have the lowest voltage / copper cell V = 0 / the bigger the difference in reactivity, the bigger the voltage / zinc has highest voltage because it is most reactive / more reactive metals have higher voltage

Q# 26/ iGCSE Chemistry/2012/s/Paper 31/ Q5

(c) Na / Ca; [1]

(d) Cu; Ag; [2]
accept: *ions Cu^{2+} and Ag^+*

Q# 27/ iGCSE Chemistry/2011/s/Paper 31/

7 **(a)** metal A is magnesium [1]
cond most reactive or fastest reaction [1]

metal B is aluminium [1]
cond faster reaction after removal of oxide layer / it would give more hydrogen / aluminium more reactive than zinc [1]

metal C is zinc [1]
zinc least reactive [1]
NOTE MAX [5]
If you encounter different reasoning which is correct, please award the appropriate marks.

(b) for magnesium and zinc same volume of hydrogen [1]

because both have valency of 2 / 1 mole of metal gives 1 mole of hydrogen / 1 mole of metal reacts with 2 moles of acid [1]

bigger volume for aluminium because its valency is 3 / 1 mole of metal gives 1.5 moles of hydrogen / 1 mole of metal reacts with 3 moles of acid [1]

If you encounter different reasoning which is correct, please award the appropriate marks.

accept balanced equations
accept ionic charges as alternative to valency

Q# 28/ iGCSE Chemistry/2010/w/Paper 31/ Q2

(c) (i) tin(IV) oxide + carbon → tin + carbon dioxide [1]
not carbon monoxide as a reductant
accept carbon monoxide as a product
not tin(IV)
accept correct symbol equation

(ii) water [1]
carbon dioxide [1]

(iii) correct labels for
(pure) copper cathode [1]
impure copper anode [1]
electrolyte copper(II) sulfate / any soluble copper(II) salt / Cu^{2+} [1]
if labels on electrodes reversed [0]

(iv) wires / pipes / jewellery / nails / roofing / ammunition / coins / cookware / catalyst / sculpture [1]

Q# 29/ iGCSE Chemistry/2010/s/Paper 31/

7 (a) a transition element has more than one oxidation state or valency [1]
accept different oxidation states

(b) by removing oxygen concentration of O_2 decreases [1]
prevents the back reaction / equilibrium shifts to right [1]

(c) oxidation number reduced (from (+) 4 to 0) [1]
accept accepts electrons **or** accepts four electrons
if number given must be 4

Q# 30/ iGCSE Chemistry/2010/s/Paper 31/

3 (a) (i) bubbles / effervescence / hydrogen / gas pushes up / lifts metal [1]

(ii) does not react with acid / zinc and iron react with acid [1]
not just unreactive

Q# 31/ iGCSE Chemistry/2009/s/Paper 31/

4 **(i)** Cu and Pd [2]

(ii) Ba and La [2]

(iii) +2 **or** 2+ **or** Ba^{2+} [1]

(iv) Ba **or** La [1]

(v) it is a transition metal **or** a d block element [1]

Q# 32/ iGCSE Chemistry/2008/w/Paper 31/

6 **(a) (i)**

aqueous solution	tin Sn	manganese Mn	silver Ag	zinc Zn
tin(II) nitrate		R	NR	R
manganese(II) nitrate	NR		NR	NR
silver(I) nitrate	R	R		R
zinc nitrate	NR	R	NR	

[1] for each row [3]
ignore anything written in blank space

(ii) $Sn + 2Ag^+ \rightarrow Sn^{2+} + 2Ag$ [2]
all species correct [1]
accept equation with Sn^{4+}

(iii) Mn to Mn^{2+} need both species [1]
electron loss **or** oxidation number increases [1]

(iv) covered with oxide layer [1]
makes it unreactive **or** protects **or** aluminium oxide unreactive [1]

Q# 33/ iGCSE Chemistry/2007/w/Paper 3/ Q4

(c) (i) $Zn^{2+} + 2e = Zn$ [1]

(ii) $4OH^- - 4e = O_2 + 2H_2O$ [2]
or $4OH^- = O_2 + 2H_2O + 4e$
or $2H_2O = 4H^+ + O_2 + 4e$
or $2H_2O - 4e = 4H^+ + O_2$
oxygen as product [1]

(iii) sulphuric acid [1]
NOTE there are no alternative answers to the above

Q# 34/ iGCSE Chemistry/2008/s/Paper 31/

5 **(a) (i)** air would react (with the magnesium **or** titanium)
OR argon would not react (with the metals) [1]
NOT argon is inert

(ii) any metal higher than magnesium in reactivity series [1]

Q# 35/ iGCSE Chemistry/2012/s/Paper 31/

(b) (i) CuO **and** NO_2 **and** O_2; [1]
accept: names or correct formulae

(ii) $2NaNO_3 \rightarrow 2NaNO_2 + O_2$ [2]
accept: $NaNO_3 \rightarrow NaNO_2 + 1/2\ O_2$
not balanced = [1]

Q# 36/ iGCSE Chemistry/2011/w/Paper 31/

7 (a) (i) any Group 1 metal [1]
accept: LiOH

(ii) $Cu(OH)_2 \rightarrow CuO + H_2O$ [2]
note: products only = 1

(iii) reactivity of metals / metals have different reactivities [1]

(b) (i) zinc oxide, nitrogen dioxide, oxygen [2]
note: two correct = 1

(ii) $2KNO_3 \rightarrow 2KNO_2 + O_2$ [2]
note: unbalanced = 1, correct word equation = 1

Q# 37/ iGCSE Chemistry/2008/w/Paper 31/ 6 (b)

(ii) potassium hydroxide → no reaction [1]
calcium hydroxide → calcium oxide and water [1]
ACCEPT metal oxide

(iii) $2KNO_3 \rightarrow 2KNO_2 + O_2$ [2]
[1] for **formula** of either product

$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$ [2]
[1] for **formulae** of any **TWO** products

Q# 38/ iGCSE Chemistry/2014/s/Paper 31/

5 (a) M1: (zinc sulfide) heated / roasted / burnt in **air** (1)

M2: zinc oxide formed (1)

M3: zinc oxide **reduced** (1)

M4: (by adding) coke or carbon (1)

M5: Balanced equation (any one of) (1) [5]

$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$
$2ZnO + C \rightarrow 2Zn + CO_2$
$ZnO + C \rightarrow Zn + CO$
$ZnO + CO \rightarrow Zn + CO_2$

Q# 39/ iGCSE Chemistry/2011/s/Paper 31/

4 (a) (i) $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$ [2]
not balanced only [1]

(ii) **two** reagents from named metal(s) more reactive than zinc/carbon monoxide [2]
not hydrogen

(iii) they have different boiling points [1]
cadmium will distil first then zinc leaving lead/lead distilled last [1]

Q# 40/ iGCSE Chemistry/2009/w/Paper 3/

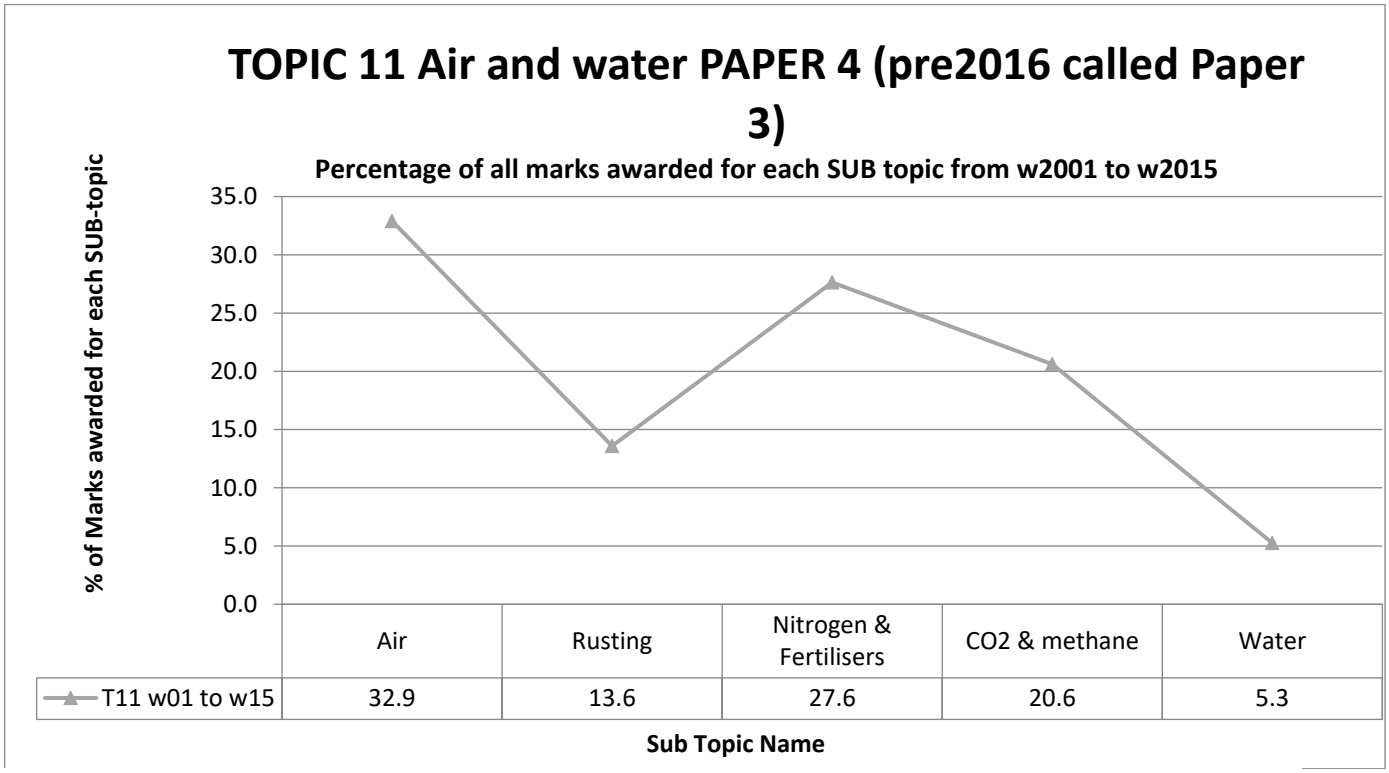
3 (a) (i) heat **or** roast **or** burn <u>in air</u> [1]
need both points for mark

(ii) $ZnO + C \rightarrow Zn + CO$ [2]
or $2ZnO + C \rightarrow 2Zn + CO_2$
unbalanced **ONLY** [1]

Q# 41/ iGCSE Chemistry/2007/w/Paper 3/ Q4 (b)

(ii) to get maximum yield of zinc **or** reduce all zinc oxide [1]
NOTE the above mark is awarded for why add excess carbon moves equilibrium to right **or** to favours the products **or** removes CO_2 from equilibrium [1]
NOTE this mark is awarded for how does the addition of excess carbon give max yield of zinc
NOTE Allow any coherent explanation flexibly based on the above ideas
EXAMPLES:
moves equilibrium to right [1] because carbon dioxide removed [1]
to get maximum yield of zinc [1] as equilibrium moves to right [1]
NOT just to make CO from CO_2

iG Chem 11 EQ P5 15w to 01w Air and Water Broken down by subtopic 124marks



11 Air and water

11.1 Water

Core

- Describe chemical tests for water using cobalt(II) chloride and copper(II) sulfate
- Describe, in outline, the treatment of the water supply in terms of filtration and chlorination
- Name some of the uses of water in industry and in the home

Supplement

- Discuss the implications of an inadequate supply of water, limited to safe water for drinking and water for irrigating crops

11.2 Air

Core

- State the composition of clean, dry air as being approximately 78% nitrogen, 21% oxygen and the remainder as being a mixture of noble gases and carbon dioxide
- Name the common pollutants in the air as being carbon monoxide, sulfur dioxide, oxides of nitrogen and lead compounds
- State the source of each of these pollutants:
  - carbon monoxide from the incomplete combustion of carbon-containing substances
  - sulfur dioxide from the combustion of fossil fuels which contain sulfur compounds (leading to 'acid rain')
  - oxides of nitrogen from car engines
  - lead compounds from leaded petrol
- State the adverse effect of these common pollutants on buildings and on health and discuss why these pollutants are of global concern
- State the conditions required for the rusting of iron
- Describe and explain methods of rust prevention, specifically paint and other coatings to exclude oxygen

Supplement

- Describe the separation of oxygen and nitrogen from liquid air by fractional distillation
- Describe and explain the presence of oxides of nitrogen in car engines and their catalytic removal
- Describe and explain sacrificial protection in terms of the reactivity series of metals and galvanising as a method of rust prevention

11.3 Nitrogen and fertilisers

Core

- Describe the need for nitrogen-, phosphorus- and potassium-containing fertilisers
- Describe the displacement of ammonia from its salts

Supplement

- Describe and explain the essential conditions for the manufacture of ammonia by the Haber process including the sources of the hydrogen and nitrogen, i.e. hydrocarbons or steam and air

11.4 Carbon dioxide and methane

Core

- State that carbon dioxide and methane are greenhouse gases and explain how they may contribute to climate change
- State the formation of carbon dioxide:
  - as a product of complete combustion of carbon-containing substances
  - as a product of respiration
  - as a product of the reaction between an acid and a carbonate
  - from the thermal decomposition of a carbonate
- State the sources of methane, including decomposition of vegetation and waste gases from digestion in animals

Supplement

- Describe the carbon cycle, in simple terms, to include the processes of combustion, respiration and photosynthesis

Topic Chem 11 SubTopic: Air **Q# 1/** iGCSE Chemistry/2009/w/Paper 3/

1 **(a)** The major gases in unpolluted air are 79% nitrogen and 20% oxygen.

(i) Name another gaseous element in unpolluted air.

..... [1]

(ii) Name **two** compounds in unpolluted air.

..... [2]

Topic Chem 11 SubTopic: Air **Q# 2/** iGCSE Chemistry/2009/w/Paper 3/ Q4

(c) It is now known that the smell of the seaside is due to the chemical dimethyl sulfide, $(CH_3)_2S$.

(ii) Name the **three** compounds formed when dimethyl sulfide is burnt in excess oxygen.

.....

.....

..... [2]

Topic Chem 11 SubTopic: Air **Q# 3/** iGCSE Chemistry/2009/w/Paper 3/ QiGCSE Chemistry/201

(b) Two common pollutants in air are carbon monoxide and the oxides of nitrogen.

(i) Name another pollutant in air.

..... [1]

(ii) Describe how carbon monoxide is formed.

.....

.....

..... [2]

(iii) How are the oxides of nitrogen formed?

.....

.....

..... [2]

(iv) Explain how a catalytic converter reduces the emission of these two gases.

.....

.....

..... [2]

Topic Chem 11 SubTopic: Air **Q# 4/** iGCSE Chemistry/2010/s/Paper 31/ Q2

(ii) Chloromethane is formed when seaweed decomposes. Name the compounds in the environment from which seaweed might have obtained the following elements:

carbon; .....

hydrogen; .....

chlorine. ..... [3]

Topic Chem 11 SubTopic: Air **Q# 5/** iGCSE Chemistry/2010/s/Paper 31/ Q2

(iv) The oxides of nitrogen are atmospheric pollutants. Describe how they are formed.

.....

.....

..... [2]

(v) Complete the equation for the decomposition of ozone.

..... O_3 → .....

[2]

Topic Chem 11 SubTopic: Air **Q# 6/** iGCSE Chemistry/2011/w/Paper 31/

1 This question is concerned with the following oxides.

sulfur dioxide
carbon monoxide
lithium oxide
aluminium oxide
nitrogen dioxide
strontium oxide

(b) Two of the oxides are responsible for acid rain.
Identify the **two** oxides and explain their presence in the atmosphere.

.....

.....

.....

.....

..... [5]

Topic Chem 11 SubTopic: Air **Q# 7/** iGCSE Chemistry/2012/s/Paper 31/Q1

(c) (i) Explain how acid rain is formed.

.....

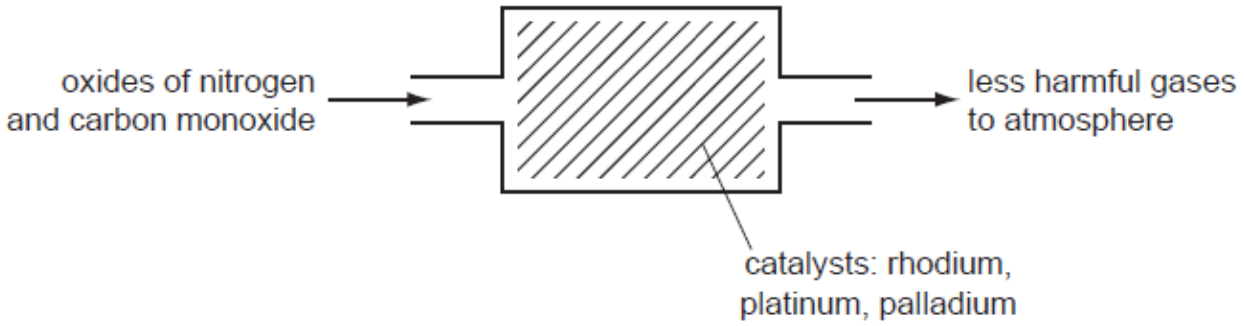
.....

.....

..... [4]

Topic Chem 11 SubTopic: Air **Q# 8/** iGCSE Chemistry/2012/w/Paper 31/ Q3

(c) Catalytic converters reduce the pollution from motor vehicles.



(i) Describe how carbon monoxide and the oxides of nitrogen are formed in car engines.

.....

.....

.....

..... [4]

(ii) Describe the reaction(s) inside the catalytic converter which change these pollutants into less harmful gases. Include at least one equation in your description.

.....

.....

..... [3]

Topic Chem 11 SubTopic: Air **Q# 9/** iGCSE Chemistry/2014/w/Paper 31/

5 Three common pollutants in the air are carbon monoxide, the oxides of nitrogen, NO and NO_2, and unburnt hydrocarbons. They are all emitted by motor vehicles.

(a) Describe how the oxides of nitrogen are formed.

.....

..... [2]

(b) Describe how a catalytic converter reduces the emission of these three pollutants.

.....

.....

.....

.....

..... [4]

(c) Other atmospheric pollutants are lead compounds from leaded petrol.
Explain why lead compounds are harmful.

.....

..... [1]

Topic Chem 11 SubTopic: Air **Q# 10/** iGCSE Chemistry/2015/s/Paper 31/Q1

(c) Sulfur, present in coal, is one major cause of acid rain. Sulfur burns to form sulfur dioxide which reacts with rain water to form sulfuric acid.

(i) Describe how the high temperatures in vehicle engines are another cause of acid rain.

.....

.....

..... [3]

(ii) Give **two** harmful effects of acid rain.

.....

..... [2]

Topic Chem 11 SubTopic: Air **Q# 11/** iGCSE Chemistry/2015/w/Paper 31/

2 Describe how to separate the following. In each example, give a description of the procedure used and explain why this method works.

(b) Nitrogen from a mixture of nitrogen and oxygen.

procedure .....

.....

explanation .....

.....

[3]

Topic Chem 11 SubTopic: Carbon cycle **Q# 12/** iGCSE Chemistry/2009/s/Paper 31/ Q4

(b) Explain the role of chlorophyll in green plants.

.....

.....

.....

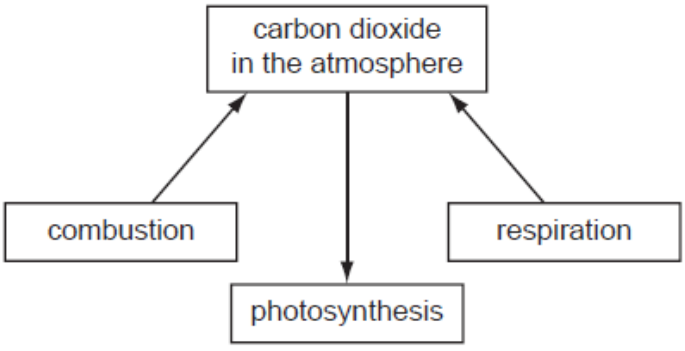
.....

.....

..... [3]

Topic Chem 11 SubTopic: Carbon cycle **Q# 13/** iGCSE Chemistry/2010/w/Paper 31/

7 The diagram shows part of the carbon cycle. This includes some of the processes which determine the percentage of carbon dioxide in the atmosphere.



(i) Carbon dioxide is one greenhouse gas. Name another one.

..... [1]

(ii) Explain the term *respiration* and how this process increases the percentage of carbon dioxide in the atmosphere.

.....

.....

..... [3]

(iii) Explain why the combustion of waste crop material should not alter the percentage of carbon dioxide in the atmosphere.

.....

..... [2]

(iv) In 1960 the percentage of carbon dioxide in the atmosphere was 0.032% and in 2008 it was 0.038%. Suggest an explanation for this increase.

.....

..... [2]

Topic Chem 11 SubTopic: Carbon cycle **Q# 14/** iGCSE Chemistry/2011/s/Paper 31/

2 Selenium and sulfur are in Group VI. They have similar properties.

(a) One of the main uses of selenium is in photoelectric cells. These cells can change light into electrical energy.

(i) Name a process which can change light into chemical energy.

.....

Topic Chem 11 SubTopic: Carbon cycle **Q# 15/** iGCSE Chemistry/2011/w/Paper 31/

2 Two important greenhouse gases are methane and carbon dioxide.

(a) Methane is twenty times more effective as a greenhouse gas than carbon dioxide. The methane in the atmosphere comes from both natural and industrial sources.

(i) Describe **two** natural sources of methane.

.....

..... [2]

(ii) Although methane can persist in the atmosphere for up to 15 years, it is eventually removed by oxidation.
What are the products of this oxidation?

..... [2]

(b) How do the processes of respiration, combustion and photosynthesis determine the percentage of carbon dioxide in the atmosphere?

.....

.....

.....

..... [4]

Topic Chem 11 SubTopic: Carbon cycle **Q# 16/** iGCSE Chemistry/2015/s/Paper 31/

1 **(a)** Coal is a solid fossil fuel.

Name **two** other fossil fuels.

..... [2]

(b) Two of the elements present in a sample of coal are carbon and sulfur.

A sample of coal was heated in the absence of air and the products included water, ammonia and hydrocarbons.

Name **three** other elements present in this sample of coal.

..... [2]

(d) In 2010, a large coal-burning power station in the UK was converted to burn both coal and wood.

Explain why the combustion of wood rather than coal can reduce the effect of the emissions from this power station on the level of carbon dioxide in the atmosphere.

.....

.....

.....

..... [3]

Topic Chem 11 SubTopic: Nitrogen and fertilisers **Q# 17/** iGCSE Chemistry/2010/w/Paper 31/ Q4

(b) Ammonia is made by the Haber Process.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ forward reaction is exothermic

The percentage of ammonia in the equilibrium mixture varies with conditions.

pressure / atmospheres	100	200	300	400
% ammonia at 300 °C	45	65	72	78
% ammonia at 500 °C	9	18	25	31

The conditions actually used are 200 atmospheres, 450 °C and an iron catalyst.

(i) The original catalyst was platinum. Suggest a reason why it was changed to iron.

..... [1]

(ii) Explain why the highest pressure gives the highest percentage of ammonia in the equilibrium mixture.

.....

..... [2]

(iii) What happens to the unreacted nitrogen and hydrogen?

.....

..... [1]

(iv) State **one** advantage and **one** disadvantage of using a lower temperature.

advantage .....

..... [1]

disadvantage .....

..... [1]

Topic Chem 11 SubTopic: Nitrogen and fertilisers **Q# 18/** iGCSE Chemistry/2013/s/Paper 31/ Q6

(b) Ammonia is manufactured by the Haber Process. The economics of this process require that as much ammonia as possible is made as quickly as possible.
Explain how this can be done using the following information.

The conditions for the following reversible reaction are:

- 450 °C
- 200 atmospheres pressure
- iron catalyst

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ the reaction is exothermic

.....

.....

.....

.....

.....

..... [5]

3 Ammonia is manufactured by the Haber process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

The forward reaction is exothermic.

(a) Describe how the reactants are obtained.

(i) Nitrogen

.....

..... [2]

(ii) Hydrogen

.....

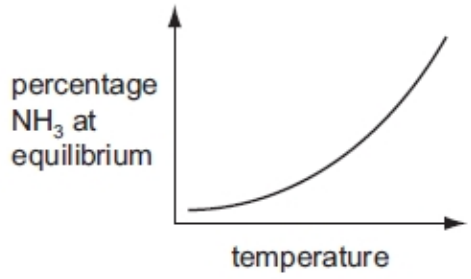
.....

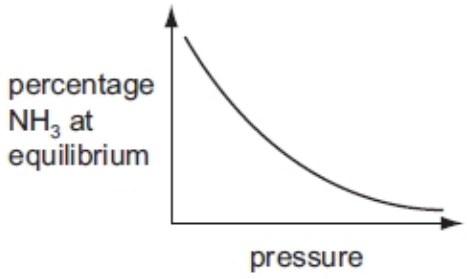
..... [3]

(b) The percentage of ammonia in the equilibrium mixture varies with temperature and pressure.

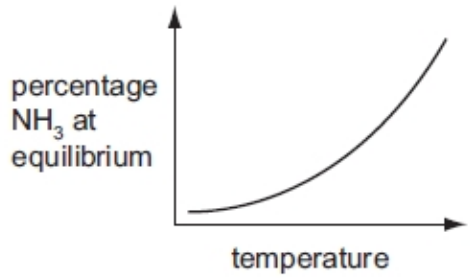
(i) Which pair of graphs, **A**, **B** or **C**, shows correctly how the percentage of ammonia at equilibrium varies with temperature and pressure?

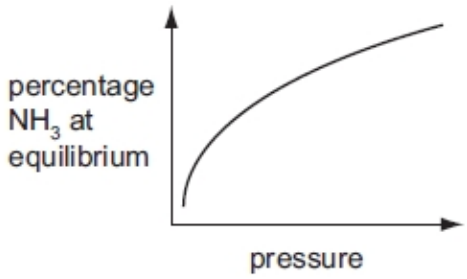
pair **A**



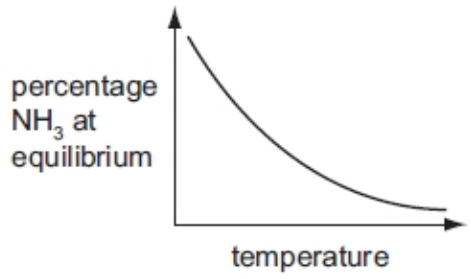


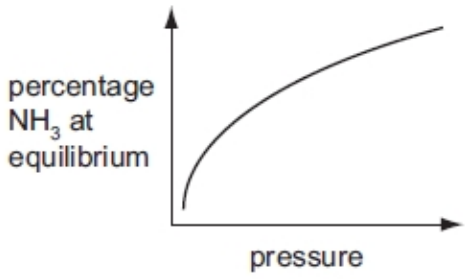
pair **B**





pair **C**





The pair with **both graphs correct** is ..... [1]

(ii) Give a full explanation of why the pair of graphs you have chosen in **(i)** is correct.

.....

.....

.....

.....

.....

.....

..... [6]

(iii) Catalysts do not alter the position of equilibrium. Explain why a catalyst is used in this process.

.....

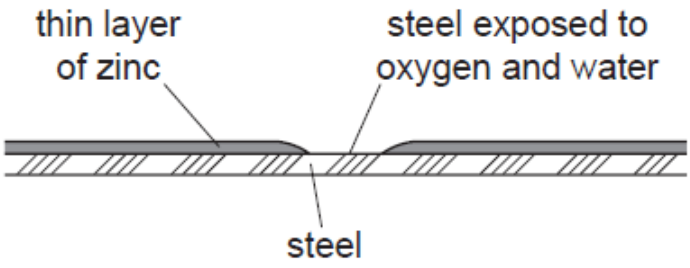
.....

.....

..... [2]

Topic Chem 11 SubTopic: Rusting **Q# 20/** iGCSE Chemistry/2009/w/Paper 3/ Q3

(b) A major use of zinc is galvanizing; steel objects are coated with a thin layer of zinc. This protects the steel from rusting even when the layer of zinc is broken.



Explain, by mentioning ions and electrons, why the exposed steel does not rust.

.....

.....

.....

.....

.....

..... [3]

Topic Chem 11 SubTopic: Rusting **Q# 21/** iGCSE Chemistry/2013/s/Paper 31/ Q6

(e) Hydrazine is a weak base and it removes dissolved oxygen from water. It is added to water in steel boilers to prevent rusting.

(i) One way it reduces the rate of rusting is by changing the pH of water.
What effect would hydrazine have on the pH of water?

..... [1]

(ii) Give a reason, other than pH, why hydrazine reduces the rate of rusting.

..... [1]

Topic Chem 11 SubTopic: Rusting **Q# 22/** iGCSE Chemistry/2014/w/Paper 31/ Q4

(c) Iron and steel rust. Iron is oxidised to hydrated iron(III) oxide, $Fe_2O_3.2H_2O$, which is rust.

(i) Name the **two** substances which cause iron to rust.

..... [1]

(ii) Explain why an aluminium article coated with aluminium oxide is protected from further corrosion but a steel article coated with rust continues to corrode.

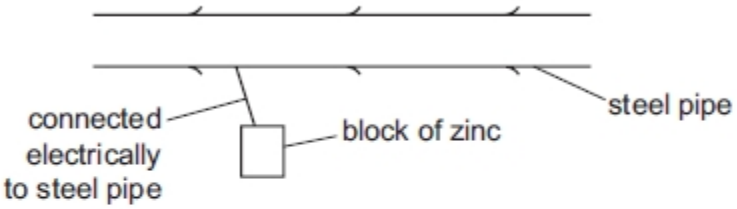
.....

..... [1]

(d) There are two electrochemical methods of rust prevention.

(i) The first method is sacrificial protection.

Explain why the steel article does not rust.



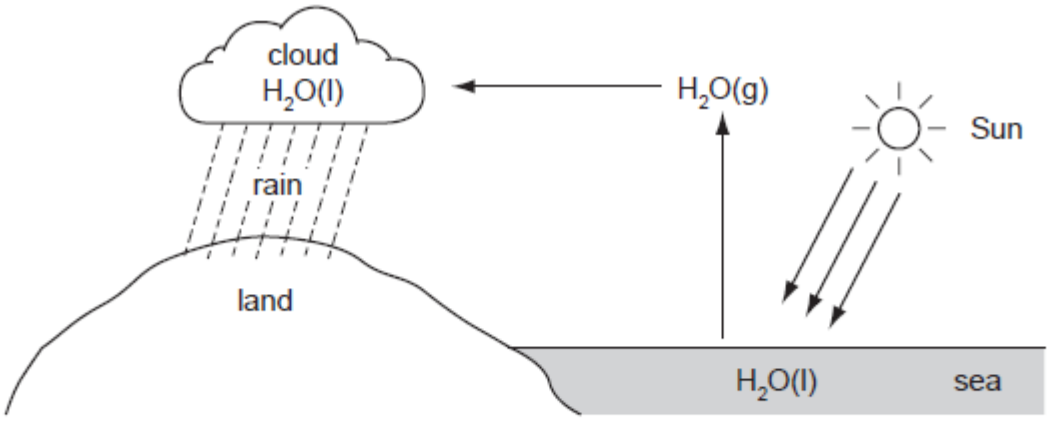
.....

.....

.....

..... [4]

1 The diagram below shows part of the Water Cycle.



(a) (i) State the name of each of the following changes of state.

$$H_2O(l) \rightarrow H_2O(g)$$

name .....

$$H_2O(g) \rightarrow H_2O(l)$$

name .....

[2]

(ii) Which **one** of the above changes of state is exothermic? Explain your choice.

.....

..... [1]

(b) The rain drains into rivers and then into reservoirs. Describe how water is treated before it enters the water supply.

.....

..... [2]

2 (a) Water is needed for industry and in the home.

(i) Rain water is collected in reservoirs. How is it treated before entering the water supply?

.....

..... [2]

(ii) State **two** industrial uses of water.

.....

..... [2]

(iii) State **two** uses of water in the home.

.....

[2]

Mark Scheme iG Chem 11 EQ P5 15w to 01w Air and Water

Q# 1/ iGCSE Chemistry/2009/w/Paper 3/

1 (a) (i) argon **or** krypton **or** helium [1]
Accept xenon and radon even though percentages are very small
NOT hydrogen

(ii) water and carbon dioxide [2]

Q# 2/ iGCSE Chemistry/2009/w/Paper 3/ 4 (c)

(ii) water
carbon dioxide
sulfur dioxide
all **three** [2]
any **two** [1]
Accept correct formulae

Q# 3/ iGCSE Chemistry/2009/w/Paper 3/ QiGCSE Chemistry/201

(b) (i) sulfur dioxide **or** lead compounds **or** CFCs **or** methane **or** particulates
or unburnt hydrocarbons **or** ozone etc. [1]

(ii) incomplete combustion [1]
of a fossil fuel **or** a named fuel **or** a fuel that contains carbon [1]

(iii) at high temperature **or** inside engine [1]
nitrogen and oxygen (from the air) react [1]

(iv) it changes carbon monoxide to carbon dioxide [1]
oxides of nitrogen to nitrogen [1]

OR symbol **or** word equation of the type:
$2NO + 2CO \rightarrow CO_2 + N_2$ [2]

OR a redox explanation – the oxides of nitrogen oxidise carbon monoxide to carbon dioxide, [1]
they are reduced to nitrogen [1]

OR $2NO \rightarrow N_2 + O_2$ [1]
$2CO + O_2 \rightarrow 2CO_2$ [1]

Q# 4/ iGCSE Chemistry/2010/s/Paper 31/ Q2

(ii) carbon dioxide / calcium carbonate [1]
not methane
water [1]
sodium chloride / brine / seawater [1]

Q# 5/ iGCSE Chemistry/2010/s/Paper 31/ Q2

(iv) oxygen and nitrogen (in air) [1]
not from fuel, negates mark 1
(react) at high temperatures / lightning / in engine [1]
not combustion or exhaust, negates mark 2

(v) $2O_3 \rightarrow 3O_2$ [2]
not balanced = [1]

Q# 6/ iGCSE Chemistry/2011/w/Paper 31/ QiGCSE Chemistry/201

(b) sulfur dioxide [1]
burn (fossil) fuel containing sulfur / volcanoes [1]
nitrogen dioxide [1]
reaction of nitrogen and oxygen [1]
high temperatures / in car engine [1]
not: exhaust

Q# 7/ iGCSE Chemistry/2012/s/Paper 31/

(c) (i) combustion of fossil fuels; [1]
(which contain) sulfur; [1]
sulfur dioxide formed; [1]
(reacts in air / with water to form) **sulfurous / sulfuric acid**; [1]
OR
nitrogen and oxygen in air; [1]
react at high temperatures / in engines; [1]
to form oxides of nitrogen **or** named oxide of nitrogen; [1]
(reacts in air / with water to form) nitrous / nitric acid; [1]
[max 4]

Q# 8/ iGCSE Chemistry/2012/w/Paper 31/ Q3

(c) (i) carbon monoxide-incomplete combustion; [1]
carbon - containing fuel / fossil fuel / petrol; [1]

oxides of nitrogen - oxygen and nitrogen react; [1]
at high temperature / in engine; [1]
not: in exhaust

(ii) carbon monoxide to carbon dioxide; [1]
oxides of nitrogen to nitrogen; [1]
correct balanced equation; [1]

Q# 9/ iGCSE Chemistry/2014/w/Paper 31/

5 (a) nitrogen and oxygen react [1]
at high temperatures (in engine) [1]

(b) M1 carbon monoxide (converted to) carbon dioxide **or** $2CO + O_2 \rightarrow 2CO_2$ [1]

M2 (by) oxides of nitrogen (which are reduced to) nitrogen
or $2NO \rightarrow N_2 + O_2$ **or** $2NO_2 \rightarrow N_2 + 2O_2$ [1]

M3 hydrocarbons (burn) making water [1]

M4 products: any **two** from:
carbon dioxide, water, nitrogen [1]

(c) lead compounds are toxic **or** brain damage **or** reduce IQ or nausea or kidney failure **or** anaemia [1]

Q# 10/ iGCSE Chemistry/2015/s/Paper 31/

1(c)(i)	M1 oxygen and nitrogen (from air) react;		**A** nitrogen combust for M1 **R** M1 if oxygen or nitrogen originate from the fuel
	M2 oxides of nitrogen **OR** nitrogen oxide(s) are formed;		**A** named oxide of nitrogen e.g. nitrogen dioxide **A** correct formulae **A** NO_x
	M3 nitrogen oxides formed react with water (to form acid);	3	

1(c)(ii)	*Any **two** from:* M1 lowers pH or acidifies lakes/rivers or kills fish; M2 changes composition of soils or reduces fertility of soil or reduces crop yields deforestation or kills crops/trees/plants/leaves; M3 attacks (limestone) buildings or statues; M4 attacks metal (structures)/bridges;	3	**R** 'global warming/greenhouse effect' **R** 'increases pH of lakes so kills fish' for M1 **A** removes nutrients/leaches the soil **A** alternative words for 'attacks' e.g. damages/reacts with/corrode/erode for M3 and M4 **I** rusting but **A** 'enhances rusting' for M4 **I** toxicity to humans

Q# 11/ iGCSE Chemistry/2015/w/Paper 31/

2(b)	diffusion (through a membrane); nitrogen diffuses faster; because it has the smaller M_r; **or** (turn into) liquid; (fractional) distillation; different boiling points; **or** burn a named substance to make non-gaseous product; oxygen reacts/nitrogen does not react; name of product of combustion;	3

Q# 12/ iGCSE Chemistry/2009/s/Paper 31/

(b) catalyst
photosynthesis **or** chloroplasts
photochemical reaction **or** needs light
carbon dioxide + water form
glucose **or** starch **or** oxygen **NOT** sugar
Any **THREE** correct points ignore incorrect answers [3]

Q# 13/ iGCSE Chemistry/2010/w/Paper 31/

7 **(i)** methane / water vapour / oxides of nitrogen / hydrofluorocarbons / perfluorocarbons / ozone [1]
not sulfur dioxide

(ii) living organisms / plants and animals / cells [1]
produce energy (from food / glucose / carbohydrates) [1]
this forms carbon dioxide (could be in an equation) [1]

(iii) when growing the crop removed carbon dioxide from atmosphere [1]
/ crop photosynthesised and used carbon dioxide
combustion returned the carbon dioxide [1]

(iv) increased combustion [1]
of fossil fuels / named fossil fuel [1]

or deforestation [1]
less photosynthesis [1]
not greater population

[Total: 8]

Q# 14/ iGCSE Chemistry/2011/s/Paper 31/

2 **(a)** **(i)** photosynthesis or a photochemical reaction [1]
not an example, question requires a process
not devices which convert light into electricity

Q# 15/ iGCSE Chemistry/2011/w/Paper 31/

2 (a) (i) (waste gases) from animals [1]
decaying vegetation / anaerobic decay [1]
accept: decomposition of organic material / natural gas

(ii) carbon dioxide [1]
water [1]

(b) photosynthesis removes carbon dioxide from the atmosphere [1]
both respiration and combustion produce carbon dioxide [1]
any **two** of the following: [2]
plants photosynthesis changes carbon dioxide into carbohydrates
(burning) of fossil fuels / named fuel / petrol / alkanes
respiration by living organisms to obtain energy from
carbon–containing compounds
comment that the balance between these processes determines the percentage of carbon dioxide

Q# 16/ iGCSE Chemistry/2015/s/Paper 31/

1(a)	*Any **two** fossil fuels from:* crude oil / petroleum; natural gas / methane; petrol / gasoline; kerosene / paraffin; diesel (oil) / gas oil; fuel oil; refinery gas / LPG; propane; butane;	2	**I** ethane / oil / naphtha / coal / gas **R** coke / bitumen / lubricating oil / wood
1(b)	hydrogen, oxygen, nitrogen; *All three for 2 marks* *two for 1 mark*	2	**A** H, O, N **I** H_2, O_2, N_2
1(d)	*Any **three** from:* M1 wood burns to produce (less) carbon dioxide; M2 trees (wood) take in carbon dioxide; M3 by photosynthesis; M4 wood is carbon neutral fuel;	3	

Q# 17/ iGCSE Chemistry/2010/w/Paper 31/ Q4

(b) (i) expensive metal / iron cheaper / better catalyst [1]

(ii) high pressure favours side with smaller volume / fewer moles [1]
this is right hand side / product / ammonia side [1]

(iii) recycled / sent over catalyst again [1]
accept used again

(iv) advantage high yield [1]
disadvantage slow reaction rate etc [1]

Q# 18/ iGCSE Chemistry/2013/s/Paper 31/ Q6

(b) any five from:

- high pressure favours lower volume side / movement to right / ammonia side, **or** high pressure increases the yield
- high pressure increases rate
- low temperature favours exothermic reaction / increases yield / favours the forward reaction
- low temperature gives low rate or vice versa
- catalyst increases rate or lowers activation energy
- 450 °C low enough to give an economic yield but with catalyst gives a fast enough rate
  note need whole concept to get this compromise temperature point [5]

Q# 19/ iGCSE Chemistry/2013/w/Paper 31/

3 (a) (i) fractional distillation [1]
(liquid) air [1]

(ii) cracking / heat in presence of catalyst [1]
of alkane / petroleum [1]
to give an alkene and hydrogen [1]

OR: electrolysis (1)
named electrolyte (1)
hydrogen at cathode (1)

OR: from methane (1)
react water / steam (1)
heat catalyst (1)
only **ACCEPT:** water with methane **or** electrolysis

(b) (i) the pair with both graphs correct is C [1]
NOTE: mark **(b)(ii)** independent of **(b)(i)**

(ii) high pressure favours side with lower volume / fewer moles [1]
this is RHS / product / ammonia [1]
%NH_3 / yield increases as pressure increases [1]

the forward reaction is exothermic [1]
exothermic reactions favoured by low temperatures [1]
%NH_3 / yield decreases as temperature increases [1]
ACCEPT: reverse arguments

(iii) increases reaction rate [1]
ACCEPT: reduces activation energy [1]
OR: decreases the amount of energy particles need to react
OR: economic rate at lower temperature so higher yield

Q# 20/ iGCSE Chemistry/2009/w/Paper 3/ Q3

(b) zinc is more reactive [1]
it loses electrons and forms ions in preference to iron [1]
zinc corrodes not iron [1]
NOT zinc rusts

OR zinc loses electrons and forms ions [1]
the electrons move on to the iron [1]
the iron cannot be oxidised **or** it cannot rust **or** it cannot lose electrons [1]
CREDIT correct Chemistry that includes the above ideas

Q# 21/ iGCSE Chemistry/2013/s/Paper 31/ Q6

(e) (i) pH increases [1]

(ii) oxygen needed for rusting / removes oxygen / reacts with oxygen [1]

Q# 22/ iGCSE Chemistry/2014/w/Paper 31/ Q4

(c) (i) air/oxygen and water (need both) [1]

(ii) aluminium oxide layer is impervious **or** non-porous **or** passive **or** unreactive **or** will not allow water/air to pass through it (rust allows passage of water **or** air **or** it flakes off) [1]

(d) (i) zinc more reactive (than iron/steel) [1]
loses electrons [1]
electrons move (from zinc) to iron [1]
Zinc reacts (with air and water) **or** zinc corrodes **or** zinc is oxidised **or** zinc is anodic **or** zinc forms positive ions **or** zinc forms Zn^{2+} **or** iron and steel don't react with air/water **or** iron and steel are not oxidised **or** iron and steel do not form ions **or** iron and steel do not lose electrons **or** iron and steel are cathodic [1]

Q# 23/ iGCSE Chemistry/2012/s/Paper 31/

1 (a) (i) evaporation / boiling / vaporisation / evaporate / vaporise; [1]
condensation / liquefaction / condense / liquefy; [1]

(ii) condensation **accept:** correct equation $H_2O_{(g)} \rightarrow H_2O_{(l)}$
because energy / heat is given out / gas has more energy than liquid / need to supply energy to change liquid to gas so reverse must give out energy / bonds form; [1]

(b) chlorination / chlorine to kill microbes; [1]

filtration or filter; [1]
accept: sedimentation or sand or gravel or grit

Q# 24/ iGCSE Chemistry/2014/s/Paper 31/

2 (a) (i) filtration (1)

chlorination (1) [2]

(ii) Any **two** from: [2]
- manufacture of ethanol
- used in the manufacture of sulfuric acid **or** in the Contact process
- manufacture of hydrogen **or** ammonia **or** for the Haber process

(iii) Any **two** from: [2]
- cooking
- washing or laundry
- drinking
- toilets
- watering plants
- (domestic) heating

12 Sulfur

12.1 Sulfur

Core

- Name some sources of sulfur
- Name the use of sulfur in the manufacture of sulfuric acid
- State the uses of sulfur dioxide as a bleach in the manufacture of wood pulp for paper and as a food preservative (by killing bacteria)

Supplement

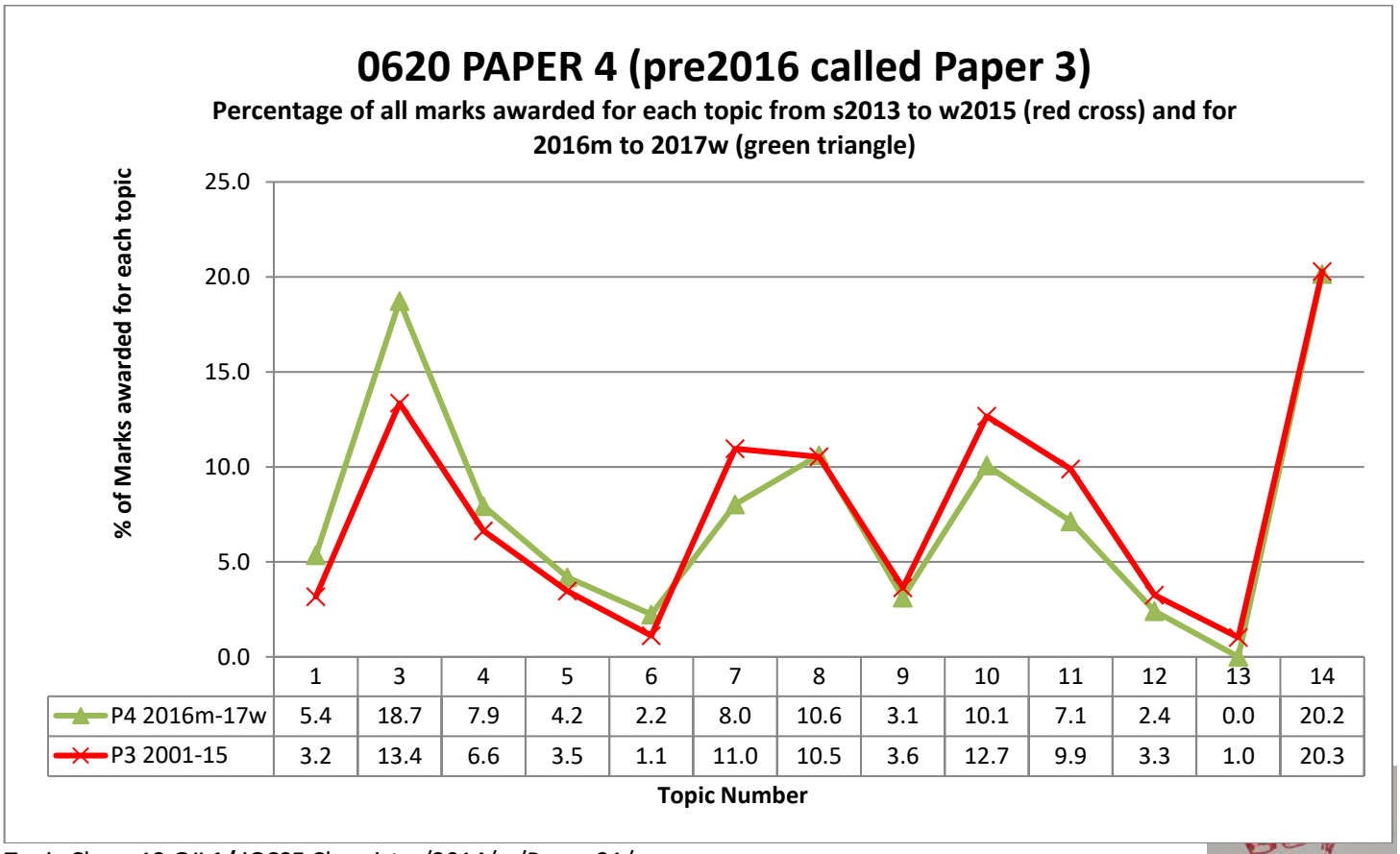
- Describe the manufacture of sulfuric acid by the Contact process, including essential conditions and reactions
- Describe the properties and uses of dilute and concentrated sulfuric acid

13 Carbonates

13.1 Carbonates

Core

- Describe the manufacture of lime (calcium oxide) from calcium carbonate (limestone) in terms of thermal decomposition
- Name some uses of lime and slaked lime such as in treating acidic soil and neutralising acidic industrial waste products, e.g. flue gas desulfurisation
- Name the uses of calcium carbonate in the manufacture of iron and cement



	1	3	4	5	6	7	8	9	10	11	12	13	14
P4 2016m-17w	5.4	18.7	7.9	4.2	2.2	8.0	10.6	3.1	10.1	7.1	2.4	0.0	20.2
P3 2001-15	3.2	13.4	6.6	3.5	1.1	11.0	10.5	3.6	12.7	9.9	3.3	1.0	20.3

Topic Chem 12 **Q# 1/** iGCSE Chemistry/2014/w/Paper 31/

3 The main use of sulfur dioxide is the manufacture of sulfuric acid.

(a) State **two** other uses of sulfur dioxide.

.....

..... [2]

(b) One source of sulfur dioxide is burning sulfur in air.
Describe how sulfur dioxide can be made from the ore zinc sulfide.

.....

..... [2]

(c) The Contact process changes sulfur dioxide into sulfur trioxide.

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
the forward reaction is exothermic
temperature 400 to 450 °C
low pressure 1 to 10 atmospheres
catalyst vanadium(V) oxide

(i) What is the formula of vanadium(V) oxide?

..... [1]

(ii) Vanadium(V) oxide is an efficient catalyst at any temperature in the range 400 to 450 °C.
Scientists are looking for an alternative catalyst which is efficient at 300 °C.
What would be the advantage of using a lower temperature?

.....

.....

..... [2]

(iii) The process does not use a high pressure because of the extra expense.
Suggest **two** advantages of using a high pressure?
Explain your suggestions.

.....

.....

.....

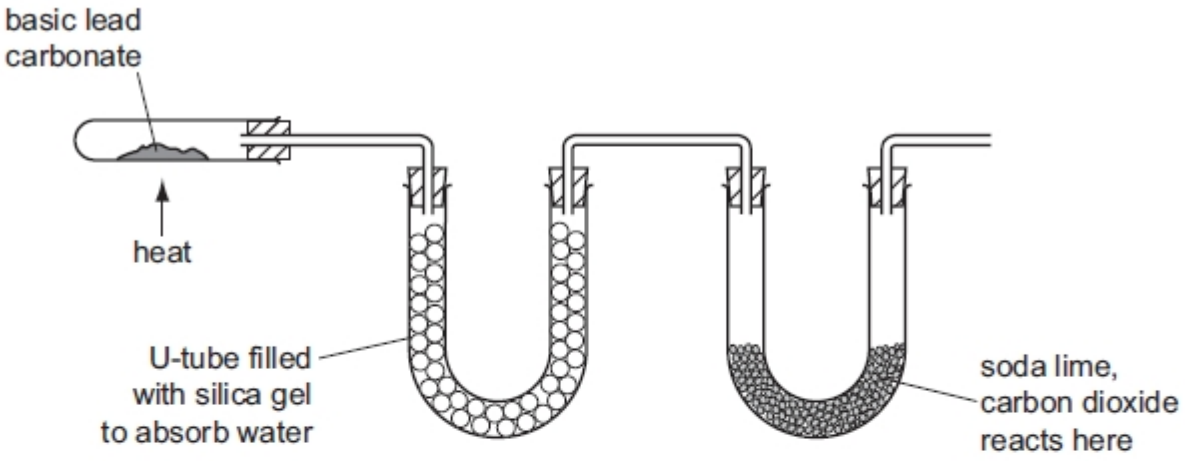
.....

..... [4]

(d) Sulfuric acid is made by dissolving sulfur trioxide in concentrated sulfuric acid to form oleum.
Water is reacted with oleum to form more sulfuric acid.
Why is sulfur trioxide not reacted directly with water?

..... [1]

(b) Basic lead(II) carbonate is heated in the apparatus shown below. Water and carbon dioxide are produced.



(i) Silica gel absorbs water. Silica gel often contains anhydrous cobalt(II) chloride. When this absorbs water it changes from blue to pink.
Suggest a reason.

..... [1]

(ii) Soda lime is a mixture of sodium hydroxide and calcium oxide. Why do these two substances react with carbon dioxide?

.....

..... [2]

(iii) Name **two** substances formed when soda lime reacts with carbon dioxide.

..... [2]

(b) Sulfur dioxide is used to make sulfur trioxide in the Contact Process.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The forward reaction is exothermic. The conditions used are:

temperature: 450 °C
pressure: 2 atmospheres
catalyst: vanadium(V) oxide

Explain, mentioning both position of equilibrium and rate, why these conditions give the most economic yield.

.....

.....

.....

..... [4]

Topic Chem 12 **Q# 4/** iGCSE Chemistry/2009/w/Paper 3/

6 **(a)** Sulfuric acid is made by the Contact process.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

This is carried out in the presence of a catalyst at 450 °C and 2 atmospheres pressure.

(i) How is the sulfur dioxide made?

.....

..... [1]

(ii) Give another use of sulfur dioxide.

..... [1]

(iii) Name the catalyst used.

..... [1]

(iv) If the temperature is decreased to 300 °C, the yield of sulfur trioxide increases. Explain why this lower temperature is not used.

.....

..... [1]

(v) Sulfur trioxide is dissolved in concentrated sulfuric acid. This is added to water to make more sulfuric acid. Why is sulfur trioxide not added directly to water?

.....

..... [1]

Topic Chem 12 **Q# 5/** iGCSE Chemistry/2008/s/Paper 31/

1 For each of the following select an element from Period 4, potassium to krypton, that matches the description.

(g) One of its oxides is the catalyst in the Contact Process. .....

Topic Chem 12 **Q# 6/** iGCSE Chemistry/2007/w/Paper 3/

4 Zinc is extracted from zinc blende, ZnS.

(a) Zinc blende is heated in air to give zinc oxide and sulphur dioxide. Most of the sulphur dioxide is used to make sulphur trioxide. This is used to manufacture sulphuric acid. Some of the acid is used in the plant, but most of it is used to make fertilisers.

(i) Give another use of sulphur dioxide.

..... [1]

(ii) Describe how sulphur dioxide is converted into sulphur trioxide.

.....

.....

..... [3]

(iii) Name a fertiliser made from sulphuric acid.

..... [1]

Topic Chem 12 **Q# 7/** iGCSE Chemistry/2006/s/Paper 3/ Q5 (b)

(iii) Explain, mentioning both rate and percentage yield, why the temperature used in the Contact process is 450°C.

.....

..... [2]

(iv) Describe how the sulphur trioxide is changed into concentrated sulphuric acid.

.....

..... [2]

Topic Chem 12 **Q# 8/** iGCSE Chemistry/2006/s/Paper 3/

5 Sulphuric acid is made by the Contact process in the following sequence of reactions.

sulphur → sulphur dioxide → sulphur trioxide → sulphuric acid

(a) (i) How is sulphur dioxide made from sulphur?

..... [1]

(ii) Sulphur dioxide has other uses.
Why is it used in the manufacture of paper?

..... [1]

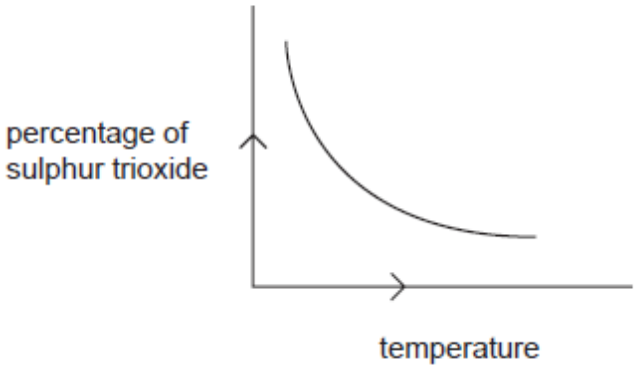
(iii) How does it preserve food?

..... [1]

(b) The equation for a stage of the Contact process is

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

The percentage of sulphur trioxide in the equilibrium mixture varies with temperature.



(i) How does the percentage of sulphur trioxide in the equilibrium mixture vary as the temperature increases? Circle the correct answer.

increases **stays the same** **decreases**

[1]

(ii) Is the forward reaction in the equilibrium $2SO_2 + O_2 \rightleftharpoons 2SO_3$ exothermic or endothermic? Give a reason for your choice.

.....

..... [2]

Topic Chem 12 **Q# 9/** iGCSE Chemistry/2005/s/Paper 3/Q4

(c) Sulphuric acid is manufactured by the Contact Process. Sulphur dioxide is oxidised to sulphur trioxide by oxygen.

$$2SO_2 + O_2 \longrightarrow 2SO_3$$

(i) Name the catalyst used in this reaction.

..... [1]

(ii) What temperature is used for this reaction?

..... [1]

(iii) Describe how sulphur trioxide is changed into sulphuric acid.

.....

..... [2]

4 The Carlsbad caverns in New Mexico are very large underground caves. Although the walls of these caves are coated with gypsum (hydrated calcium sulphate), the caves have been formed in limestone.

(a) It is believed that the caves were formed by sulphuric acid reacting with the limestone.

(i) Complete the word equation.

calcium carbonate + sulphuric acid → calcium sulphate + ... + ...

[1]

(ii) Describe how you could test the water entering the cave to show that it contained sulphate ions.

test .....

result ..... [2]

(iii) How could you show that the water entering the cave has a high concentration of hydrogen ions?

..... [1]

(b) Hydrogen sulphide gas which was escaping from nearby petroleum deposits was being oxidised to sulphuric acid.

(i) Complete the equation for this reaction forming sulphuric acid.

H_2S + ...O_2 → ..... [2]

(ii) Explain why all the hydrogen sulphide should be removed from the petroleum before it is used as a fuel.

.....

..... [1]

2 Sulphur is used to make sulphuric acid. In the UK, the annual production of the acid is about 2.5 million tonnes.

(a) The reactions in the manufacture of sulphuric acid by the Contact Process are shown below.

Sulphur	⟶	Sulphur dioxide
S	**reaction 1**	SO_2
Sulphur dioxide + oxygen	⟶	Sulphur trioxide
$2SO_2 + O_2$	**reaction 2**	$2SO_3$

Sulphur trioxide	⟶	Oleum
SO_3	**reaction 3**	$H_2S_2O_7$
Oleum + water	⟶	Sulphuric acid
$H_2S_2O_7$	**reaction 4**	H_2SO_4

(i) Give a large scale source of the element sulphur.

..... [1]

(ii) State another use of sulphur dioxide.

..... [1]

(iii) How is sulphur changed into sulphur dioxide?

..... [1]

(iv) Name the catalyst used in reaction **2**.

..... [1]

(v) Reaction **2** is exothermic. Why is a catalyst, rather than a higher temperature, used to increase the rate of this reversible reaction?

.....

..... [2]

(vi) Write a word equation for reaction **3**.

..... [1]

(vii) Write a symbol equation for reaction **4**.

..... [1]

Topic Chem 12 **Q# 12/** iGCSE Chemistry/2003/w/Paper 3/

5 Sulphur dioxide, SO_2, and sulphur trioxide, SO_3, are the two oxides of sulphur.

(a) Sulphur dioxide can kill bacteria and has bleaching properties. Give a use of sulphur dioxide that depends on each of these properties.

(i) ability to kill bacteria .....[1]

(ii) bleaching properties .....[1]

(b) Sulphur trioxide can be made from sulphur dioxide.

(i) Why is this reaction important industrially?

.....[1]

(ii) Complete the word equation.

sulphur dioxide + ... → sulphur trioxide [1]

(iii) What are the conditions for this reaction?

.....

.....[2]

Topic Chem 12 **Q# 13/** iGCSE Chemistry/2002/w/Paper 3/

1 **(a)** Sulphuric acid is made by the Contact Process.

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ forward reaction is exothermic

(i) What are the reaction conditions for the Contact Process?

.....

.....[3]

(ii) Would the yield of sulphur trioxide increase, decrease or stay the same when the temperature is increased? Explain your answer.

.....

.....

.....[2]

(iii) Describe how sulphur trioxide is changed into concentrated sulphuric acid.

.....

.....[2]

Topic Chem 12 **Q# 14/** iGCSE Chemistry/2001/w/Paper 3/

5 **(a)** In the USA, sulphur is obtained from underground deposits. It burns to form sulphur dioxide. This is used in paper making, to preserve food and in the manufacture of sulphuric acid.

(i) Why is sulphur dioxide needed in paper making?

.....[1]

(ii) How does sulphur dioxide preserve food?

.....[1]

3 Sulfuric acid is made by the Contact process.

(a) Sulfur is burned by spraying droplets of molten sulfur into air.

Suggest and explain an advantage of using this method.

.....

..... [2]

(b) The following equation represents the equilibrium in the Contact process.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Oxygen is supplied from the air.
The composition of the reaction mixture is 1 volume of sulfur dioxide to 1 volume of oxygen.

What volume of air contains 1 dm^3 of oxygen?

..... dm^3 [1]

(c) Sulfur dioxide is more expensive than air.

What is the advantage of using an excess of air?

.....

..... [2]

(d) The forward reaction is exothermic. The reaction is usually carried out at a temperature between 400 and 450 °C.

(i) What is the effect on the position of equilibrium of using a temperature above 450 °C?
Explain your answer.

.....

.....

..... [2]

(ii) What is the effect on the rate of using a temperature below 400 °C?
Explain your answer.

.....

.....

..... [3]

(e) A low pressure, 2 atmospheres, is used. At equilibrium, about 98% SO_3 is present.

(i) What is the effect on the position of equilibrium of using a higher pressure?

..... [1]

(ii) Explain why a higher pressure is **not** used.

..... [1]

(f) Name the catalyst used in the Contact process.

..... [1]

(g) Describe how concentrated sulfuric acid is made from sulfur trioxide.

.....

.....

.....

..... [2]

Topic Chem 13 **Q# 16/** iGCSE Chemistry/2012/s/Paper 31/ QiGCSE Chemistry/201(c)

(ii) Fish live in water which is neutral (neither acidic nor alkaline). Acid rain decreases the pH of water in lakes and rivers. Both of the bases, calcium oxide and calcium carbonate, can neutralise this acid and increase the pH. Explain why calcium carbonate is a better choice.

.....

..... [2]

Topic Chem 13 **Q# 17/** iGCSE Chemistry/2012/s/Paper 31/

5 Reactive metals tend to have unreactive compounds. The following is part of the reactivity series.

sodium	most reactive
calcium	↓
zinc	
copper	↓
silver	least reactive

(a) Sodium hydroxide and sodium carbonate do not decompose when heated. The corresponding calcium compounds do decompose when heated. Complete the following equations.

calcium carbonate → ..... + ...

....

$Ca(OH)_2$ → ..... + ... [2]

Topic Chem 13 **Q# 18/** iGCSE Chemistry/2006/w/Paper 3/Q3

(c) Calcium carbonate is used to control soil acidity.

(i) Why is it important to control soil acidity?

..... [1]

(ii) Both calcium carbonate, insoluble in water, and calcium oxide, slightly soluble, are used to increase soil pH. Suggest **two** advantages of using calcium carbonate.

.....

..... [2]

(iii) Give **one** use of calcium carbonate other than for making calcium oxide and controlling soil pH.

..... [1]

Topic Chem 13 **Q# 19/** iGCSE Chemistry/2006/w/Paper 3/

3 Calcium carbonate is an important raw material.

(a) Name a rock which is made up of calcium carbonate.

..... [1]

Mark Scheme iG Chem 12 13 EQ P3 15w to 01w 100marks

Q# 1/ iGCSE Chemistry/2014/w/Paper 31/

3 **(a)** Any **two** from:
bleach/making wood pulp/making paper
food/fruit juice/wine preservative
fumigant/sterilising/insecticide [2]

(b) heating/roasting/burning (zinc sulfides) [1]
in air/oxygen COND on M1 [1]

(c) **(i)** V_2O_5 [1]

(ii) position of equilibrium shifts right/yield increases [1]
to save energy [1]

(iii) faster reaction/rate [1]

more collisions per second/higher collision frequency [1]

fewer moles/molecules (of gas) on right [1]

(so) position of equilibrium shifts right/yield increases [1]

(d) (the reaction is) too violent/too exothermic **or** produces mist/fumes (of acid) [1]

Q# 2/ iGCSE Chemistry/2013/w/Paper 31/ Q6

(b) (i) anhydrous cobalt chloride becomes hydrated [1]
ACCEPT: hydrous

(ii) carbon dioxide is acidic [1]
sodium hydroxide and calcium oxide are bases / alkalis [1]

(iii) Any two of:
water, calcium carbonate and sodium carbonate [2]
ACCEPT: sodium bicarbonate

Q# 3/ iGCSE Chemistry/2011/s/Paper 31/ Q4

(b) for a high yield need low temperature [1]
then rate would be too slow or uneconomic [1]
a discussion of optimum temperature could score mark 1 and 2

presence of catalyst would increase rate (at same temperature) [1]
does not alter the yield (at that temperature) [1]
/ economic rate at lower temperature, therefore higher yield

higher pressure which would increase yield / rate [1]
yield high enough / high pressure expensive [1]
max [4]

accept reverse arguments
note increase yield ≡ position of equilibrium to right

Q# 4/ iGCSE Chemistry/2009/w/Paper 3/

6 (a) (i) burn sulfur in air **or** oxygen [1]
or heat a metal sulfide in air

(ii) bleach for wood pulp/cloth/straw **or** preserve food **or** sterilising
or making wine **or** fumigant **or** refrigerant [1]
Accept making paper

(iii) vanadium(V) oxide **accept** vanadium oxide **or** V_2O_5
or vanadium pentoxide [1]
oxidation state not essential but if given it has to be (V)

(iv) rate too slow **or** rate not economic [1]

(v) reaction too violent **or** forms a mist [1]

Q# 5/ iGCSE Chemistry/2008/s/Paper 31/ QiGCSE Chemistry/201

(g) vanadium [1]

ACCEPT name or symbol

Q# 6/ iGCSE Chemistry/2007/w/Paper 3/

4 (a) (i) bleach for wood pulp **or** preserving food **or** sterilising
or in wine making **or** as a refrigerant **or** in metallurgy **or**
(liquid) sulphur dioxide is used in the petroleum industry
or kill microbes(etc) **or** insecticide [1]

(ii) (react with) oxygen **or** air [1]
NOT burnt/burn in air/oxygen
450°C [1]
vanadium oxide catalyst (if oxidation state given has to be correct) **or** platinum [1]
If four conditions are given which include high pressure then **MAX** [2]
High pressure is incorrect **MAX** 10 atm.

(iii) ammonium sulphate **or** superphosphate [1]
or potassium sulphate **or** magnesium sulphate

Q# 7/ iGCSE Chemistry/2006/s/Paper 3/Q5 (b)

(iii) Low enough for good yield [1]
High enough for (economic) rate [1]
Any similar explanation will be awarded the mark
NOT just that it is the optimum temperature

(iv) bubble into (conc) sulphuric acid [1]
add water [1]
NOT consequential

Q# 8/ iGCSE Chemistry/2006/s/Paper 3/

5 (a) (i) Burn sulphur in air (or oxygen) [1]

(ii) as a bleach [1]

(iii) kill bacteria/micro-organisms [1]
NOT prevents food going bad or rotten or decaying

(b) (i) decrease [1]

(ii) exothermic [1]
COND increase temperature favours back reaction so it is endothermic, so forward reaction must be exothermic [1]
OR any similar explanation will be awarded the mark, for example
The forward reaction is not favoured by an increase in temperature so it is exothermic (rather than endothermic)

(iii) Low enough for good yield [1]
High enough for (economic) rate [1]
Any similar explanation will be awarded the mark
NOT just that it is the optimum temperature

Q# 9/ iGCSE Chemistry/2005/s/Paper 3/

(c) (i) vanadium oxide **or** vanadium(V) oxide **or** vanadium pentoxide or V_2O_5
Must be correct oxidation state if one given [1]

(ii) 400 to 500° C [1]

(iii) add to (concentrated) sulphuric acid **NOT** dilute [1]
COND (upon sulphuric acid) above then add water [1]

Q# 10/ iGCSE Chemistry/2005/s/Paper 3/

4 (a) (i) correct word equation (carbon dioxide and water) [1]
Accept correct symbol equation

(ii) Must have a correct reagent otherwise wc = 0
add (acidified) barium chloride(aq) **or** nitrate **or** add barium ions [1]
COND white precipitate [1]
NOT lead(II) compounds

(iii) low pH **or** universal indicator turns red(aq) [1]
pH 3 **or** less

(b) (i) $H_2S + 2O_2 = H_2SO_4$ [2]
unbalanced [1]

(ii) unpleasant smell **or** it is poisonous **or** when burnt forms acid rain **or** forms sulphur dioxide **or** forms sulphuric acid **[1]**
NOT it is a pollutant

(iii) 2H to 1S
COND 8e around sulphur atom
2e per hydrogen atom
THREE correct **[2]**
TWO from above [1]
Ionic structure = [0]

Q# 11/ iGCSE Chemistry/2004/s/Paper 3/

2. **(a)** **(i)** USA **or** Texas **or** Poland **or** Mexico **or** Japan **or** Ethiopia
Australia **or** Sicily **[1]**
accept other sources of sulphur eg petroleum
or natural gas **or** metal sulphides **or** volcanoes
NOT coal, **NOT** underground

(ii) Preserving food **or** bleaching **or** sterilising **or**
disinfecting **or** making paper **or** bleaching wood pulp
or wine **or** jam **or** fumigation **or** making paper **[1]**
NOT making wood pulp

(iii) burnt/roast in oxygen **or** air **[1]**

(iv) vanadium(V) oxide **or** vanadium oxide **or** platinum **[1]**
ignore oxidation state of vanadium

(v) Increase temperature (increases rate) but reduces yield **[1]**
catalyst only increases rate **or** a catalyst does not
influence position of equilibrium **[1]**
NOT a definition of a catalyst

(vi) sulphur trioxide + sulphuric acid = oleum **[1]**
correct symbol equation acceptable

(vii) $H_2S_2O_7 + H_2O = 2H_2SO_4$ **[1]**

Q# 12/ iGCSE Chemistry/2003/w/Paper 3/

5 (a) (i) preserve food **or** sterilising [1]
(ii) making paper [1]

(b) (i) making sulphuric acid **or** Contact Process [1]
(ii) oxygen [1]
(iii) vanadium oxide as catalyst (ignore oxidation state)
400 to 500 °C
pressure less than 10 atm
Any TWO [2]

Q# 13/ iGCSE Chemistry/2002/w/Paper 3/

1 (a) (i) vanadium(V) oxide as catalyst - ignore oxidation state
and accept no oxidation state
temperature 300 to 600 °C
pressure up to 10 atmos, accept atmospheric pressure
volume ratio of gases either 2:1 **or** slight excess of oxygen
ANY three [3]

(ii) decrease [1]
COND back reaction is endothermic or same argument based on
forward reaction is exothermic [1]
or increase in temp favours back reaction

(iii) dissolve in (conc) sulphuric acid **NOT** dilute [1]
add water **or** dilute [1]

Q# 14/ iGCSE Chemistry/2001/w/Paper 3/Q4

5 (a) (i) bleach [1]

(ii) kills bacteria or germs or micro organisms [1]

Q# 15/ iGCSE Chemistry/2015/w/Paper 31/

Question	Answer	Marks
3(a)	fast(er) reaction; large(r) surface area;	1 1
3(b)	4.76 (dm^3);	1
3(c)	moves equilibrium to right; increases yield (of sulfur trioxide) / uses up more sulfur dioxide;	1 1
3(d)(i)	moves equilibrium to left; (forward reaction) exothermic;	1 1
3(d)(ii)	decrease rate; molecules have less energy / move slower; fewer collisions (per second) / fewer particles have the activation energy / fewer collisions have the activation energy;	1 1 1
3(e)(i)	moves to right;	1
3(e)(ii)	high yield at 2 atm;	1
3(f)	vanadium(V) oxide / vanadium pentoxide;	1
3(g)	**M1** dissolve / react sulfur trioxide in (concentrated) sulfuric acid; add water to product of **M1**;	1 1

Q# 16/ iGCSE Chemistry/2012/s/Paper 31/ QiGCSE Chemistry/201(c)

(ii) calcium oxide is soluble in water / reacts with water to form calcium hydroxide; [1]
pH above 7 / the water becomes alkaline; [1]
OR
calcium carbonate insoluble in water; [1]
pH cannot be above 7 / water is neutral / does not make water alkaline; [1]
[max 2]

Q# 17/ iGCSE Chemistry/2012/s/Paper 31/

5 (a) calcium carbonate → calcium oxide + carbon dioxide [1]
accept: correct symbol equation

$Ca(OH)_2 \rightarrow CaO + H_2O$ [1]

Q# 18/ iGCSE Chemistry/2006/w/Paper 3/Q3

(c) (i) Any reasonable explanation
Plants prefer soil pH about 7
Plants do not grow (well) in acidic soils/plants grow better
To increase crop yields
Any **ONE** [1]
Do **NOT** accept in acidic soils plants die

(ii) With calcium carbonate, pH cannot go above 7 [1]
It is not washed away by the rain/remains longer in the soil
It is not absorbed by the plant [1]
OR
With calcium oxide, pH can go above 7 [1]
It is washed away by the rain [1]

(iii) Any correct use - making steel/iron, making cement, making glass, disposing of acid wastes, removing sulphur dioxide from flue gases, (stone in) building, indigestion tablets, toothpaste, cosmetics etc [1]

Q# 19/ iGCSE Chemistry/2006/w/Paper 3/

3 (a) limestone **or** marble **or** chalk or coral or calcite or aragonite [1]

12 Sulfur

12.1 Sulfur

Core

- Name some sources of sulfur
- Name the use of sulfur in the manufacture of sulfuric acid
- State the uses of sulfur dioxide as a bleach in the manufacture of wood pulp for paper and as a food preservative (by killing bacteria)

Supplement

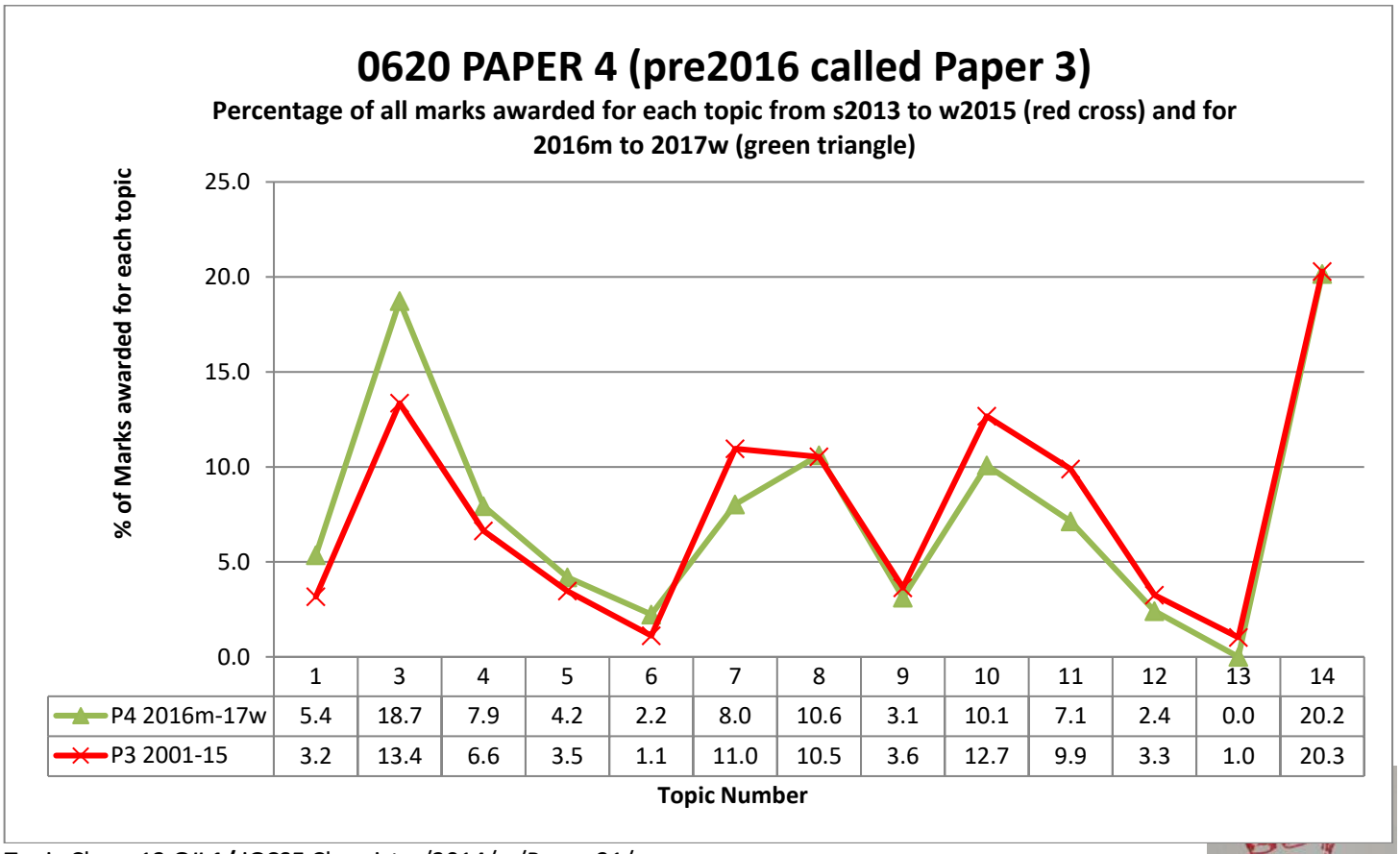
- Describe the manufacture of sulfuric acid by the Contact process, including essential conditions and reactions
- Describe the properties and uses of dilute and concentrated sulfuric acid

13 Carbonates

13.1 Carbonates

Core

- Describe the manufacture of lime (calcium oxide) from calcium carbonate (limestone) in terms of thermal decomposition
- Name some uses of lime and slaked lime such as in treating acidic soil and neutralising acidic industrial waste products, e.g. flue gas desulfurisation
- Name the uses of calcium carbonate in the manufacture of iron and cement



	1	3	4	5	6	7	8	9	10	11	12	13	14
P4 2016m-17w	5.4	18.7	7.9	4.2	2.2	8.0	10.6	3.1	10.1	7.1	2.4	0.0	20.2
P3 2001-15	3.2	13.4	6.6	3.5	1.1	11.0	10.5	3.6	12.7	9.9	3.3	1.0	20.3

Topic Chem 12 **Q# 1/** iGCSE Chemistry/2014/w/Paper 31/

3 The main use of sulfur dioxide is the manufacture of sulfuric acid.

(a) State **two** other uses of sulfur dioxide.

.....

..... [2]

(b) One source of sulfur dioxide is burning sulfur in air.
Describe how sulfur dioxide can be made from the ore zinc sulfide.

.....

..... [2]

(c) The Contact process changes sulfur dioxide into sulfur trioxide.

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
the forward reaction is exothermic
temperature 400 to 450 °C
low pressure 1 to 10 atmospheres
catalyst vanadium(V) oxide

(i) What is the formula of vanadium(V) oxide?

..... [1]

(ii) Vanadium(V) oxide is an efficient catalyst at any temperature in the range 400 to 450 °C.
Scientists are looking for an alternative catalyst which is efficient at 300 °C.
What would be the advantage of using a lower temperature?

.....

.....

..... [2]

(iii) The process does not use a high pressure because of the extra expense.
Suggest **two** advantages of using a high pressure?
Explain your suggestions.

.....

.....

.....

.....

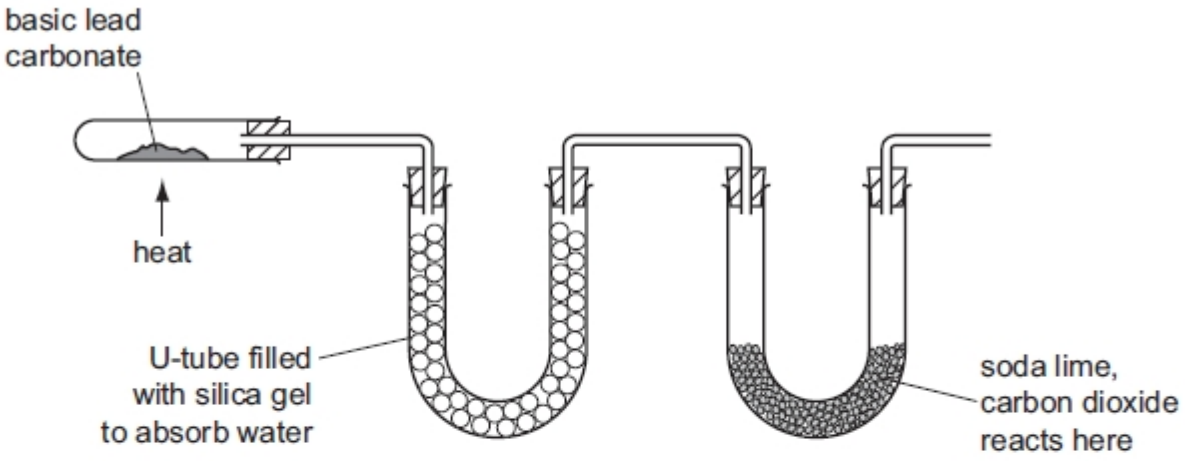
..... [4]

(d) Sulfuric acid is made by dissolving sulfur trioxide in concentrated sulfuric acid to form oleum.
Water is reacted with oleum to form more sulfuric acid.
Why is sulfur trioxide not reacted directly with water?

..... [1]

Topic Chem 12 **Q# 2/** iGCSE Chemistry/2013/w/Paper 31/ Q6

(b) Basic lead(II) carbonate is heated in the apparatus shown below. Water and carbon dioxide are produced.



(i) Silica gel absorbs water. Silica gel often contains anhydrous cobalt(II) chloride. When this absorbs water it changes from blue to pink.
Suggest a reason.

..... [1]

(ii) Soda lime is a mixture of sodium hydroxide and calcium oxide. Why do these two substances react with carbon dioxide?

.....

..... [2]

(iii) Name **two** substances formed when soda lime reacts with carbon dioxide.

..... [2]

Topic Chem 12 **Q# 3/** iGCSE Chemistry/2011/s/Paper 31/ Q4

(b) Sulfur dioxide is used to make sulfur trioxide in the Contact Process.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The forward reaction is exothermic. The conditions used are:

temperature: 450 °C
pressure: 2 atmospheres
catalyst: vanadium(V) oxide

Explain, mentioning both position of equilibrium and rate, why these conditions give the most economic yield.

.....

.....

.....

..... [4]

Topic Chem 12 **Q# 4/** iGCSE Chemistry/2009/w/Paper 3/

6 **(a)** Sulfuric acid is made by the Contact process.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

This is carried out in the presence of a catalyst at 450 °C and 2 atmospheres pressure.

(i) How is the sulfur dioxide made?

.....

..... [1]

(ii) Give another use of sulfur dioxide.

..... [1]

(iii) Name the catalyst used.

..... [1]

(iv) If the temperature is decreased to 300 °C, the yield of sulfur trioxide increases. Explain why this lower temperature is not used.

.....

..... [1]

(v) Sulfur trioxide is dissolved in concentrated sulfuric acid. This is added to water to make more sulfuric acid. Why is sulfur trioxide not added directly to water?

.....

..... [1]

Topic Chem 12 **Q# 5/** iGCSE Chemistry/2008/s/Paper 31/

1 For each of the following select an element from Period 4, potassium to krypton, that matches the description.

(g) One of its oxides is the catalyst in the Contact Process. .....

Topic Chem 12 **Q# 6/** iGCSE Chemistry/2007/w/Paper 3/

4 Zinc is extracted from zinc blende, ZnS.

(a) Zinc blende is heated in air to give zinc oxide and sulphur dioxide. Most of the sulphur dioxide is used to make sulphur trioxide. This is used to manufacture sulphuric acid. Some of the acid is used in the plant, but most of it is used to make fertilisers.

(i) Give another use of sulphur dioxide.

..... [1]

(ii) Describe how sulphur dioxide is converted into sulphur trioxide.

.....

.....

..... [3]

(iii) Name a fertiliser made from sulphuric acid.

..... [1]

Topic Chem 12 **Q# 7/** iGCSE Chemistry/2006/s/Paper 3/ Q5 (b)

(iii) Explain, mentioning both rate and percentage yield, why the temperature used in the Contact process is 450°C.

.....

..... [2]

(iv) Describe how the sulphur trioxide is changed into concentrated sulphuric acid.

.....

..... [2]

Topic Chem 12 **Q# 8/** iGCSE Chemistry/2006/s/Paper 3/

5 Sulphuric acid is made by the Contact process in the following sequence of reactions.

sulphur → sulphur dioxide → sulphur trioxide → sulphuric acid

(a) (i) How is sulphur dioxide made from sulphur?

..... [1]

(ii) Sulphur dioxide has other uses.
Why is it used in the manufacture of paper?

..... [1]

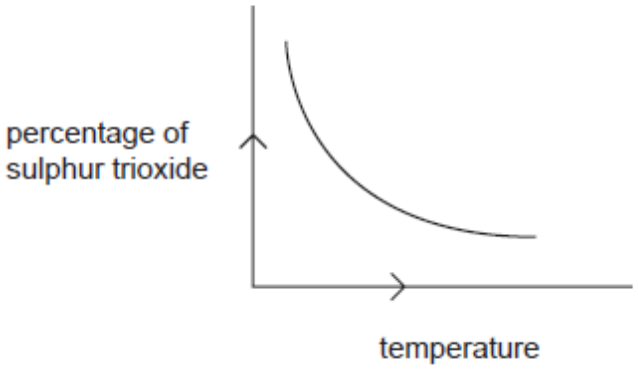
(iii) How does it preserve food?

..... [1]

(b) The equation for a stage of the Contact process is

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

The percentage of sulphur trioxide in the equilibrium mixture varies with temperature.



(i) How does the percentage of sulphur trioxide in the equilibrium mixture vary as the temperature increases? Circle the correct answer.

increases **stays the same** **decreases**

[1]

(ii) Is the forward reaction in the equilibrium $2SO_2 + O_2 \rightleftharpoons 2SO_3$ exothermic or endothermic? Give a reason for your choice.

.....

..... [2]

Topic Chem 12 **Q# 9/** iGCSE Chemistry/2005/s/Paper 3/Q4

(c) Sulphuric acid is manufactured by the Contact Process. Sulphur dioxide is oxidised to sulphur trioxide by oxygen.

$$2SO_2 + O_2 \longrightarrow 2SO_3$$

(i) Name the catalyst used in this reaction.

..... [1]

(ii) What temperature is used for this reaction?

..... [1]

(iii) Describe how sulphur trioxide is changed into sulphuric acid.

.....

..... [2]

4 The Carlsbad caverns in New Mexico are very large underground caves. Although the walls of these caves are coated with gypsum (hydrated calcium sulphate), the caves have been formed in limestone.

(a) It is believed that the caves were formed by sulphuric acid reacting with the limestone.

(i) Complete the word equation.

calcium carbonate + sulphuric acid → calcium sulphate + ... + ...

[1]

(ii) Describe how you could test the water entering the cave to show that it contained sulphate ions.

test .....

result ..... [2]

(iii) How could you show that the water entering the cave has a high concentration of hydrogen ions?

..... [1]

(b) Hydrogen sulphide gas which was escaping from nearby petroleum deposits was being oxidised to sulphuric acid.

(i) Complete the equation for this reaction forming sulphuric acid.

H_2S + ...O_2 → ..... [2]

(ii) Explain why all the hydrogen sulphide should be removed from the petroleum before it is used as a fuel.

.....

..... [1]

2 Sulphur is used to make sulphuric acid. In the UK, the annual production of the acid is about 2.5 million tonnes.

(a) The reactions in the manufacture of sulphuric acid by the Contact Process are shown below.

Sulphur	⟶	Sulphur dioxide
S	**reaction 1**	SO_2
Sulphur dioxide + oxygen	⟶	Sulphur trioxide
$2SO_2 + O_2$	**reaction 2**	$2SO_3$

Sulphur trioxide	⟶	Oleum
SO_3	**reaction 3**	$H_2S_2O_7$
Oleum + water	⟶	Sulphuric acid
$H_2S_2O_7$	**reaction 4**	H_2SO_4

(i) Give a large scale source of the element sulphur.

..... [1]

(ii) State another use of sulphur dioxide.

..... [1]

(iii) How is sulphur changed into sulphur dioxide?

..... [1]

(iv) Name the catalyst used in reaction **2**.

..... [1]

(v) Reaction **2** is exothermic. Why is a catalyst, rather than a higher temperature, used to increase the rate of this reversible reaction?

.....

..... [2]

(vi) Write a word equation for reaction **3**.

..... [1]

(vii) Write a symbol equation for reaction **4**.

..... [1]

Topic Chem 12 **Q# 12/** iGCSE Chemistry/2003/w/Paper 3/

5 Sulphur dioxide, SO_2, and sulphur trioxide, SO_3, are the two oxides of sulphur.

(a) Sulphur dioxide can kill bacteria and has bleaching properties. Give a use of sulphur dioxide that depends on each of these properties.

(i) ability to kill bacteria .....[1]

(ii) bleaching properties .....[1]

(b) Sulphur trioxide can be made from sulphur dioxide.

(i) Why is this reaction important industrially?

.....[1]

(ii) Complete the word equation.

sulphur dioxide + ... → sulphur trioxide [1]

(iii) What are the conditions for this reaction?

.....

.....[2]

Topic Chem 12 **Q# 13/** iGCSE Chemistry/2002/w/Paper 3/

1 **(a)** Sulphuric acid is made by the Contact Process.

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ forward reaction is exothermic

(i) What are the reaction conditions for the Contact Process?

.....

.....[3]

(ii) Would the yield of sulphur trioxide increase, decrease or stay the same when the temperature is increased? Explain your answer.

.....

.....

.....[2]

(iii) Describe how sulphur trioxide is changed into concentrated sulphuric acid.

.....

.....[2]

Topic Chem 12 **Q# 14/** iGCSE Chemistry/2001/w/Paper 3/

5 **(a)** In the USA, sulphur is obtained from underground deposits. It burns to form sulphur dioxide. This is used in paper making, to preserve food and in the manufacture of sulphuric acid.

(i) Why is sulphur dioxide needed in paper making?

.....[1]

(ii) How does sulphur dioxide preserve food?

.....[1]

3 Sulfuric acid is made by the Contact process.

(a) Sulfur is burned by spraying droplets of molten sulfur into air.

Suggest and explain an advantage of using this method.

.....

..... [2]

(b) The following equation represents the equilibrium in the Contact process.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

Oxygen is supplied from the air.
The composition of the reaction mixture is 1 volume of sulfur dioxide to 1 volume of oxygen.

What volume of air contains 1 dm^3 of oxygen?

..... dm^3 [1]

(c) Sulfur dioxide is more expensive than air.

What is the advantage of using an excess of air?

.....

..... [2]

(d) The forward reaction is exothermic. The reaction is usually carried out at a temperature between 400 and 450 °C.

(i) What is the effect on the position of equilibrium of using a temperature above 450 °C?
Explain your answer.

.....

.....

..... [2]

(ii) What is the effect on the rate of using a temperature below 400 °C?
Explain your answer.

.....

.....

..... [3]

(e) A low pressure, 2 atmospheres, is used. At equilibrium, about 98% SO_3 is present.

(i) What is the effect on the position of equilibrium of using a higher pressure?

..... [1]

(ii) Explain why a higher pressure is **not** used.

..... [1]

(f) Name the catalyst used in the Contact process.

..... [1]

(g) Describe how concentrated sulfuric acid is made from sulfur trioxide.

.....

.....

.....

..... [2]

Topic Chem 13 **Q# 16/** iGCSE Chemistry/2012/s/Paper 31/ QiGCSE Chemistry/201(c)

(ii) Fish live in water which is neutral (neither acidic nor alkaline). Acid rain decreases the pH of water in lakes and rivers. Both of the bases, calcium oxide and calcium carbonate, can neutralise this acid and increase the pH. Explain why calcium carbonate is a better choice.

.....

..... [2]

Topic Chem 13 **Q# 17/** iGCSE Chemistry/2012/s/Paper 31/

5 Reactive metals tend to have unreactive compounds. The following is part of the reactivity series.

sodium	most reactive
calcium	↓
zinc	
copper	↓
silver	least reactive

(a) Sodium hydroxide and sodium carbonate do not decompose when heated. The corresponding calcium compounds do decompose when heated. Complete the following equations.

calcium carbonate → ..... + ...

....

$Ca(OH)_2$ → ..... + ... [2]

Topic Chem 13 **Q# 18/** iGCSE Chemistry/2006/w/Paper 3/Q3

(c) Calcium carbonate is used to control soil acidity.

(i) Why is it important to control soil acidity?

..... [1]

(ii) Both calcium carbonate, insoluble in water, and calcium oxide, slightly soluble, are used to increase soil pH. Suggest **two** advantages of using calcium carbonate.

.....

..... [2]

(iii) Give **one** use of calcium carbonate other than for making calcium oxide and controlling soil pH.

..... [1]

Topic Chem 13 **Q# 19/** iGCSE Chemistry/2006/w/Paper 3/

3 Calcium carbonate is an important raw material.

(a) Name a rock which is made up of calcium carbonate.

..... [1]

Mark Scheme iG Chem 12 13 EQ P3 15w to 01w 100marks

Q# 1/ iGCSE Chemistry/2014/w/Paper 31/

3 **(a)** Any **two** from:
bleach/making wood pulp/making paper
food/fruit juice/wine preservative
fumigant/sterilising/insecticide [2]

(b) heating/roasting/burning (zinc sulfides) [1]
in air/oxygen COND on M1 [1]

(c) **(i)** V_2O_5 [1]

(ii) position of equilibrium shifts right/yield increases [1]
to save energy [1]

(iii) faster reaction/rate [1]

more collisions per second/higher collision frequency [1]

fewer moles/molecules (of gas) on right [1]

(so) position of equilibrium shifts right/yield increases [1]

(d) (the reaction is) too violent/too exothermic **or** produces mist/fumes (of acid) [1]

Q# 2/ iGCSE Chemistry/2013/w/Paper 31/ Q6

(b) (i) anhydrous cobalt chloride becomes hydrated [1]
ACCEPT: hydrous

(ii) carbon dioxide is acidic [1]
sodium hydroxide and calcium oxide are bases / alkalis [1]

(iii) Any two of:
water, calcium carbonate and sodium carbonate [2]
ACCEPT: sodium bicarbonate

Q# 3/ iGCSE Chemistry/2011/s/Paper 31/ Q4

(b) for a high yield need low temperature [1]
then rate would be too slow or uneconomic [1]
a discussion of optimum temperature could score mark 1 and 2

presence of catalyst would increase rate (at same temperature) [1]
does not alter the yield (at that temperature) [1]
/ economic rate at lower temperature, therefore higher yield

higher pressure which would increase yield / rate [1]
yield high enough / high pressure expensive [1]
max [4]

accept reverse arguments
note increase yield ≡ position of equilibrium to right

Q# 4/ iGCSE Chemistry/2009/w/Paper 3/

6 (a) (i) burn sulfur in air **or** oxygen [1]
or heat a metal sulfide in air

(ii) bleach for wood pulp/cloth/straw **or** preserve food **or** sterilising
or making wine **or** fumigant **or** refrigerant [1]
Accept making paper

(iii) vanadium(V) oxide **accept** vanadium oxide **or** V_2O_5
or vanadium pentoxide [1]
oxidation state not essential but if given it has to be (V)

(iv) rate too slow **or** rate not economic [1]

(v) reaction too violent **or** forms a mist [1]

Q# 5/ iGCSE Chemistry/2008/s/Paper 31/ QiGCSE Chemistry/201

(g) vanadium [1]

ACCEPT name or symbol

Q# 6/ iGCSE Chemistry/2007/w/Paper 3/

4 (a) (i) bleach for wood pulp **or** preserving food **or** sterilising
or in wine making **or** as a refrigerant **or** in metallurgy **or**
(liquid) sulphur dioxide is used in the petroleum industry
or kill microbes(etc) **or** insecticide [1]

(ii) (react with) oxygen **or** air [1]
NOT burnt/burn in air/oxygen
450°C [1]
vanadium oxide catalyst (if oxidation state given has to be correct) **or** platinum [1]
If four conditions are given which include high pressure then **MAX** [2]
High pressure is incorrect **MAX** 10 atm.

(iii) ammonium sulphate **or** superphosphate [1]
or potassium sulphate **or** magnesium sulphate

Q# 7/ iGCSE Chemistry/2006/s/Paper 3/Q5 (b)

(iii) Low enough for good yield [1]
High enough for (economic) rate [1]
Any similar explanation will be awarded the mark
NOT just that it is the optimum temperature

(iv) bubble into (conc) sulphuric acid [1]
add water [1]
NOT consequential

Q# 8/ iGCSE Chemistry/2006/s/Paper 3/

5 (a) (i) Burn sulphur in air (or oxygen) [1]

(ii) as a bleach [1]

(iii) kill bacteria/micro-organisms [1]
NOT prevents food going bad or rotten or decaying

(b) (i) decrease [1]

(ii) exothermic [1]
COND increase temperature favours back reaction so it is endothermic, so forward reaction must be exothermic [1]
OR any similar explanation will be awarded the mark, for example
The forward reaction is not favoured by an increase in temperature so it is exothermic (rather than endothermic)

(iii) Low enough for good yield [1]
High enough for (economic) rate [1]
Any similar explanation will be awarded the mark
NOT just that it is the optimum temperature

Q# 9/ iGCSE Chemistry/2005/s/Paper 3/

(c) (i) vanadium oxide **or** vanadium(V) oxide **or** vanadium pentoxide or V_2O_5
Must be correct oxidation state if one given [1]

(ii) 400 to 500° C [1]

(iii) add to (concentrated) sulphuric acid **NOT** dilute [1]
COND (upon sulphuric acid) above then add water [1]

Q# 10/ iGCSE Chemistry/2005/s/Paper 3/

4 (a) (i) correct word equation (carbon dioxide and water) [1]
Accept correct symbol equation

(ii) Must have a correct reagent otherwise wc = 0
add (acidified) barium chloride(aq) **or** nitrate **or** add barium ions [1]
COND white precipitate [1]
NOT lead(II) compounds

(iii) low pH **or** universal indicator turns red(aq) [1]
pH 3 **or** less

(b) (i) $H_2S + 2O_2 = H_2SO_4$ [2]
unbalanced [1]

(ii) unpleasant smell **or** it is poisonous **or** when burnt forms acid rain **or** forms sulphur dioxide **or** forms sulphuric acid **[1]**
NOT it is a pollutant

(iii) 2H to 1S
COND 8e around sulphur atom
2e per hydrogen atom
THREE correct **[2]**
TWO from above [1]
Ionic structure = [0]

Q# 11/ iGCSE Chemistry/2004/s/Paper 3/

2. **(a)** **(i)** USA **or** Texas **or** Poland **or** Mexico **or** Japan **or** Ethiopia Australia **or** Sicily **[1]**
accept other sources of sulphur eg petroleum **or** natural gas **or** metal sulphides **or** volcanoes
NOT coal, **NOT** underground

(ii) Preserving food **or** bleaching **or** sterilising **or** disinfecting **or** making paper **or** bleaching wood pulp **or** wine **or** jam **or** fumigation **or** making paper **[1]**
NOT making wood pulp

(iii) burnt/roast in oxygen **or** air **[1]**

(iv) vanadium(V) oxide **or** vanadium oxide **or** platinum **[1]**
ignore oxidation state of vanadium

(v) Increase temperature (increases rate) but reduces yield **[1]**
catalyst only increases rate **or** a catalyst does not influence position of equilibrium **[1]**
NOT a definition of a catalyst

(vi) sulphur trioxide + sulphuric acid = oleum **[1]**
correct symbol equation acceptable

(vii) $H_2S_2O_7 + H_2O = 2H_2SO_4$ **[1]**

Q# 12/ iGCSE Chemistry/2003/w/Paper 3/

5 (a) (i) preserve food **or** sterilising [1]
(ii) making paper [1]

(b) (i) making sulphuric acid **or** Contact Process [1]
(ii) oxygen [1]
(iii) vanadium oxide as catalyst (ignore oxidation state)
400 to 500 °C
pressure less than 10 atm
Any TWO [2]

Q# 13/ iGCSE Chemistry/2002/w/Paper 3/

1 (a) (i) vanadium(V) oxide as catalyst - ignore oxidation state and accept no oxidation state
temperature 300 to 600 °C
pressure up to 10 atmos, accept atmospheric pressure
volume ratio of gases either 2:1 **or** slight excess of oxygen
ANY three [3]

(ii) decrease [1]
COND back reaction is endothermic or same argument based on forward reaction is exothermic [1]
or increase in temp favours back reaction

(iii) dissolve in (conc) sulphuric acid **NOT** dilute [1]
add water **or** dilute [1]

Q# 14/ iGCSE Chemistry/2001/w/Paper 3/Q4

5 (a) (i) bleach [1]

(ii) kills bacteria or germs or micro organisms [1]

Q# 15/ iGCSE Chemistry/2015/w/Paper 31/

Question	Answer	Marks
3(a)	fast(er) reaction; large(r) surface area;	1 1
3(b)	4.76 (dm^3);	1
3(c)	moves equilibrium to right; increases yield (of sulfur trioxide) / uses up more sulfur dioxide;	1 1
3(d)(i)	moves equilibrium to left; (forward reaction) exothermic;	1 1
3(d)(ii)	decrease rate; molecules have less energy / move slower; fewer collisions (per second) / fewer particles have the activation energy / fewer collisions have the activation energy;	1 1 1
3(e)(i)	moves to right;	1
3(e)(ii)	high yield at 2 atm;	1
3(f)	vanadium(V) oxide / vanadium pentoxide;	1
3(g)	**M1** dissolve / react sulfur trioxide in (concentrated) sulfuric acid; add water to product of **M1**;	1 1

Q# 16/ iGCSE Chemistry/2012/s/Paper 31/ QiGCSE Chemistry/201(c)

(ii) calcium oxide is soluble in water / reacts with water to form calcium hydroxide; [1]
pH above 7 / the water becomes alkaline; [1]
OR
calcium carbonate insoluble in water; [1]
pH cannot be above 7 / water is neutral / does not make water alkaline; [1]
[max 2]

Q# 17/ iGCSE Chemistry/2012/s/Paper 31/

5 (a) calcium carbonate → calcium oxide + carbon dioxide [1]
accept: correct symbol equation

$Ca(OH)_2 \rightarrow CaO + H_2O$ [1]

Q# 18/ iGCSE Chemistry/2006/w/Paper 3/Q3

(c) (i) Any reasonable explanation
Plants prefer soil pH about 7
Plants do not grow (well) in acidic soils/plants grow better
To increase crop yields
Any **ONE** [1]
Do **NOT** accept in acidic soils plants die

(ii) With calcium carbonate, pH cannot go above 7 [1]
It is not washed away by the rain/remains longer in the soil
It is not absorbed by the plant [1]
OR
With calcium oxide, pH can go above 7 [1]
It is washed away by the rain [1]

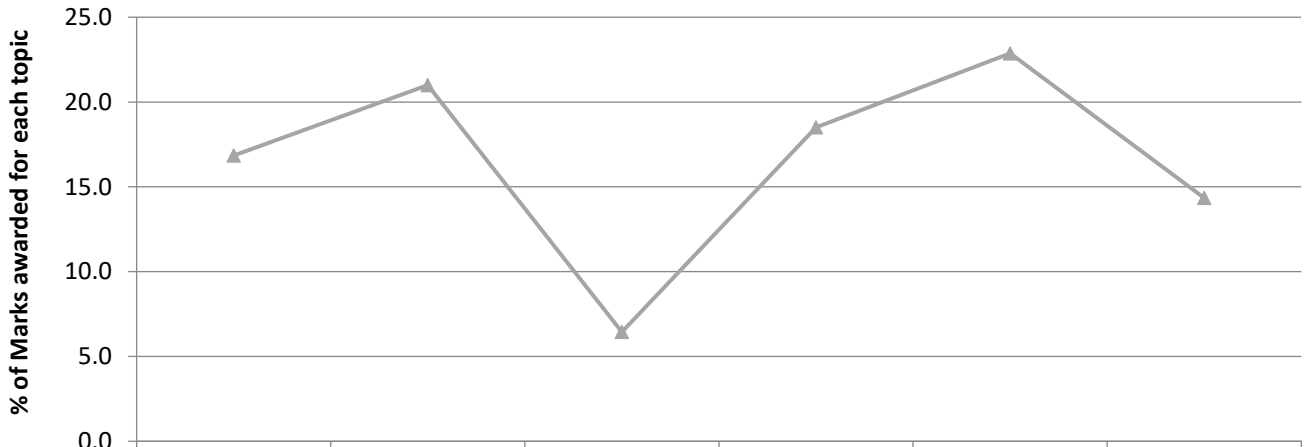
(iii) Any correct use - making steel/iron, making cement, making glass, disposing of acid wastes, removing sulphur dioxide from flue gases, (stone in) building, indigestion tablets, toothpaste, cosmetics etc [1]

Q# 19/ iGCSE Chemistry/2006/w/Paper 3/

3 (a) limestone **or** marble **or** chalk or coral or calcite or aragonite [1]

PAPER 4 Topic 14 (Organic) (pre2016 called Paper 3)

Percentage of all marks awarded for each subtopic from s2001 to w2015 green triangle)



	14.1 - 3 Naming, fuels & homologous series	14.4 5 Alkanes and alkenes	14.6 Alcohols	14.7 Carboxylic acids & esters	14.82 Synthetic polymers	14.83 Natural polymers
P3 2001-15	16.8	21.0	6.4	18.5	22.9	14.3

Paper 3 Topic Number

14 Organic chemistry

14.1 Names of compounds

Core

- Name and draw the structures of methane, ethane, ethene, ethanol, ethanoic acid and the products of the reactions stated in sections 14.4–14.6
- State the type of compound present, given a chemical name ending in *-ane*, *-ene*, *-ol*, or *-oic acid* or a molecular structure

Supplement

- Name and draw the structures of the unbranched alkanes, alkenes (not *cis-trans*), alcohols and acids containing up to four carbon atoms per molecule
- Name and draw the structural formulae of the esters which can be made from unbranched alcohols and carboxylic acids, each containing up to four carbon atoms

14.4 Alkanes

Core

- Describe the properties of alkanes (exemplified by methane) as being generally unreactive, except in terms of burning
- Describe the bonding in alkanes

Supplement

- Describe substitution reactions of alkanes with chlorine

14.5 Alkenes

Core

- Describe the manufacture of alkenes and of hydrogen by cracking
- Distinguish between saturated and unsaturated hydrocarbons:
  - from molecular structures
  - by reaction with aqueous bromine
- Describe the formation of poly(ethene) as an example of addition polymerisation of monomer units

Supplement

- Describe the properties of alkenes in terms of addition reactions with bromine, hydrogen and steam

14.6 Alcohols

Core

- Describe the manufacture of ethanol by fermentation and by the catalytic addition of steam to ethene
- Describe the properties of ethanol in terms of burning
- Name the uses of ethanol as a solvent and as a fuel

Supplement

- Outline the advantages and disadvantages of these two methods of manufacturing ethanol

14.7 Carboxylic acids

Core

- Describe the properties of aqueous ethanoic acid

Supplement

- Describe the formation of ethanoic acid by the oxidation of ethanol by fermentation and with acidified potassium manganate(VII)
- Describe ethanoic acid as a typical weak acid
- Describe the reaction of a carboxylic acid with an alcohol in the presence of a catalyst to give an ester

14.8 Polymers

14.8.1 Polymers

Core

- Define polymers as large molecules built up from small units (monomers)

Supplement

- Understand that different polymers have different units and/or different linkages

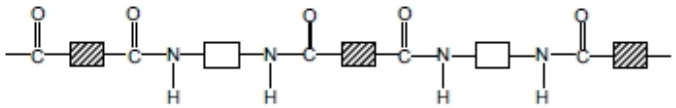
14.8.2 Synthetic polymers

Core

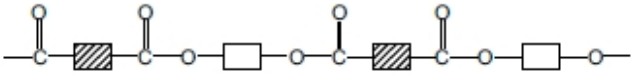
- Name some typical uses of plastics and of man-made fibres such as nylon and *Terylene*
- Describe the pollution problems caused by non-biodegradable plastics

Supplement

- Explain the differences between condensation and addition polymerisation
- Deduce the structure of the polymer product from a given alkene and *vice versa*
- Describe the formation of nylon (a polyamide) and *Terylene* (a polyester) by condensation polymerisation, the structure of nylon being represented as:



and the structure of *Terylene* as:



(Details of manufacture and mechanisms of these polymerisations are **not** required.)

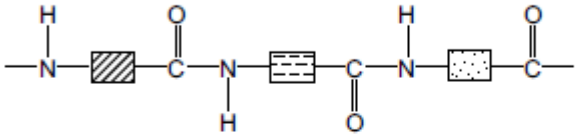
14.8.3 Natural polymers

Core

- Name proteins and carbohydrates as constituents of food

Supplement

- Describe proteins as possessing the same (amide) linkages as nylon but with different units
- Describe the structure of proteins as:



- Describe the hydrolysis of proteins to amino acids. (Structures and names are **not** required.)
- Describe complex carbohydrates in terms of a large number of sugar units, considered as HO—□—OH, joined together by condensation polymerisation, e.g.

- Describe the hydrolysis of complex carbohydrates (e.g. starch), by acids or enzymes to give simple sugars
- Describe the fermentation of simple sugars to produce ethanol (and carbon dioxide). (Candidates will **not** be expected to give the molecular formulae of sugars.)
- Describe, in outline, the usefulness of chromatography in separating and identifying the products of hydrolysis of carbohydrates and proteins

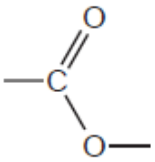
Topic Chem 14 SubTopic: Carboxylic acids & Esters **Q# 1/** iGCSE Chemistry/2009/w/Paper 3/Q7b

(ii) Write a word equation for the preparation of the ester butyl methanoate.

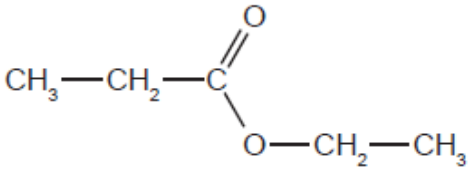
..... [2]

Topic Chem 14 SubTopic: Carboxylic acids & Esters **Q# 2/** iGCSE Chemistry/2010/s/Paper 31/

4 Hydrolysis is used in chemistry to break down complex molecules into simpler ones.

(a) Compounds containing the group  or —COO— are esters.

(i) Give the names and formulae of the two compounds formed when the ester ethyl propanoate is hydrolysed.



name ..... name .....

formula formula

[4]

(iii) Name a synthetic polyester.

..... [1]

Topic Chem 14 SubTopic: Carboxylic acids & Esters **Q# 3/** iGCSE Chemistry/2010/s/Paper 31/

8 Methanoic acid is the first member of the homologous series of carboxylic acids.

(b) In some areas when water is boiled, the inside of kettles become coated with a layer of calcium carbonate. This can be removed by adding methanoic acid.

(i) Complete the equation.

..... $HCOOH + CaCO_3 \rightarrow Ca(HCOO)_2$ + ... + ...

[2]

(ii) Methanoic acid reacts with most metals above hydrogen in the reactivity series. Complete the word equation.

zinc + methanoic acid → ..... + ...

[2]

Topic Chem 14 SubTopic: Carboxylic acids & Esters **Q# 4/** iGCSE Chemistry/2011/s/Paper 31/ Q6 (a)

(ii) Explain, in general terms, what is meant by *fermentation*.

.....

.....

.....

..... [3]

(b) Butanol can be oxidised to a carboxylic acid by heating with acidified potassium manganate(VII). Give the name and structural formula of the carboxylic acid.

name ..... [1]

structural formula

[1]

(c) Butanol reacts with ethanoic acid to form a liquid, **X**, which has the sweet smell of bananas. Its empirical formula is C_3H_6O and its M_r is 116.

(i) What type of compound is liquid **X**?

..... [1]

(ii) Give the molecular formula of liquid **X**.

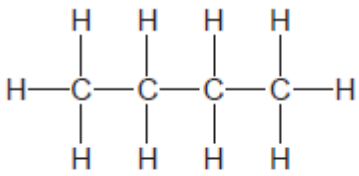
..... [1]

(iii) Draw the structural formula of **X**. Show all the individual bonds.

[2]

Topic Chem 14 SubTopic: Carboxylic acids & Esters **Q# 5/** iGCSE Chemistry/2012/s/Paper 31/

6 Butane is an alkane. It has the following structural formula.



(c) One of the chlorobutanes reacts with sodium hydroxide to form butan-1-ol. Butan-1-ol can be oxidised to a carboxylic acid.

(i) State a reagent, other than oxygen, which will oxidise butan-1-ol to a carboxylic acid.

..... [1]

(ii) Name the carboxylic acid formed.

..... [1]

(iii) Butan-1-ol reacts with ethanoic acid to form an ester. Name this ester and give its structural formula showing all the individual bonds.

name ..... [1]

structural formula

[2]

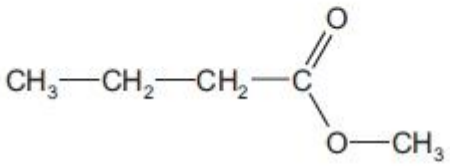
Topic Chem 14 SubTopic: Carboxylic acids & Esters **Q# 6/** iGCSE Chemistry/2014/w/Paper 31/

6 Esters, polyesters and fats all contain the ester linkage.

(a) Esters can be made from alcohols and carboxylic acids. For example, the ester ethyl ethanoate can be made by the following reaction.

$$CH_3COOH + CH_3CH_2OH \rightarrow CH_3COOCH_2CH_3 + H_2O$$

(i) Name the carboxylic acid and the alcohol from which the following ester could be made.



name of carboxylic acid .....

name of alcohol .....

[2]

(ii) 6.0 g of ethanoic acid, $M_r = 60$, was reacted with 5.5 g of ethanol, $M_r = 46$.
Determine which is the limiting reagent and the maximum yield of ethyl ethanoate, $M_r = 88$.

number of moles of ethanoic acid = ... [1]

number of moles of ethanol = ... [1]

the limiting reagent is ..... [1]

number of moles of ethyl ethanoate formed = ... [1]

maximum yield of ethyl ethanoate = ... [1]

Topic Chem 14 SubTopic: Carboxylic acids & Esters **Q# 7/** iGCSE Chemistry/2015/s/Paper 31/ Q4

(c) This question is based on typical reactions of butan-1-ol.

(ii) Suggest the name of the ester formed from butanol and ethanoic acid.

..... [1]

(iii) Butan-1-ol is oxidised by acidified potassium manganate(VII).

Deduce the name and the structural formula of the organic product in this reaction.

name .....

structural formula

[2]

Topic Chem 14 SubTopic: Carboxylic acids & Esters **Q# 8/** iGCSE Chemistry/2015/w/Paper 31/ NOT w/ith 5(a)

Q5 Compound **X** has/ the molecular formula of $C_4H_6O_2$

(b) **(i)** Bromine water changes from brown to colourless when added to **X**.

What does this tell you about the structure of **X**?

..... [1]

(ii) Magnesium powder reacts with an aqueous solution of **X**. Hydrogen is evolved.

What does this tell you about the structure of **X**?

..... [1]

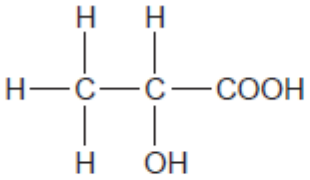
(iii) **X** contains two different functional groups.

Draw a structural formula of **X**.

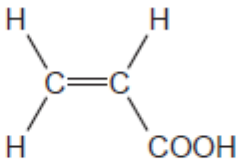
[1]

Topic Chem 14 SubTopic: Alkanes and alkenes **Q# 9/** iGCSE Chemistry/2009/s/Paper 31/Q8

(c) When lactic acid is heated, acrylic acid is formed.



lactic acid



acrylic acid

(i) Complete the word equation for the action of heat on lactic acid.

lactic acid → ..... + ... [1]

(ii) Describe a test that would distinguish between lactic acid and acrylic acid.

test .....

result for lactic acid .....

result for acrylic acid ..... [3]

Topic Chem 14 SubTopic: Alkanes and alkenes **Q# 10/** iGCSE Chemistry/2009/w/Paper 3/

7 Butan-1-ol is used as a solvent for paints and varnishes, to make esters and as a fuel. Butan-1-ol can be manufactured from but-1-ene, which is made from petroleum.

Biobutanol is a fuel of the future. It can be made by the fermentation of almost any form of biomass - grain, straw, leaves etc.

(a) But-1-ene can be obtained from alkanes such as decane, $C_{10}H_{22}$, by cracking.

(i) Give the reaction conditions.

.....

..... [2]

(ii) Complete an equation for the cracking of decane, $C_{10}H_{22}$, to give but-1-ene.

$C_{10}H_{22}$ → ..... [2]

(iii) Name the reagent that reacts with but-1-ene to form butan-1-ol.

..... [1]

Topic Chem 14 SubTopic: Alkanes and alkenes **Q# 11/** iGCSE Chemistry/2010/s/Paper 31/

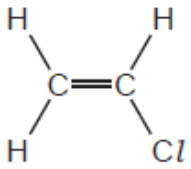
2 Ozone is a form of oxygen. Ozone is present in the upper atmosphere and it prevents dangerous solar radiation from reaching the Earth's surface. Some of the chemicals that diffuse into the upper atmosphere decompose ozone. Chemicals that have this effect are methane (CH_4), chloromethane (CH_3Cl) and an oxide of nitrogen (NO_2).

(iii) How can chloromethane be made from methane?

reagent .....

condition ..... [2]

(b) An important monomer is chloroethene which has the structural formula shown below.



It is made by the following method.

$$C_2H_4 + Cl_2 \rightarrow C_2H_4Cl_2 \text{ dichloroethane}$$

This is heated to make chloroethene.

$$C_2H_4Cl_2 \rightarrow C_2H_3Cl + HCl$$

(i) Ethene is made by cracking alkanes. Complete the equation for cracking dodecane.

$$C_{12}H_{26} \rightarrow \text{.....} + 2C_2H_4$$

[1]

Another method of making dichloroethane is from ethane.

$$C_2H_6 + 2Cl_2 \rightarrow C_2H_4Cl_2 + 2HCl$$

(ii) Suggest a reason why the method using ethene is preferred.

.....

..... [1]

6 The structural formula of a butanol is given below.

$$CH_3—CH_2—CH_2—CH_2—OH$$

(a) Butanol can be made from petroleum and also by fermentation.

(i) Describe the chemistry of making butanol from petroleum by the following route.

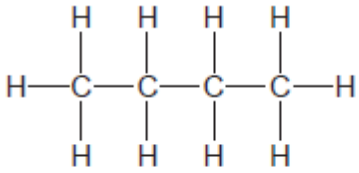
petroleum → butene → butanol

.....

.....

..... [3]

6 Butane is an alkane. It has the following structural formula.



(b) Butane reacts with chlorine to form two isomers of chlorobutane.

(i) What type of reaction is this?

..... [1]

(ii) Explain the term *isomer*.

.....

..... [2]

(iii) Draw the structural formulae of these two chlorobutanes.

[2]

(c) Butter contains mainly saturated fats. Fats based on vegetable oils, such as olive oil, contain mainly unsaturated fats.

A small amount of fat was dissolved in an organic solvent.
Describe how you could determine if the fat was saturated or unsaturated.

.....

.....

..... [3]

Topic Chem 14 SubTopic: Alkanes and alkenes **Q# 16/** iGCSE Chemistry/2013/s/Paper 31/Q3

(e) Describe a test which would distinguish between cyclohexane and the unsaturated hydrocarbon hexene.

test .....

result of test with cyclohexane .....

.....

result of test with hexene .....

..... [3]

Topic Chem 14 SubTopic: Alkanes and alkenes **Q# 17/** iGCSE Chemistry/2013/w/Paper 31/

7 **(a)** The following are two examples of substitution reactions. Only the reaction involving chlorine is a photochemical reaction.

$$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$$

$$CH_4 + Br_2 \rightarrow CH_3Br + HBr$$

(i) Explain the phrase *substitution reaction*.

.....

..... [1]

(ii) How do photochemical reactions differ from other reactions?

.....

..... [1]

Topic Chem 14 SubTopic: Alkanes and alkenes **Q# 18/** iGCSE Chemistry/2013/w/Paper 31/

5 The alkenes are unsaturated hydrocarbons. They form a homologous series, the members of which have the same chemical properties.
They undergo addition reactions and are easily oxidised.

(b) Give the structural formula and name of each of the products of the following addition reactions.

(i) ethene and bromine

structural formula of product

name of product ..... [2]

(ii) propene and hydrogen

structural formula of product

name of product ..... [2]

(iii) but-1-ene and water

structural formula of product

name of product ..... [2]

(c) Alkenes can be oxidised to carboxylic acids.

(i) For example, propene, $CH_3-CH=CH_2$, would produce ethanoic acid, CH_3-COOH, and methanoic acid, $H-COOH$. Deduce the formulae of the alkenes which would form the following carboxylic acids when oxidised.

ethanoic acid and propanoic acid

only ethanoic acid

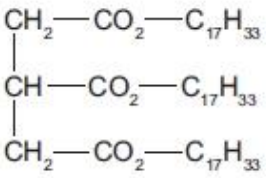
[2]

(ii) Describe the colour change you would observe when an alkene is oxidised with acidified potassium manganate(VII).

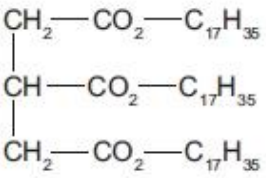
..... [2]

Topic Chem 14 SubTopic: Alkanes and alkenes **Q# 19/** iGCSE Chemistry/2014/w/Paper 31/ Q6

(c) Fats and vegetable oils are esters. The formulae of two examples of natural esters are given below.



ester 1



ester 2

(i) One ester is saturated, the other is unsaturated.
Describe a test to distinguish between them.

test .....

result with unsaturated ester .....

.....

result with saturated ester .....

.....

[3]

(ii) Deduce which one of the above esters is unsaturated. Give a reason for your choice.

.....

.....

..... [2]

Topic Chem 14 SubTopic: All up to & including homologous series **Q# 20/** iGCSE Chemistry/2009/w/Paper 3/

5 The first three elements in Group IV are carbon, silicon and germanium.
The elements and their compounds have similar properties.

(c) Germanium forms a series of hydrides comparable to the alkanes.

(i) Draw the structural formula of the hydride which contains four germanium atoms per molecule.

[1]

(ii) Predict the products of the complete combustion of this hydride.

..... [2]

Topic Chem 14 SubTopic: All up to & including homologous series **Q# 21/** iGCSE Chemistry/2009/w/Paper 3/ Q7

(c) The fermentation of biomass by bacteria produces a mixture of products which include biobutanol, propanol, hydrogen and propanoic acid.

(i) Draw the structural formula of propanol and of propanoic acid. Show all the bonds.

propanol

propanoic acid

[2}

(ii) Why is it important to develop these fuels, such as biobutanol, as alternatives to petroleum?

..... [1]

(d) How could you show that butanol made from petroleum and biobutanol are the same chemical?

.....

..... [1]

Topic Chem 14 SubTopic: All up to & including homologous series **Q# 22/** iGCSE Chemistry/2009/w/Paper 3/Q7

(b) (i) Balance the equation for the complete combustion of butan-1-ol.

..... C_4H_9OH + ... O_2 → ..... CO_2 + ... H_2O [2]

Topic Chem 14 SubTopic: All up to & including homologous series **Q# 23/** iGCSE Chemistry/2010/s/Paper 31/

8 Methanoic acid is the first member of the homologous series of carboxylic acids.

(a) Give **two** general characteristics of a homologous series.

.....

.....

..... [2]

(c) Give the name, molecular formula and empirical formula of the fourth acid in this series.

name ..... [1]

molecular formula ..... [1]

empirical formula ..... [1]

Topic Chem 14 SubTopic: All up to & including homologous series **Q# 24/** iGCSE Chemistry/2011/w/Paper 31/

6 Structural formulae are an essential part of Organic Chemistry.

(a) Draw the structural formula of each of the following. Show all the bonds in the structure.

(i) ethanoic acid

[1]

(ii) ethanol

[1}

1 Petroleum contains hydrocarbons which are separated by fractional distillation.

(a) (i) Complete the following definition of a hydrocarbon.

A hydrocarbon is a compound which .....

..... [2]

(ii) Explain what is meant by the term *fractional distillation*.

.....

.....

..... [2]

(b) Some of the fractions obtained from petroleum are given below.
State a use for each fraction.

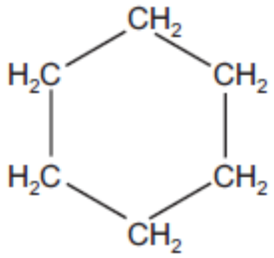
bitumen .....

lubricating fraction .....

paraffin fraction .....

gasoline fraction ..... [4]

4 The structural formula of cyclohexane is drawn below.



(a) The name gives information about the structure of the compound.
Hex because there are six carbon atoms and **cyclo** because they are joined in a ring.
What information about the structure of this compound is given by the ending **ane**?

.....

..... [2]

(b) What are the molecular and empirical formulae of cyclohexane?

molecular formula .....

empirical formula ..... [2]

(c) Draw the structural formula of cyclobutane.

[1]

(d) **(i)** Deduce the molecular formula of hexene.

..... [1]

(ii) Explain why cyclohexane and the alkene, hexene, are isomers.

.....

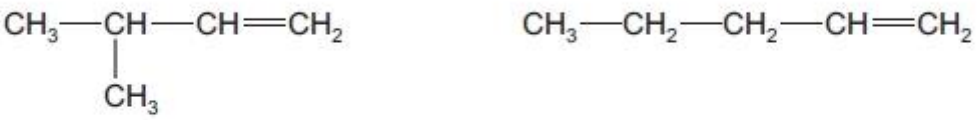
.....

..... [2]

Topic Chem 14 SubTopic: All up to & including homologous series **Q# 27/** iGCSE Chemistry/2013/w/Paper 31/

5 The alkenes are unsaturated hydrocarbons. They form a homologous series, the members of which have the same chemical properties.
They undergo addition reactions and are easily oxidised.

(a) The following hydrocarbons are isomers.



(i) Explain why these two hydrocarbons are isomers.

.....

..... [2]

(ii) Give the structural formula of another hydrocarbon which is isomeric with the above.

[1]

Topic Chem 14 SubTopic: All up to & including homologous series **Q# 28/** iGCSE Chemistry/2014/s/Paper 31/ Q3

(c) Most helium is obtained from natural gas found in the USA. Natural gas contains methane and 7% helium. One possible way to obtain the helium would be to burn the methane.

(i) Write an equation for the complete combustion of methane.

..... [1]

(ii) Suggest why this would **not** be a suitable method to obtain the helium.

.....

..... [1]

Topic Chem 14 SubTopic: All up to & including homologous series **Q# 29/** iGCSE Chemistry/2015/s/Paper 31/

4 The alcohols form a homologous series.

(a) (i) Give **three** characteristics which all members of a homologous series share.

.....

.....

.....

..... [3]

(ii) Give the name of the third member of this series.

name ..... [1]

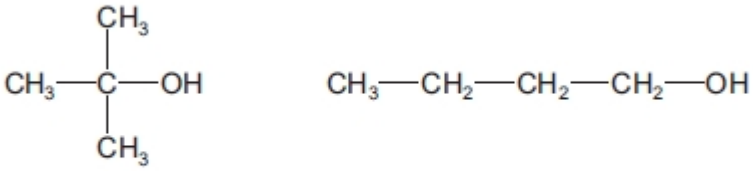
(iii) Deduce the molecular formula of the alcohol whose M_r = 158. Show your working.

.....

.....

..... [2]

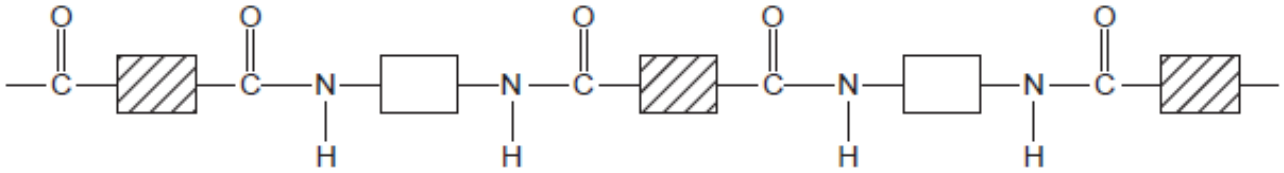
(b) Explain why the following two alcohols are isomers.



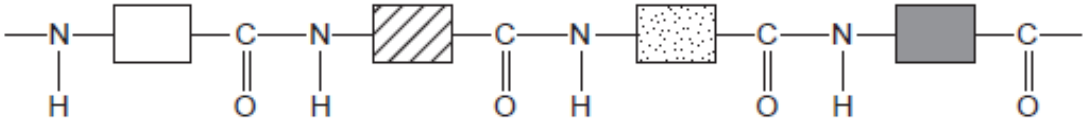
.....

..... [2]

(c) Two macromolecules have the same amide linkage.
Nylon, a synthetic polymer, has the following structure.



Protein, a natural macromolecule, has the following structure.



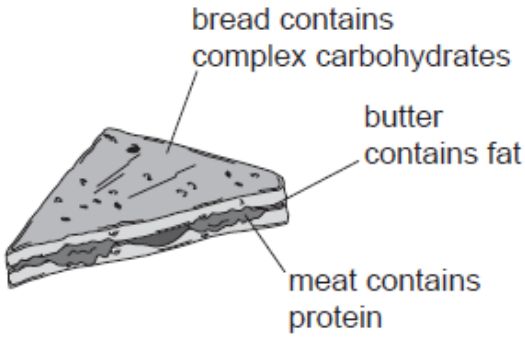
How are they different?

.....

.....

..... [2]

6 A sandwich contains three of the main constituents of food.



(a) **(i)** These constituents of food can be hydrolysed by boiling with acid or alkali.
Complete the table.

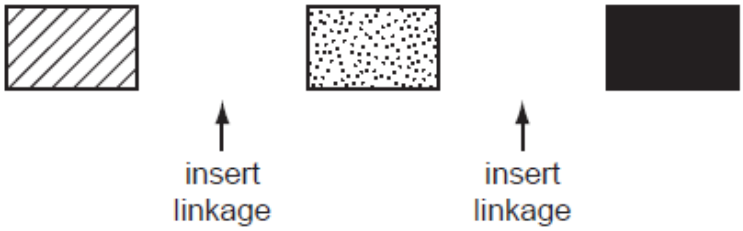
constituent of food	product of hydrolysis
protein	
complex carbohydrate	

[2]

(ii) What type of synthetic polymer contains the same linkage as proteins? .....

[1]

(b) An incomplete structural formula of a protein is given below.
Complete this diagram by inserting the linkages.



[2]

Topic Chem 14 SubTopic: Natural polymers **Q# 32/** iGCSE Chemistry/2015/w/Paper 31/

2 Describe how to separate the following. In each example, give a description of the procedure used and explain why this method works.

(c) Glycine from a mixture of the two amino acids glycine and alanine. Glycine has the lower R_f value.

procedure .....

.....

explanation .....

.....

[2]

Topic Chem 14 SubTopic: Natural polymers **Q# 33/** iGCSE Chemistry/2015/w/Paper 31/ Q7 (c)

(iii) The structural formula of glucose can be represented by H—O—□—O—H .

Draw part of the structural formula of starch which contains two glucose units.

[2]

(iv) Living organisms need carbohydrates for respiration.

What is meant by *respiration*?

..... [1]

(c) This question is based on typical reactions of butan-1-ol.

(i) When butan-1-ol, $CH_3–CH_2–CH_2–CH_2–OH$, is passed over the catalyst silicon(IV) oxide, water is lost.

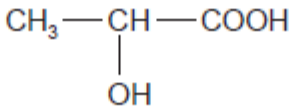
Deduce the name and the structural formula of the organic product in this reaction.

name .....

structural formula

[2]

8 Lactic acid can be made from corn starch.



lactic acid

It polymerises to form the polymer, polylactic acid (PLA) which is biodegradable.

(a) Suggest **two** advantages that PLA has compared with a polymer made from petroleum.

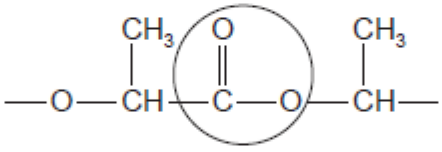
.....

.....

.....

..... [2]

(b) The structure of PLA is given below.



(i) What type of compound contains the group that is circled?

..... [1]

(ii) Complete the following sentence.

Lactic acid molecules can form this group because they contain both an

..... group and an ..... group. [2]

(iii) Is the formation of PLA, an addition or condensation polymerisation? Give a reason for your choice.

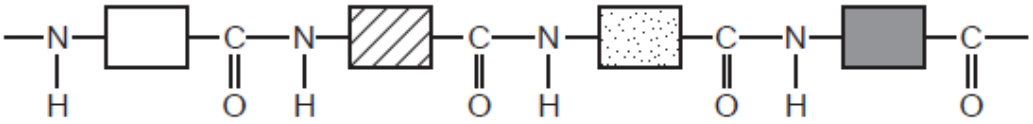
.....

.....

..... [2]

Topic Chem 14 SubTopic: Synthetic polymers **Q# 36/** iGCSE Chemistry/2010/s/Paper 31/Q4

(b) The structure of a typical protein is drawn below.



(i) What is the name of the polymer linkage?

..... [1]

(ii) Draw the structural formula of a man-made polymer with the same linkage.

[3]

Topic Chem 14 SubTopic: Synthetic polymers **Q# 37/** iGCSE Chemistry/2010/w/Paper 31/

5 Monomers polymerise to form polymers or macromolecules.

(a) (i) Explain the term *polymerise*.

.....

..... [1]

(ii) There are two types of polymerisation - addition and condensation. What is the difference between them?

.....

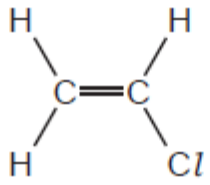
.....

..... [2]

5 Monomers polymerise to form polymers or macromolecules.

(b)

An important monomer is chloroethene which has the structural formula shown below.



(iv) Draw the structural formula of poly(chloroethene).

Include three monomer units.

[2]

8 There are two types of polymerisation - addition and condensation.

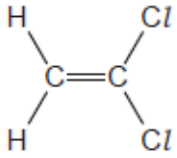
(a) Explain the difference between them.

.....

.....

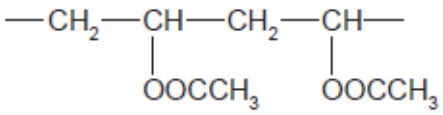
..... [2]

(b) Poly(dichloroethene) is used to package food. Draw its structure. The structural formula of dichloroethene is shown below.



[2]

(c) The polymer known as PVA is used in paints and adhesives. Its structural formula is shown below.



Deduce the structural formula of its monomer.

[1]

Topic Chem 14 SubTopic: Synthetic polymers **Q# 40/** iGCSE Chemistry/2011/s/Paper 31/ Q8

(d) A condensation polymer can be made from the following monomers.

$HOOC(CH_2)_4COOH$ and $H_2N(CH_2)_6NH_2$

Draw the structural formula of this polymer.

[3]

Topic Chem 14 SubTopic: Synthetic polymers **Q# 41/** iGCSE Chemistry/2011/w/Paper 31/Q6

(b) **(i)** Ethanoic acid and ethanol react to form an ester.
What is the name of this ester?

..... [1]

(ii) The same linkage is found in polyesters. Draw the structure of the polyester which can be formed from the monomers shown below.

$HOOC—C_6H_4—COOH$ and $HO—CH_2—CH_2—OH$

[3]

(iii) Describe the pollution problems caused by non-biodegradable polymers.

.....

.....

..... [2]

Topic Chem 14 SubTopic: Synthetic polymers **Q# 42/** iGCSE Chemistry/2012/s/Paper 31/

7 Plastics are polymers. They are formed from their monomers by polymerisation.

(a) Two methods for the disposal of waste plastics are

- burning
- recycling.

Describe one advantage **and** one disadvantage of each method.

burning .....

.....

.....

recycling .....

.....

..... [4]

(b) **(i)** There are two types of polymerisation reaction. Give their names and explain the differences between them.

.....

.....

.....

..... [4]

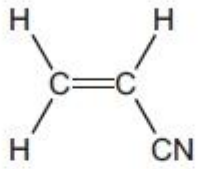
(ii) Give the structural formula of a polymer which is formed from two different monomers.

[2]

Topic Chem 14 SubTopic: Synthetic polymers **Q# 43/** iGCSE Chemistry/2013/w/Paper 31/

5 The alkenes are unsaturated hydrocarbons. They form a homologous series, the members of which have the same chemical properties.
They undergo addition reactions and are easily oxidised.

(d) Alkenes polymerise to form addition polymers.
Draw the structural formula of poly(cyanoethene), include at least **two** monomer units.
The structural formula of the monomer, cyanoethene, is given below.

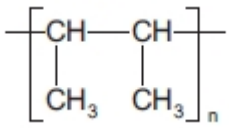


[3]

Topic Chem 14 SubTopic: Synthetic polymers **Q# 44/** iGCSE Chemistry/2014/s/Paper 31/

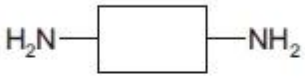
8 Polymers are made by the polymerisation of simple molecules called monomers.

(a) (i) The structural formula of a polymer is given below.



This polymer is made by addition polymerisation. Draw the structural formula of its monomer.

(ii) The two monomers shown below form a nylon which is a condensation polymer.



Draw its structural formula showing one repeat unit of the polymer.

[3]

(iii) Name the natural macromolecule which contains the same linkage as nylon.

..... [1]

(iv) Explain the difference between addition polymerisation and condensation polymerisation.

.....

.....

..... [2]

(b) Many polymers are non-biodegradable.

(i) Explain the term *non-biodegradable*.

.....

..... [2]

(ii) State **three** problems caused by the disposal of non-biodegradable polymers.

.....

.....

..... [3]

(c) Storage tanks for cold water are now made from polymers because they are cheaper than metal tanks. Suggest **two** other advantages of making cold water tanks from polymers.

.....

..... [2]

Topic Chem 14 SubTopic: Synthetic polymers **Q# 45/** iGCSE Chemistry/2014/w/Paper 31/Q6

(b) The following two monomers can form a polyester.

Draw the structural formula of this polyester. Include two ester linkages.

[3]

Topic Chem 14 SubTopic: Synthetic polymers **Q# 46/** iGCSE Chemistry/2015/w/Paper 31/

4 **(a)** Synthetic polymers are disposed of in landfill sites and by burning.

(i) Describe **two** problems caused by the disposal of synthetic polymers in landfill sites.

.....

..... [2]

(ii) Describe **one** problem caused by burning synthetic polymers.

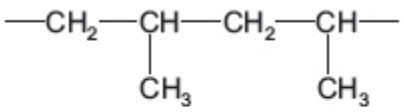
..... [1]

(b) State **two** uses of synthetic polymers.

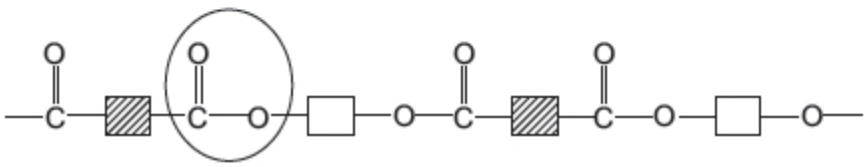
.....

..... [1]

(c) The structural formulae of two synthetic polymers are given below.



polymer **A**



polymer **B**

(i) Draw the structural formula of the monomer of polymer **A**.

{2}

(ii) Identify the functional group circled in polymer **B**.

..... [1]

(iii) Deduce the **two** types of organic compound which have reacted to form polymer **B**.

..... [2]

(d) Explain the difference between addition and condensation polymers. Classify **A** and **B** as either addition or condensation polymers.

.....

.....

.....

..... [3]

Mark Scheme iG Chem 14 EQ P3 Organic Chemistry

Q# 1/ iGCSE Chemistry/2009/w/Paper 3/

(ii) butanol + methanoic acid → butyl methanoate + water [2]
correct products **or** reactants ONLY [1]

Q# 2/ iGCSE Chemistry/2010/s/Paper 31/

4 **(a)** **(i)** ethanol [1]
CH_3-CH_2-OH [1]

propanoic acid [1]
CH_3-CH_2-COOH [1]
independent marking, no ecf
accept C_2H_5
not – HO

(iii) terylene / PET / Dacron / diolen / mylar / crimplene [1]

Q# 3/ iGCSE Chemistry/2010/s/Paper 31/

8 **(a)** same general formula
same chemical properties
same functional group
physical properties vary in predictable way
common methods of preparation
consecutive members differ by CH_2
any **two** [2]
mark first two
ignore others unless it contradicts a point which has been awarded a mark

(b) **(i)** $2HCOOH + CaCO_3 \rightarrow Ca(HCOO)_2 + CO_2 + H_2O$ [2]
not balanced = [1]

(ii) zinc + methanoic acid → zinc methanoate + hydrogen [2]
[1] for each product

(iii) protected by oxide layer [1]

(c) butanoic acid [1]
CH_3-CH_2-CH_2-COOH / $C_4H_8O_2$ / C_3H_7COOH / C_4H_7OOH [1]
C_2H_4O [1]
mark **ecf** to molecular formula

Q# 4/ iGCSE Chemistry/2011/s/Paper 31/ Q6 (a)

(ii) glucose / sugar changed to alcohol / ethanol [2]
accept an unbalanced equation
(catalysed by) enzymes / yeast [1]

(b) butanoic acid [1]
CH_3-CH_2-CH_2-COOH [1]
hydrogen atoms omitted from ends of bonds, penalise once

(c) (i) ester [1]

(ii) $C_6H_{12}O_2$
ignore $CH_3COOC_4H_9$ [1]

(iii) correct structural formula of butyl ethanoate showing all bonds [2]

Q# 5/ iGCSE Chemistry/2012/s/Paper 31/

(c) (i) potassium manganate(VII) / potassium dichromate(VI) / copper(II) oxide; [1]
note: do not insist on oxidation numbers but if given must be correct

(ii) butanoic acid; [1]

(iii) butyl ethanoate; [1]

correct formula all bonds shown = [2]
if alkyl groups incorrect then correct ester linkage showing bonds = [1] [2]

Q# 6/ iGCSE Chemistry/2014/w/Paper 31/

6 (a) (i) butanoic acid [1]
methanol [1]

(ii) number of moles of ethanoic acid = 0.1 [1]
number of moles of ethanol = 0.12(0) [1]
the limiting reagent is ethanoic acid [1]
number of moles of ethyl ethanoate formed = 0.1 [1]
maximum yield of ethyl ethanoate is 8.8 g [1]

Q# 7/ iGCSE Chemistry/2015/s/Paper 31/

4(c)(ii)	butyl ethanoate;	1	**A** butanyl **R** ethenoate and ethanoic
4(c)(iii)	butanoic acid; structural formula of butanoic acid;	2	**A** butyric acid Minimum acceptable structure is $CH_3CH_2CH_2CO_2H$ **A** $CH_3CH_2CH_2COOH$ with C–HO connectivity in acid group

Q# 8/ iGCSE Chemistry/2015/w/Paper 31/

5(b)(i)	unsaturated / C=C double bond / alkene;	1
5(b)(ii)	(organic / carboxylic) acid / contains or releases H^+ ions;	1
5(b)(iii)	CH_3CH=$CHCOOH$ / CH_2=$CHCH_2COOH$ / CH_2=$CH(CH_3)COOH$;	1

Q# 9/ iGCSE Chemistry/2009/s/Paper 31/Q8

(c) (i) lactic acid → acrylic acid + water [1]

(ii) add bromine (water) or bromine in an organic solvent [1]
remains brown/orange/yellow [1]
goes colourless **NOT** clear [1]
If mark 1 near miss e.g. bromide allow marks 2 and 3
Colour of reagent must be shown somewhere for [3] otherwise max [2]

OR acidified potassium manganate(VII)
purple/pink to colourless

OR alkaline potassium manganate(VII)
purple/pink to green
or purple/pink to brown precipitate

Q# 10/ iGCSE Chemistry/2009/w/Paper 3/

7 (a) (i) heat [1]
catalyst [1]

(ii) an equation that gives:
alkene + alkane
or alkene + alkene + hydrogen [1]

a correct and balanced equation for the cracking of decane, $C_{10}H_{22}$ but not but-1-ene [1]

(iii) water **or** steam [1]

Q# 11/ iGCSE Chemistry/2010/s/Paper 31/

(iii) chlorine [1]
not chlorine water
cond light / UV / heat / high temperature if numerical value given about 200°C / lead tetraethyl [1]
not warm

Q# 12/ iGCSE Chemistry/2010/w/Paper 31/

(b) (i) $C_{12}H_{26} \rightarrow C_8H_{18} + 2C_2H_4$ [1]
/ any other correct version

(ii) ethane and chlorine give range of products [1]
/ ethene more readily available than ethane
/ waste half chlorine as hydrogen chloride
/ ethene more reactive than ethane

Q# 13/ iGCSE Chemistry/2011/s/Paper 31/

6 (a) (i) cracking / heat with catalyst [1]
to make butane [1]
butene reacts with steam/water / hydrated [1]
accept heat and catalyst for cracking but if specified: 450 to 800°C zeolites / aluminosilicates / silica / aluminium oxide/alumina / china / broken pot / porcelain / chromium oxide

Q# 14/ iGCSE Chemistry/2012/s/Paper 31/

(b) (i) chlorination / substitution / photochemical / exothermic / halogenation / free radical; [1]

(ii) (compounds) same molecular formula; different structural formulae; [2]

(iii) $CH_3–CH_2–CH_2–CH_2–Cl$ [1]
$CH_3–CH_2–CH(Cl)–CH_3$ [1]

Q# 15/ iGCSE Chemistry/2012/w/Paper 31/

(c) bromine / bromine water / aqueous bromine; [1]
unsaturated - brown / orange to colourless **not:** clear [1]
saturated - stays brown / orange [1]

or: alkaline potassium manganate(VII);
from purple / pink to green / brown;
stays purple;
or: acidic potassium manganate(VII)
from purple / pink to colourless; **not:** clear
stays purple;

Q# 16/ iGCSE Chemistry/2013/s/Paper 31/Q3

(e) add bromine (water) or (I) [1]

cond: (remains) brown **or** orange **or** red or yellow [1]

cond: changes from brown, etc. to colourless or decolourises [1]
not: clear

OR
potassium manganate(VII) [1]
note: oxidation state not essential but if given must be correct or [0]
accept: potassium permanganate

cond: remains pink / purple [1]

cond: changes from pink to colourless **(acidic)** [1]
not: clear

cond: change from pink to green / brown **(alkaline)**

Q# 17/ iGCSE Chemistry/2013/w/Paper 31/

7 (a) (i) hydrogen (atoms) replaced by (atoms) of a different element e.g. chlorine [1]
NOT: substitute

(ii) light required [1]

Q# 18/ iGCSE Chemistry/2013/w/Paper 31/

5 (a) (i) have same molecular formula / both are C_5H_{12} [1]
they have different structural formulae / different structures [1]

(ii) CH_3-CH_2-CH=CH-CH_3 / any other correct isomer [1]

(b) (i) CH_2-(Br)-CH_2Br [1]
NOT: $C_2H_4Br_2$
dibromoethane [1]
NOTE: numbers not required but if given must be 1, 2

(ii) CH_3-CH_2-CH_3 [1]
NOT: C_3H_8
propane [1]

(iii) CH_3-CH_2-CH_2-OH / CH_3-CH_2-CH(OH)-CH_3 [1]
butanol [1]
numbers not required but if given must be correct and match formula

(c) (i) CH_3-CH=CH-CH_2-CH_3 [1]
CH_3-CH=CH-CH_3 [1]

(ii) pink / purple [1]
colourless [1]
NOT: clear

Q# 19/ iGCSE Chemistry/2014/w/Paper 31/ Q6

(c) (i) add bromine water/bromine [1]
turns colourless [1]
remains brown/orange/reddish brown/yellow [1]

ALLOW: potassium manganate(VII) (acidic or alkaline) [1]
correct colour colourless/green or brown ppt [1]
stays pink/purple [1]

(ii) ester 1 [1]
COND alkyl group is C_nH_{2n+1} which is NOT $C_{17}H_{33}$
or $C_{17}H_{35}$ is C_nH_{2n+1} **or** less hydrogen [1]

(iii) soap **or** (sodium) salt (of a carboxylic acid) **or** carboxylate [1]

alcohol [1]

Q# 20/ iGCSE Chemistry/2009/w/Paper 3/

(c) (i) structural formula of Ge_4H_{10} all bonds shown [1]

(ii) germanium(IV) oxide [1]
water [1]

Q# 21/ iGCSE Chemistry/2009/w/Paper 3/ Q7

(c) (i) correct structural formulae [1] each [2]
accept either propanol and –OH in alcohol and acid
penalise once for CH_3 type diagrams
For either C_3H_8O **or** $C_3H_6O_2$ [0]

(ii) to conserve petroleum **or** reduce greenhouse effect [1]

(d) have same boiling point [1]

Q# 22/ iGCSE Chemistry/2009/w/Paper 3/

(b) (i) $C_4H_9OH + 6O_2 \rightarrow 4CO_2 + 5H_2O$ [2]
If only error is balancing the oxygen atoms [1]

Q# 23/ iGCSE Chemistry/2010/s/Paper 31/

8 (a) same general formula
same chemical properties
same functional group
physical properties vary in predictable way
common methods of preparation
consecutive members differ by CH_2
any **two** [2]
mark first two
ignore others unless it contradicts a point which has been awarded a mark

(c) butanoic acid [1]
CH_3-CH_2-CH_2-COOH / $C_4H_8O_2$ / C_3H_7COOH / C_4H_7OOH [1]
C_2H_4O [1]
mark **ecf** to molecular formula

Q# 24/ iGCSE Chemistry/2011/w/Paper 31/

6 (a) (i) correct structural formula of ethanoic acid [1]
allow: –OH **not:** –COOH

(ii) correct structural formula of ethanol [1]
allow: –OH

Q# 25/ iGCSE Chemistry/2013/s/Paper 31/

1 (a) (i) contains carbon and hydrogen [1]
cond: only / just [1]

(ii) (different) boiling points [1]
cond: separate [1]

(b) bitumen-making roads / roofs / water-proofing, etc. [1]

lubricating fraction – waxes / vaseline / grease, etc. or machinery example, e.g. (oil a) bike / hinges / reducing friction [1]

paraffin fraction – jet fuel / (home) heating or tractors or cooking or lighting [1]

gasoline fraction – petrol or fuel for cars / vans / trucks [1]

Q# 26/ iGCSE Chemistry/2013/s/Paper 31/

3 (a) (i) pieces have (same) surface area [1]
same amount / mass / quantity / volume / number of moles of carbonate [1]

(ii) no more bubbles / carbon dioxide **or** piece disappears / dissolves [1]

(b) experiment 1 $Ca^{2+} + CO_2 + H_2O$ [1]

(c) (i) more concentrated **or** higher concentration (of acid) (in experiment 1) [1]
accept: arguments based on collision theory

(ii) ethanoic acid is a weak acid **or** hydrochloric acid is a strong acid [1]
accept: stronger or weaker

ethanoic acid less ionised / dissociated / lower / smaller concentration of hydrogen ions [1]
accept: less hydrogen ions and vice versa argument but not dissociation of ions

(iii) lower temperature (particles) have less energy [1]
moving more slowly [1]
fewer collisions / lower collision rate [1]
or
lower temperature (particles) have less energy [1]
fewer particles collide [1]
with the necessary energy to react [1]
note: less energy fewer successful collisions gains all 3 marks

(d) (i) C_6H_{12} [1]
accept: a correct structural formula

(ii) same molecular formula **not**: chemical formula [1]
different structural formulae / structures [1]

Q# 27/ iGCSE Chemistry/2013/w/Paper 31/

5 (a) (i) have same molecular formula / both are C_5H_{12} [1]
they have different structural formulae / different structures [1]

(ii) CH_3-CH_2-CH=CH-CH_3 / any other correct isomer [1]

Q# 28/ iGCSE Chemistry/2014/s/Paper 31/ Q3

(c) (i) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ (1) [1]

(ii) would get a mixture of helium and carbon dioxide
or would get a mixture of gases
or waste of methane / natural gas / fossil fuel (1) [1]

Q# 29/ iGCSE Chemistry/2015/s/Paper 31/

4(a)(i)	*Any **three** from:* same general formula; contain the same functional group; consecutive members differ by CH_2; common methods of preparation; same or similar chemical properties; physical properties vary in a predictable manner / show trends / show a gradual change / an example of a physical variation e.g. mpt, bpt volatility viscosity;	3	**I** different physical properties / physical properties change / an unqualified or slight change **R** same or similar physical properties
4(a)(ii)	propanol / propan-1-ol / propan-2-ol;	1	
4(a)(iii)	if molecular formula is given as $C_{10}H_{22}O$ award 2 marks if not, look for evidence of some correct working for one mark 158 – 17 = 141 **OR** 12n + 2n + 1 = 141 **OR** n = 10	2	**A** $C_{10}H_{21}OH$ for two marks **A** (10 × 12) + (22 × 1) + 16 = 158 for one (working) mark
4(b)	they have the same molecular formula ($C_4H_{10}O$); different structures;	2	**A** same number of each type of atom **I** same number of atoms **A** different structural formula or different arrangement of atoms

Q# 30/ iGCSE Chemistry/2011/w/Paper 31/ Q6

(c) synthetic – only two monomers [1]
protein – many different monomers [1]
or:
protein has 1 C=O and 1N–H [1]
nylon has 2 C=O / 2N–H [1]
or:
synthetic – one monomer is a dicarboxylic acid and the other is a diamine [1]
protein all monomers are amino acids [1]

Q# 31/ iGCSE Chemistry/2012/w/Paper 31/

6 (a) (i) amino acid / peptides; [1]
salt / carboxylate or soap / fatty acid or glycerine / alcohol; [1]
sugars or glucose; [1]
accept: named sugar

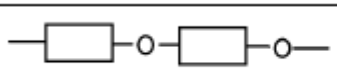
(ii) polyester; [1]
allow: named polyester
polyamide; [1]
allow: nylon

(b) one correct amide linkage; [1]
second amide linkage correctly orientated
– NHCO – followed by – NHCO –; [1]
note: monomers are amino acids not diamines or dicarboxylic acid

Q# 32/ iGCSE Chemistry/2015/w/Paper 31/

2(c)	chromatography; use a locating agent / the two acids move at different rates / alanine travels faster / alanine higher up paper / travels further;	1 1

Q# 33/ iGCSE Chemistry/2015/w/Paper 31/ Q7 (c)

7(c)(iii)	 one correct –O– link between rectangles; two correct glucose units with continuation bonds;	 1 1
7(c)(iv)	the reaction of glucose with oxygen to release (carbon dioxide and water and) energy; **or** the reaction of glucose in a biological system to release energy;	1

Q# 34/ iGCSE Chemistry/2015/s/Paper 31/

4(c)(i)	M1 butene or but-1-ene; M2 structural formula of but-1-ene;	 2	M1 and M2 are independent **A** but-2-ene for M1 Minimum acceptable structure is $CH_3CH_2CH=CH_2$ Double bond must be shown **R** structure of but-2-ene for M2

Q# 35/ iGCSE Chemistry/2009/s/Paper 31/

8 **(a)** biodegradable or breaks down naturally
made from a renewable source **or** does not use up petroleum

reduce visual pollution **or** reduces need for landfill sites **or** less danger to wildlife
any **TWO** [2]
ignore mention of toxic gases

(b) **(i)** ester [1]
accept polyester **or** fat **or** lipid **or** vegetable oil **or** carboxylic acid

(ii) acid **or** carboxylic acid **or** alkanoic acid [1]
alcohol **or** hydroxyl **or** alkanol [1]
NOT formulae **NOT** hydroxide

(iii) condensation [1]
COND because water is formed in reaction
or monomer does not have C=C bond [1]

Q# 36/ iGCSE Chemistry/2010/s/Paper 31/

(b) **(i)** polyamide / amide / peptide / polypeptide [1]

(ii) correct amide linkage NHCO then CONH [1]
cond to mark 1, 2 monomers (different shading in box) [1]
cond continuation (to **ONE** correct linkage) [1]

OR nylon 6
only one linkage – NHCO [1]
cond only one monomer [1]
cond continuation (to correct linkage) [1]

Q# 37/ iGCSE Chemistry/2010/w/Paper 31/

5 **(a)** **(i)** many (simple) molecules form one (large) molecule / monomer molecules form one polymer molecule [1]

(ii) addition - polymer is the only product [1]
accept - nX → Xn
condensation polymer and simpler molecules formed [1]
accept nX → Xn + nHC*l* / H_2O

Q# 38/ iGCSE Chemistry/2010/w/Paper 31/ Q5 (b)

(iv) must have **three** correct units [1]
cond continuation [1]
accept –(CH2–CH(C*l*))n–

Q# 39/ iGCSE Chemistry/2011/s/Paper 31/

8 (a) addition – polymer only product / only one product [1]
accept monomer has C=C
accept monomer and polymer have same empirical formula
accept no loss of material in polymerisation
not only one monomer

condensation – polymer and water / small molecule formed [1]

(b) $-CH_2 - CCl_2-$
repeat unit correct [1]
COND continuation [1]

(c) $CH_2=CHOOCCH_3$ [1]

Q# 40/ iGCSE Chemistry/2011/s/Paper 31/ Q8

(d) $-OC(CH_2)_4CONH(CH_2)_6NH-$
COND amide correct linkage [1]
correct repeat units [1]
continuation [1]
not NH_2 **or** COOH endings

Q# 41/ iGCSE Chemistry/2011/w/Paper 31/

(b) (i) ethyl ethanoate [1]

(ii) $–OC_6H_4COOCH_2CH_2O–$
correct ester linkage [1]
correct repeat units [1]
continuation [1]
accept: boxes if it is clear what the box represents

(iii) any **two** from:
long time to decay
landfill sites
visual pollution / litter
danger to animals
poisonous gases when burnt [2]
accept: any correct suggestion

Q# 42/ iGCSE Chemistry/2012/s/Paper 31/

7 (a) **burning**
produces toxic gases / harmful to health
increases greenhouse gases / global warming
reduces visual pollution / litter
reduces risks to wildlife
shortage of landfill sites / reduces space needed in landfill sites / saves space
non-biodegradable / long time to rot / decompose / accumulates waste
burning source of energy / used to generate electricity

recycling
conserves petroleum / natural resources
difficult to recycle / expensive / takes much energy
problems over sorting
reduces need for landfill
quality of plastic is reduced each time it is recycled
four DIFFERENT valid points which are advantages or disadvantages of burning and/or recycling [4]

(b) (i) addition (polymerisation); [1]

(polymer) only product / no by-products; [1]

condensation (polymerisation); [1]

(polymer and) simple molecule / water / hydrogen chloride / one other product forms; [1]

(ii) a correct linkage (for a polyamide / polyester); [1]
two different monomers; [1]

Q# 43/ iGCSE Chemistry/2013/w/Paper 31/

(d) $-CH_2-CH(CN)-CH_2-CH(CN)-$
correct repeat unit $CH_2-CH(CN)$ [1]
COND: at least 2 units in diagram [1]
continuation [1]

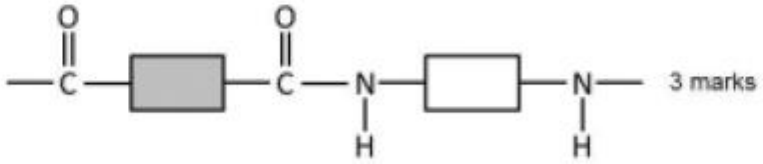
Q# 44/ iGCSE Chemistry/2014/s/Paper 31/

8 (a) (i) $CH_3–CH=CH–CH_3$ (1) [1]

(ii) one correct amide linkage between two rectangles (1)

correct sequencing of a second amide link and monomers (1)

two correct amide links **and** rest of structure correct (including additional monomers if seen) **and** correct continuation bonds (1) [3]



3 marks

(iii) protein **or** polypeptide **or** named protein (1) [1]

(iv) addition: **only** the polymer **or** one product is formed (1)

condensation: the polymer **and** a small molecule/water/HC*l* is formed (1) [2]

(b) (i) does not break down **or** rot **or** decompose (1)

by microbes **or** fungi **or** bacteria **or** by living organisms (1) [2]

(ii) Any **three** from: [3]
visual pollution (1)

(shortage of) landfill sites (1)

danger to wildlife / animals (including at sea) (1)

toxic gases when burnt **or** greenhouse gases produced when burned (1)

(c) Any **two** from: [2]

(c) Any **two** from: [2]
resistant to corrosion / unreactive to water / more durable (1)

lighter / less dense (1)

easier to manufacture / can be moulded (1)

good insulator / keeps the water cold (1)

[Total: 14]

Q# 45/ iGCSE Chemistry/2014/w/Paper 31/Q6

(b) correct ester linkage [1]
two ester linkages (COND on M1) [1]
continuation (COND on M2) [1]

Q# 46/ iGCSE Chemistry/2015/w/Paper 31/

Question	Answer	Marks
4(a)(i)	any two from: • shortage of sites / landfill sites fill up; • visual pollution / litter; • danger to wild life;	2
4(a)(ii)	(produce) toxic gases or CO or HCl or HF / carbon dioxide / greenhouse gases;	1
4(b)	any two from: bags / clothing or specified clothing / packaging / bowls / cups / plates / flooring / carpets / pipes / insulation / non-stick coatings / ropes;	1

Question	Answer	Marks
4(c)(i)	$CH_2=CHCH_3$ double bond is shown; rest of structure correct;	2
4(c)(ii)	ester;	1
4(c)(iii)	(carboxylic) acid; alcohol;	1 1
4(d)	addition – polymer only product / only one product; condensation – (polymer and) simple molecule / water / hydrogen chloride made; polymer **A** is an addition polymer **and** polymer **B** is a condensation polymer;	1 1 1