iG Chem ALL TOPICS EQ P4 NEW 16 March to 18 November 1679marks

Contents

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	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	

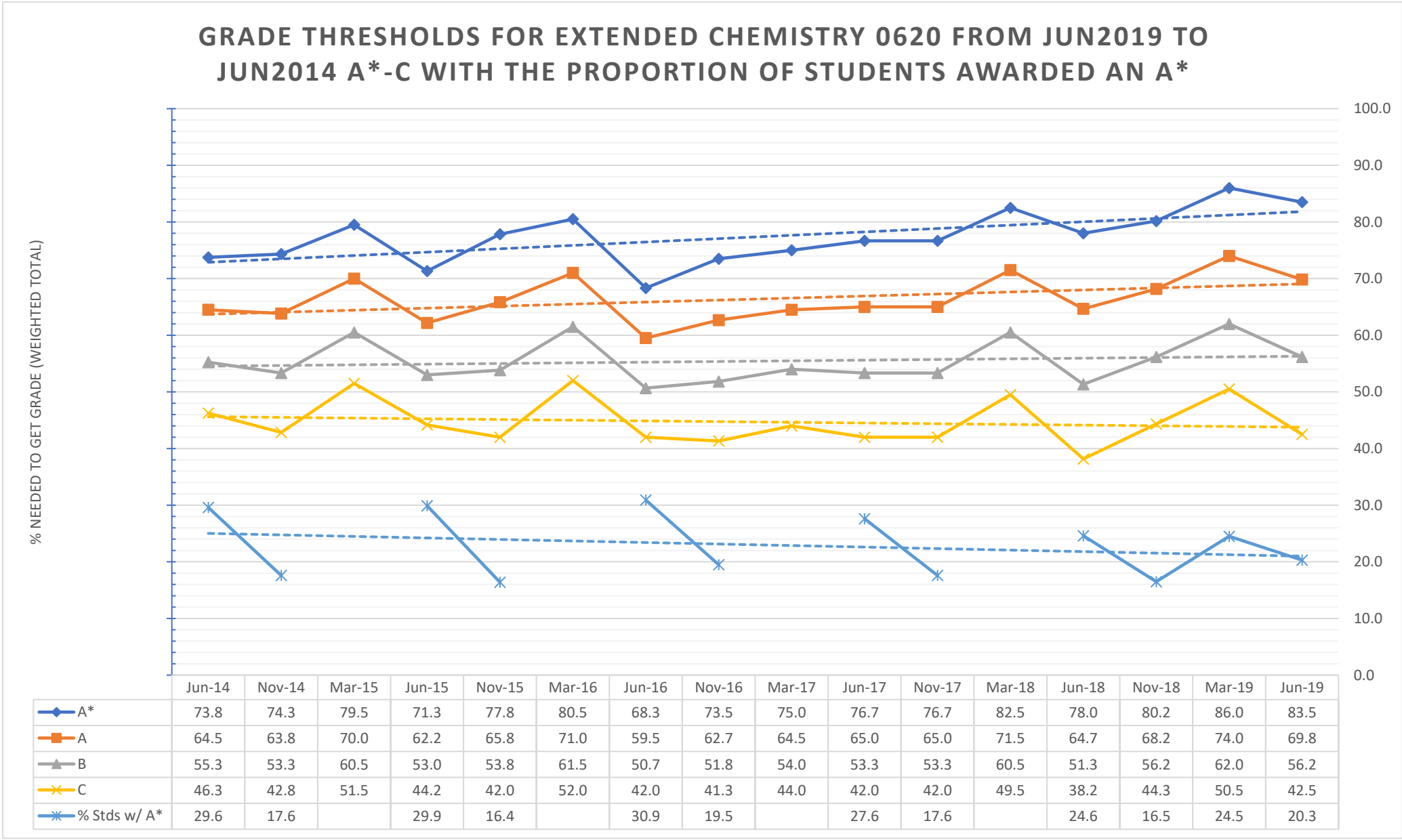
*58-71 Lanthanoid series
†90-103 Actinoid series

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.).

Name

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) **WEEK starting: _____**

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							
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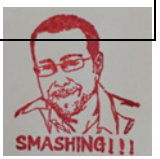

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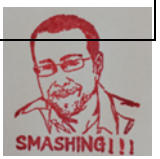

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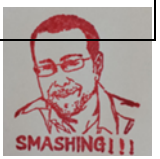

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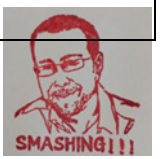
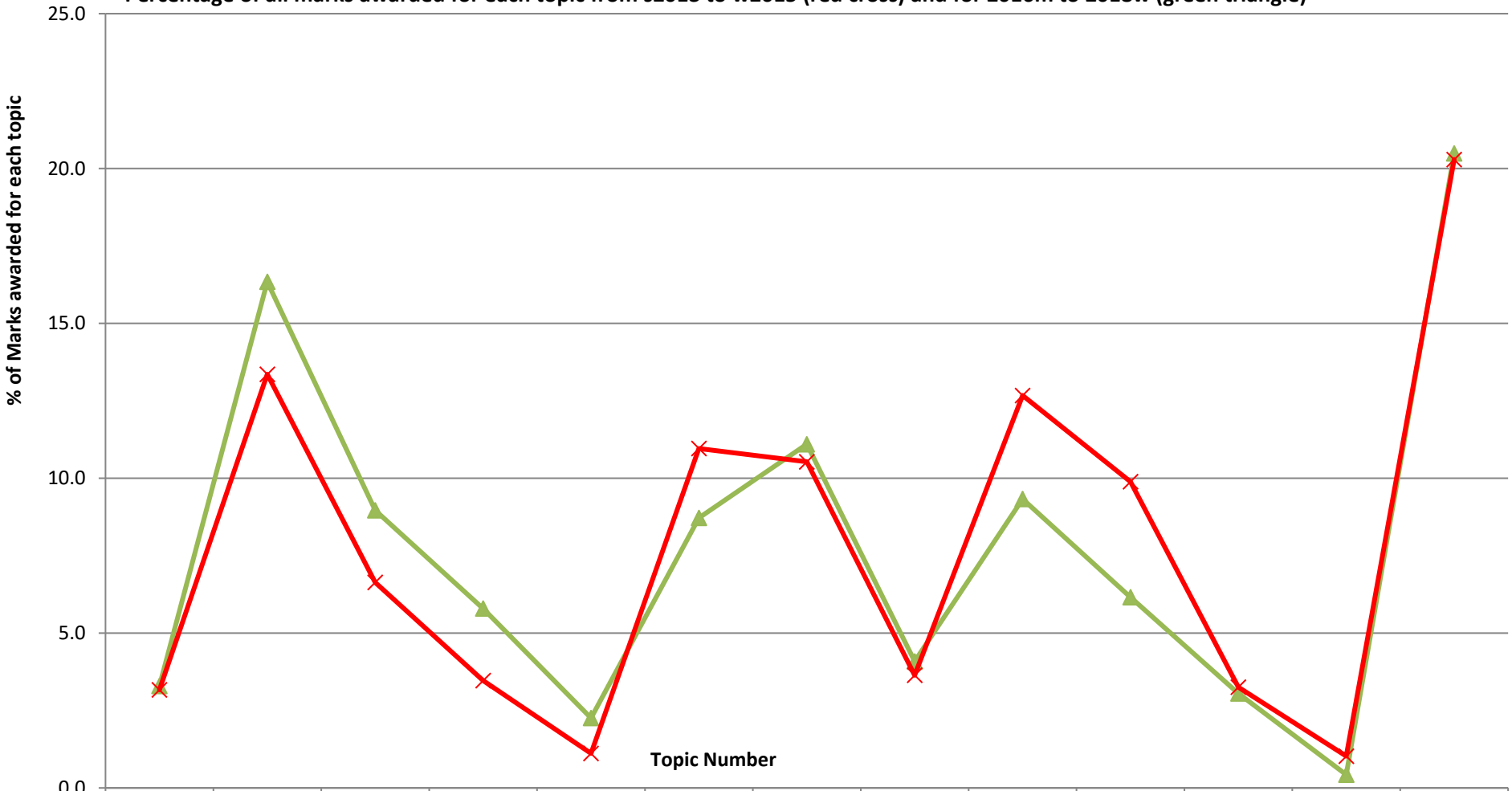


0620 PAPER 4 (pre2016 called Paper 3)

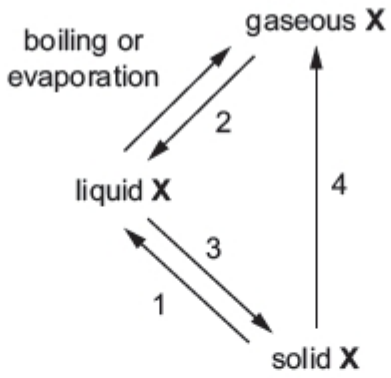
Percentage of all marks awarded for each topic from s2013 to w2015 (red cross) and for 2016m to 2018w (green triangle)



	1	3	4	5	6	7	8	9	10	11	12	13	14
P4 2016m-18w	3.3	16.3	9.0	5.8	2.3	8.7	11.1	4.1	9.3	6.2	3.0	0.4	20.5
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 1 **Q# 1/** IGCSE Chemistry/2018/w/Paper 42/Q1

1 Element **X** can undergo the following physical changes.



(a) (i) Give the scientific name for each of the numbered physical changes.

1 .....

2 .....

3 .....

4 .....

[4]

(ii) Explain why the changes shown are physical changes.

.....

..... [1]

(iii) One difference between boiling and evaporation is the rate at which the processes occur.

State **one** other difference between boiling and evaporation.

.....

..... [1]

(b) Describe the separation, arrangement and motion of particles of element **X** in the solid state.

separation .....

arrangement .....

motion .....

[3]

(c) Element **X** is a Group I metal. It burns in air to form an oxide X_2O.

Write a chemical equation for this reaction.

..... [2]

1 **(a)** Dust particles in the air move around in a random way.

(i) What term describes the random movement of the dust particles?

..... [1]

(ii) Identify the particles in the air which cause the random movement of the dust particles.

..... [2]

(iii) Explain why the dust particles move in this way.

.....

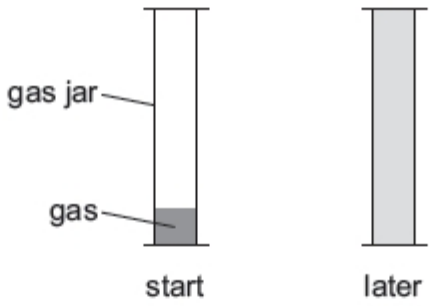
.....

..... [2]

(b) When chlorine gas, Cl_2, is put into a gas jar, it spreads out to fill the gas jar.

When bromine gas, Br_2, is put into a gas jar, it also spreads out to fill the gas jar.

The process takes longer for bromine gas than for chlorine gas.



(i) What term describes the way that the gas particles spread out?

..... [1]

(ii) Use **data** from the Periodic Table to explain why bromine gas takes longer to fill a gas jar than chlorine gas.

.....

.....

..... [2]

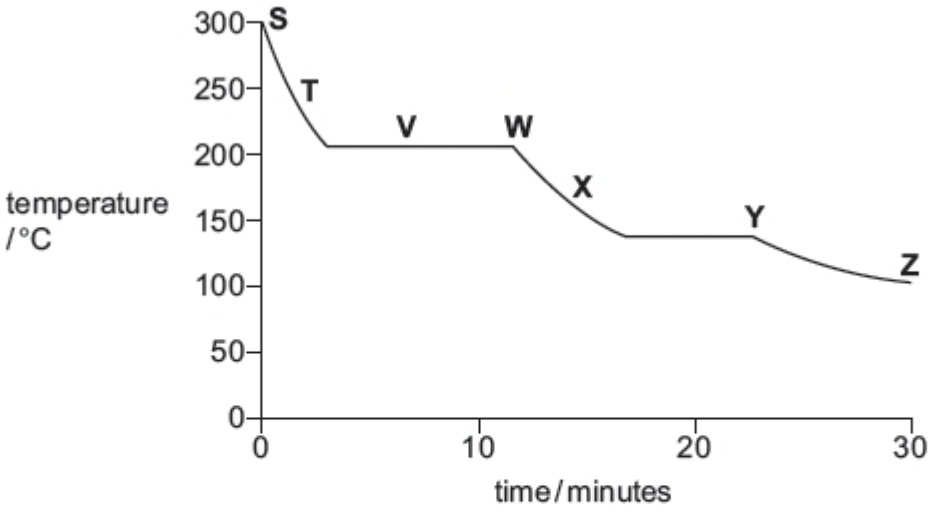
(iii) Explain why increasing the temperature increases the rate at which the gas particles spread out.

.....

..... [1]

[Total: 9]

2 The graph shows how the temperature of a substance changes as it is cooled over a period of 30 minutes. The substance is a gas at the start.



Each letter on the graph may be used once, more than once or not at all.

(a) Which letter, **S**, **T**, **V**, **W**, **X**, **Y** or **Z**, shows when

(i) the particles in the substance have the most kinetic energy,

..... [1]

(ii) the particles in the substance are furthest apart,

..... [1]

(iii) the substance exists as both a gas and a liquid?

..... [1]

(b) Use the graph to estimate the freezing point of the substance.

..... °C [1]

(c) Name the change of state directly from a solid to a gas.

..... [1]

(d) When smoke is viewed through a microscope, the smoke particles in the air appear to jump around.

(i) What term describes this movement of the smoke particles?

..... [1]

(ii) Explain why the smoke particles move in this way.

.....

.....

..... [2]

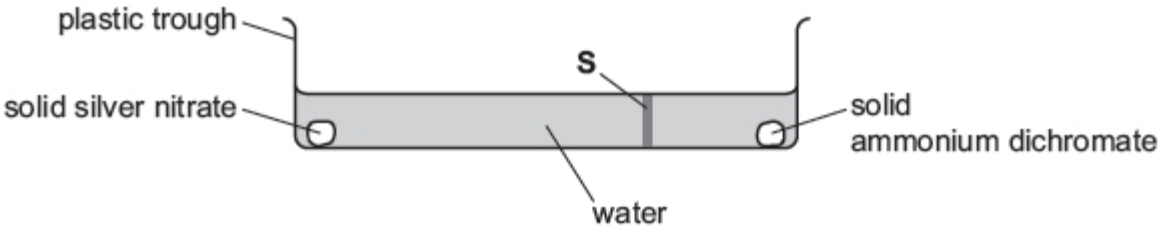
Topic Chem 1 **Q# 4/** IGCSE Chemistry/2017/m/Paper 42/

2 Silver dichromate, $Ag_2Cr_2O_7$, is a red insoluble salt.

Silver dichromate can be made by reacting silver nitrate solution with ammonium dichromate solution. The chemical equation for the reaction is shown.

$$2AgNO_3(aq) + (NH_4)_2Cr_2O_7(aq) \rightarrow 2NH_4NO_3(aq) + Ag_2Cr_2O_7(s)$$

(d) The apparatus shown was set up.



After five minutes, a red solid appeared along the line marked **S** on the diagram.

(i) Explain why a red solid appeared along the line marked **S**.

.....

.....

.....

..... [3]

(ii) The experiment was repeated at a higher temperature.

What effect, if any, would this have on the time taken for the red solid to appear? Explain your answer.

.....

..... [2]

Topic Chem 1 **Q# 5/** IGCSE Chemistry/2016/w/Paper 42/

1 Particles behave differently when in different physical states.

(a) Solids have a fixed volume and a definite shape.
Gases have no fixed volume and take the shape of the container.

Describe the volume and shape of liquids.

.....

..... [1]

(b) Complete the table to show the separation, arrangement and movement of particles in each physical state.

state	separation of particles	arrangement of particles	movement of particles
solid			
liquid	touching one another	randomly arranged	move over one another
gas			

[6]

(c) Name the following changes of state.

(i) Ice turning into water.

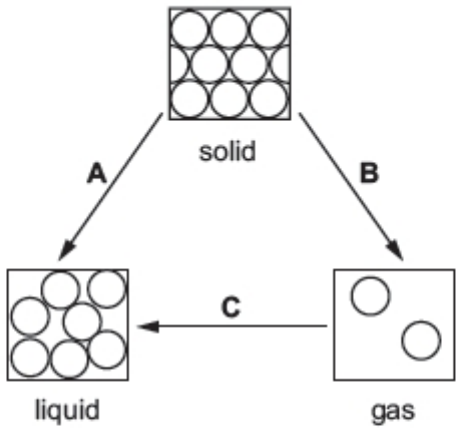
..... [1]

(ii) Solid carbon dioxide turning directly into gaseous carbon dioxide at room temperature.

..... [1]

Topic Chem 1 **Q# 6/** IGCSE Chemistry/2016/w/Paper 41/

2 Matter can exist as solid, liquid or gas. The arrows show some changes of state.



(a) Name the changes of state represented on the diagram.

(i) **A** ..... [1]

(ii) **B** ..... [1]

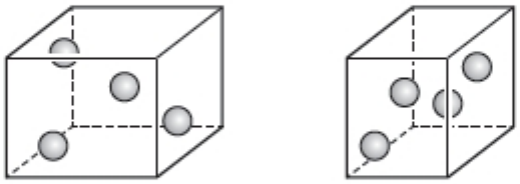
(iii) **C** ..... [1]

(b) Explain why energy has to be supplied to turn a liquid into a gas.

.....

..... [1]

(c) The diagrams represent the same number of particles of a gas in two containers, **D** and **E**, which have different volumes. The two containers are at the same temperature.



In which container will the pressure be higher? Explain your answer.

.....

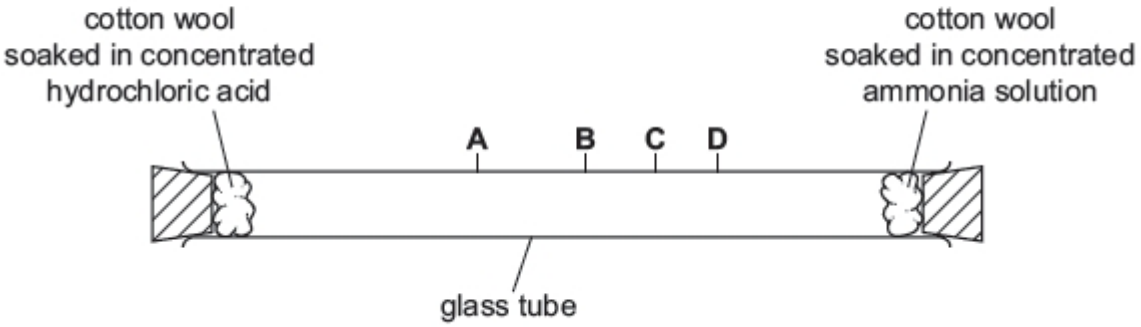
.....

..... [1]

Topic Chem 1 **Q# 7/** IGCSE Chemistry/2016/s/Paper 43/

6 Concentrated ammonia solution gives off ammonia gas. Concentrated hydrochloric acid gives off hydrogen chloride gas. Ammonia, NH_3, and hydrogen chloride, HCl, are both colourless gases. Ammonia reacts with hydrogen chloride to make the white solid ammonium chloride.

Apparatus is set up as shown.



After ten minutes a white solid forms in the tube where the gases meet.

(a)

(ii) Name the process by which the ammonia and hydrogen chloride gases move in the tube.

..... [1]

(iii) At which point, **A**, **B**, **C** or **D**, does the white solid form? Explain why the white solid forms at that point.

the solid forms at .....

explanation .....

..... [3]

(ii) Name the process by which the ammonia and hydrogen chloride gases move in the tube.

..... [1]

(iii) At which point, **A**, **B**, **C** or **D**, does the white solid form? Explain why the white solid forms at that point.

the solid forms at .....

explanation .....

.....

[3]

(iv) The experiment was repeated at a higher temperature.

Predict how the results of the experiment would be different. Explain your answer.

.....

.....

..... [3]

Topic Chem 2 **Q# 8/** IGCSE Chemistry/2018/w/Paper 42/Q3c

step 1 Add an excess of zinc carbonate to 20 cm^3 of 0.4 mol/dm^3 dilute sulfuric acid until the reaction is complete.

step 2 Filter the mixture.

step 3 Heat the filtrate until a saturated solution forms and then allow it to crystallise.

(i) Name a suitable piece of apparatus for measuring 20 cm^3 of dilute sulfuric acid in **step 1**.

..... [1]

(iv) What is meant by the term *saturated solution* in **step 3**?

.....

..... [2]

Topic Chem 2 **Q# 9/** IGCSE Chemistry/2018/s/Paper 42/Q8b

(iv) How would the student test to determine if the water produced in **(b)(iii)** is pure?

..... [1]

Topic Chem 2 **Q# 10/** IGCSE Chemistry/2018/s/Paper 42/

1 Give the name of the process that is used:

(a) to obtain water from aqueous sodium chloride

..... [1]

(c) to separate an insoluble solid from a liquid

..... [1]

(e) to separate a mixture of coloured dyes.

..... [1]

Topic Chem 2 **Q# 11/** IGCSE Chemistry/2018/s/Paper 41/Q1

(b) Mixtures can be separated by physical processes.

A sequence of physical processes can be used to separate common salt (sodium chloride) from a mixture containing sand and common salt only.

Give the order and the correct scientific term for the physical processes used to separate the common salt from the mixture.

1 .....

2 .....

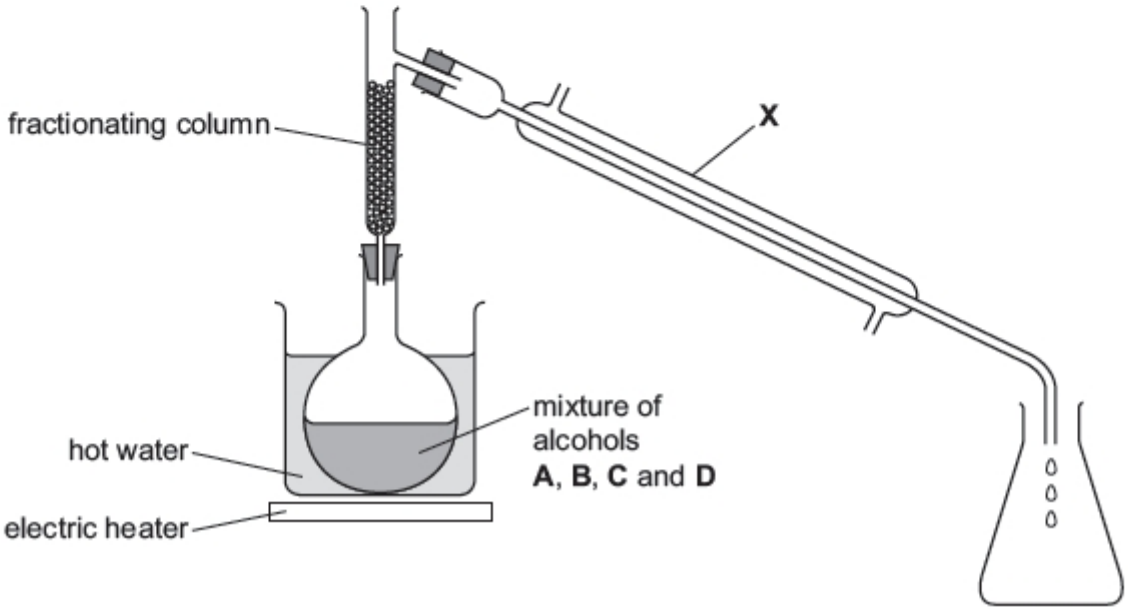
3 .....

[4]

The boiling points of four different alcohols, **A**, **B**, **C** and **D**, are shown.

alcohol	**A**	**B**	**C**	**D**
boiling point/°C	56	78	122	160

(c) A student suggested that the apparatus shown could be used to separate the mixture of alcohols.



(i) Apparatus **X** needs to have cold water flowing through it.

- Draw an arrow on the diagram to show where the cold water enters apparatus **X**.
- Name apparatus **X**.

.....

[2]

(ii) Part of the fractionating column is missing. This means that the experiment will not work.

- Draw on the diagram the part of the fractionating column which is missing.
- Explain why the experiment will **not** work with this part of the fractionating column missing.

.....

.....

[2]

(iii) Suggest why a Bunsen burner is **not** used to heat the flask.

..... [1]

(iv) A hot water bath cannot be used to separate alcohols **C** and **D**.

Explain why.

.....

.....

..... [2]

Topic Chem 2 **Q# 12/** IGCSE Chemistry/2018/m/Paper 42/Q5

(e) Chromatography can be used to identify simple sugars in a mixture.

A student analysed a mixture of simple sugars by chromatography. All the simple sugars in the mixture were colourless.

(i) What is the name given to the type of substance used to identify the positions of the simple sugars on the chromatogram?

..... [1]

(ii) The student calculated the R_f value of a spot on the chromatogram.

Complete the expression for the R_f value of the spot.

R_f =

[1]

(iii) How could a student identify a simple sugar from its R_f value?

.....

..... [1]

(iv) Sometimes not all the substances in a mixture can be identified from the chromatogram produced.

Explain why this may happen.

..... [1]

Topic Chem 2 **Q# 13/** IGCSE Chemistry/2017/s/Paper 42/

1 **(a)** State the name of the process that is used to

(ii) separate the individual dyes in ink,

..... [1]

(iv) obtain water from aqueous sodium chloride,

..... [1]

(v) separate the precipitate formed when aqueous silver nitrate is added to aqueous sodium chloride.

..... [1]

Topic Chem 2 **Q# 14/** IGCSE Chemistry/2017/s/Paper 41/

3 Magnesium sulfate and lead(II) sulfate are examples of salts.

(a) A student prepared magnesium sulfate crystals starting from magnesium carbonate. The student carried out the experiment in four steps.

step 1 The student added excess magnesium carbonate to a small volume of dilute sulfuric acid until no more magnesium carbonate would react.

step 2 The student filtered the mixture.

step 3 The student heated the filtrate obtained from **step 2** until it was saturated.

step 4 The student allowed the hot filtrate to cool to room temperature and then removed the crystals which formed.

(iii) A saturated solution forms in **step 3**.

What is a saturated solution?

.....

..... [2]

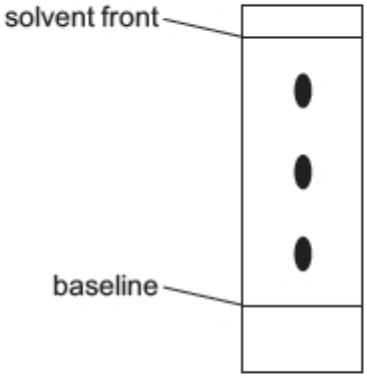
(iv) Explain why magnesium sulfate crystals form during **step 4**.

.....

..... [1]

Topic Chem 2 **Q# 15/** IGCSE Chemistry/2016/w/Paper 42/Q7

(c) A colourless mixture of amino acids was separated by chromatography.
Amino acid **X** has an R_f value of 0.8.
The chromatogram of the mixture after treatment with a locating agent is shown.



(i) How is an R_f value calculated?

R_f =

[1]

(ii) On the diagram put a ring around the spot caused by amino acid **X**. [1]

(iii) Describe how you would perform a chromatography experiment to produce the chromatogram shown in **(c)**. Assume you have been given the mixture of amino acids and a suitable locating agent. You are provided with common laboratory apparatus.

.....

.....

.....

.....

.....

..... [3]

Topic Chem 2 **Q# 16/** IGCSE Chemistry/2016/w/Paper 41/

1 The table gives some information about five substances.

substance	melting point /°C	boiling point /°C	solubility in water	electrical conductivity when molten	electrical conductivity when solid
F	–97	65	very soluble	does not conduct	does not conduct
G	1600	2230	insoluble	does not conduct	does not conduct
H	801	1413	soluble	conducts	does not conduct
I	–57	126	insoluble	does not conduct	does not conduct
J	1085	2562	insoluble	conducts	conducts

(c) Name a method you could use to separate a mixture of substance **J** and water.

..... [1]

(d) Name a method you could use to obtain substance **F** from a mixture of substance **F** and water.

..... [2]

(e) Describe how you could obtain a solid sample of substance **H** from a mixture of substance **H** and substance **G**.

.....

.....

.....

.....

.....

..... [3]

Topic Chem 3 **Q# 17/** IGCSE Chemistry/2018/w/Paper 43/Q1

1 Answer the following questions using only the substances in the list.
Each substance may be used once, more than once or not at all.

ammonia	**bauxite**	**carbon dioxide**	**carbon monoxide**
hematite	**oxygen**	**sodium chloride**	**sulfur dioxide**

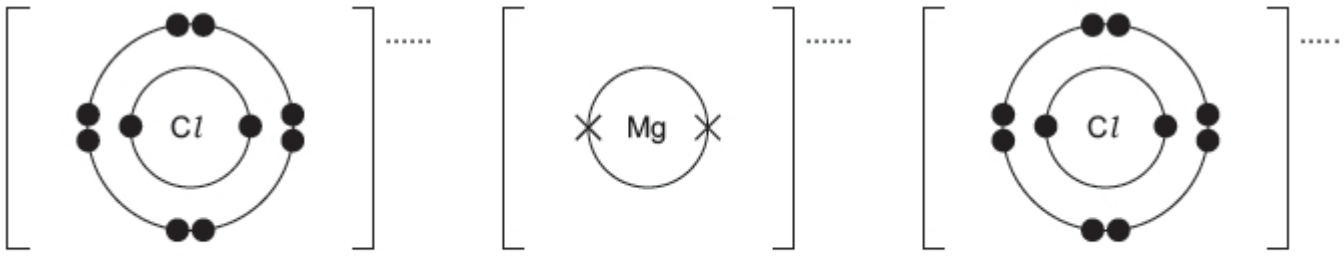
State which substance is:

(f) an ionic compound ..... [1]

Topic Chem 3 **Q# 18/** IGCSE Chemistry/2018/w/Paper 42/Q2

(d) Magnesium reacts with chlorine to form magnesium chloride, $MgCl_2$. Magnesium chloride is an ionic compound.

(i) Complete the diagrams to show the electronic structures of the ions in magnesium chloride. Show the charges on the ions.



[3]

(ii) Give **three** physical properties that are typical of ionic compounds such as $MgCl_2$.

1 .....

2 .....

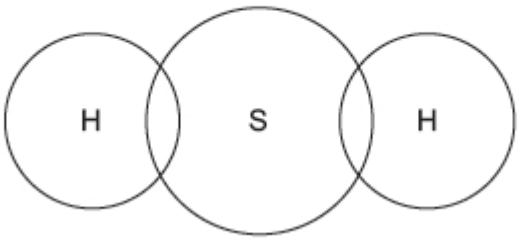
3 .....

[3]

Topic Chem 3 **Q# 19/** IGCSE Chemistry/2018/w/Paper 41/Q4

(c) The gas hydrogen sulfide, H_2S, is produced when concentrated sulfuric acid is added to solid potassium iodide.

(ii) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of hydrogen sulfide. Show outer shell electrons only.



[2]

(iii) Hydrogen sulfide has a simple molecular structure.

Explain why hydrogen sulfide has a low boiling point.

.....

.....

..... [2]

Topic Chem 3 **Q# 20/** IGCSE Chemistry/2018/w/Paper 41/Q2

2 The table gives some information about four different particles, **A**, **B**, **C** and **D**.

particle	number of electrons	number of neutrons	number of protons	electronic structure	charge on particle
A	11	12	11	2,8,1	0
B		14	11	2,8,1	0
C	18	20		2,8,8	0
D	18	20	17		

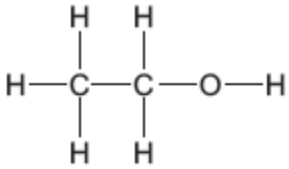
(a) Complete the table. The first row has been done for you. [4]

(b) Give **two** particles from the table which are isotopes of each other.

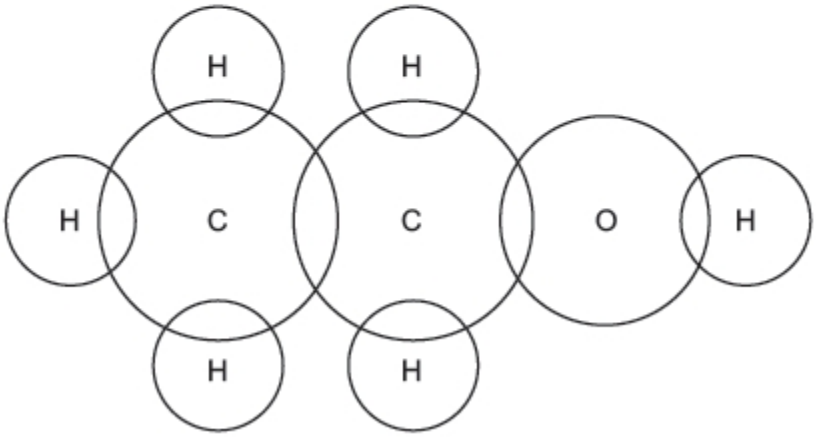
..... [1]

Topic Chem 3 **Q# 21/** IGCSE Chemistry/2018/s/Paper 43/Q4

(b) The structure of ethanol is shown.



Complete the dot-and-cross diagram to show the electron arrangement in a molecule of ethanol. Show outer shell electrons only.



[2]

Topic Chem 3 **Q# 22/** IGCSE Chemistry/2018/s/Paper 43/

2 **(a)** ^{29}Al is a radioactive isotope of aluminium. The only non-radioactive isotope of aluminium is ^{27}Al.

(i) Describe, in terms of protons, neutrons and electrons, how the isotopes ^{29}Al and ^{27}Al are similar and how they are different.

how they are similar .....

how they are different .....

[2]

(ii) Complete the table to show the number of nucleons, neutrons and electrons in an $^{27}_{13}Al^{3+}$ ion.

	number in $^{27}_{13}Al^{3+}$
nucleons	
neutrons	
electrons	

[3]

Topic Chem 3 **Q# 23/** IGCSE Chemistry/2018/s/Paper 42/

2 This question is about the elements in Period 3 of the Periodic Table.

Na	Mg	Al	Si	P	S	Cl	Ar

For each of the following, identify a Period 3 element which matches the description. Each element may be used once, more than once or not at all.

State which Period 3 element:

(a) forms an oxide with a macromolecular structure

..... [1]

Topic Chem 3 **Q# 24/** IGCSE Chemistry/2018/s/Paper 42/

4 Potassium reacts with bromine at room temperature to form potassium bromide.

(b) Potassium bromide exists as an ionic lattice.
Potassium bromide does **not** conduct electricity when solid but does conduct electricity when molten.

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

.....

..... [2]

(ii) Explain why potassium bromide does **not** conduct electricity when solid but does conduct electricity when molten.

.....

.....

..... [2]

(d) Iodine reacts with chlorine to form iodine monochloride, ICl, as the only product.

(i) Write a chemical equation for this reaction.

..... [2]

(ii) Draw a dot-and-cross diagram to show the electron arrangement in a molecule of iodine monochloride. Show outer shell electrons only.

[2]

(e) Potassium bromide has a melting point of 734 °C.
Iodine monochloride has a melting point of 27 °C.

In terms of attractive forces, explain why there is a large difference between these melting points.

.....

.....

.....

.....

..... [3]

Topic Chem 3 **Q# 25/** IGCSE Chemistry/2018/s/Paper 42/

3 Complete the following table.

particle	number of protons	number of electrons	number of neutrons	number of nucleons
$^{23}_{11}Na$	11	11	.....	23
$^{37}_{17}Cl^-$	.....	.....	20	.....
$^{56}_{26}$.....	26	24	30	56

[6]

Topic Chem 3 **Q# 26/** IGCSE Chemistry/2018/s/Paper 41/

1 Substances can be classified as elements, compounds or mixtures.

(a) What is meant by the term *compound*?

.....

.....

..... [2]

Topic Chem 3 **Q# 27/** IGCSE Chemistry/2018/s/Paper 41/

2 Flerovium, F*l*, atomic number 114, was first made in research laboratories in 1998.

(a) Flerovium was made by bombarding atoms of plutonium, Pu, atomic number 94, with atoms of element **Z**.

- The nucleus of **one** atom of plutonium combined with the nucleus of **one** atom of element **Z**.
- This formed the nucleus of **one** atom of flerovium.

(d) Two isotopes of flerovium are ^{286}Fl and ^{289}Fl. The nuclei of both of these isotopes are unstable and emit energy when they split up.

(i) State the term used to describe isotopes with unstable nuclei.

..... [1]

(ii) Complete the table to show the number of protons, neutrons and electrons in the atoms of the isotopes shown.

isotope	number of protons	number of neutrons	number of electrons
^{286}Fl			
^{289}Fl			

[2]

(e) Only a relatively small number of atoms of flerovium have been made in the laboratory and the properties of flerovium have not yet been investigated.

It has been suggested that flerovium is a typical metal.

(i) Suggest **two** physical properties of flerovium.

1 .....

2 .....

[2]

(ii) Suggest **one** chemical property of flerovium oxide.

..... [1]

Topic Chem 3 **Q# 28/** IGCSE Chemistry/2018/m/Paper 42/

1 This question is about gases.

(a) The following substances are gases at room temperature.

letter	A	B	C	D	E	F	G	H
substance	SO_2	Ar	CO	Cl_2	NH_3	CO_2	CH_4	C_3H_8

Identify, by letter:

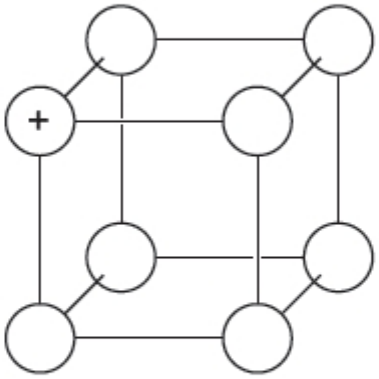
(ii) **two** gases which exist as diatomic molecules ..... [2]

Topic Chem 3 **Q# 29/** IGCSE Chemistry/2018/m/Paper 42/

2 Sodium chloride is a typical ionic compound.

(a) The diagram shows part of a lattice of sodium chloride.

(i) Complete the diagram to show the ions present. Use '+' for Na^+ ions and '–' for Cl^- ions. One ion has been completed for you.



[2]

(ii) How many electrons does a chloride ion have?

..... [1]

(iii) Identify an element which has atoms with the same number of electrons as a sodium ion.

..... [1]

Topic Chem 3 **Q# 30/** IGCSE Chemistry/2018/m/Paper 42/

1 This question is about gases.

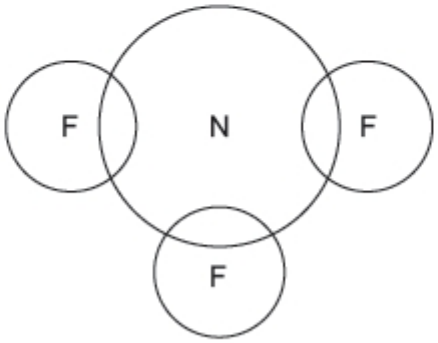
(b) NF_3 has covalent bonds.

(i) What is a covalent bond?

.....

..... [2]

(ii) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of NF_3.
Show outer shell electrons only.



[3]

(c) (i) Describe the bonding in iron. Include a diagram in your answer.

.....

..... [3]

(ii) Use your diagram in **(c)(i)** to explain why iron is malleable.

.....

..... [2]

2 (a) (i) Define the term *molecule*.

.....

..... [2]

(ii) Define the term *element*.

.....

..... [1]

(b) The table shows the composition of four atoms or ions, **A**, **B**, **C** and **D**.

	number of protons	number of neutrons	number of electrons
A	10	10	10
B	10	12	10
C	12	10	10
D	13	14	10

(i) What is the atomic number of **A**?

..... [1]

(ii) What is the nucleon number of **B**?

..... [1]

(iii) Which of **A**, **B**, **C** and **D** are isotopes of each other?

..... [1]

(iv) Which of **A**, **B**, **C** and **D** are atoms?

..... [1]

(v) Which of **A**, **B**, **C** and **D** are positive ions?

..... [1]

(c) Complete the table.

	number of protons	number of electrons
Na		
S^{2-}		
Cl_2		

[3]

Topic Chem 3 **Q# 33/** IGCSE Chemistry/2017/w/Paper 43/

1 Substances can be classified as elements, compounds or mixtures.

State whether each of the following is an element, a compound or a mixture.

(b) gold ..... [1]

(d) air ..... [1]

Topic Chem 3 **Q# 34/** IGCSE Chemistry/2017/w/Paper 42/

2 **(a)** Complete the table to show the electronic structure of the atoms and ions.

	electronic structure
F	2,7
Si	
Ca^{2+}	
N^{3-}	

[3]

(b) Predict the formula of the compound formed between Ca^{2+} and N^{3-}.

..... [1]

(c) Draw a dot-and-cross diagram to show the electron arrangements in the **two** ions present in lithium chloride, LiCl.
Show outer shell electrons only. Include the charges on the ions.

[3]

(d) Sulfur dichloride, SCl_2, is a covalent compound. It has the structure Cl–S–Cl.

Draw a dot-and-cross diagram to show the electron arrangement in a molecule of sulfur dichloride.
Show outer shell electrons only.

[3]

(e) In terms of attractive forces, explain why LiCl has a higher melting point than SCl_2.

.....

.....

.....

.....

..... [3]

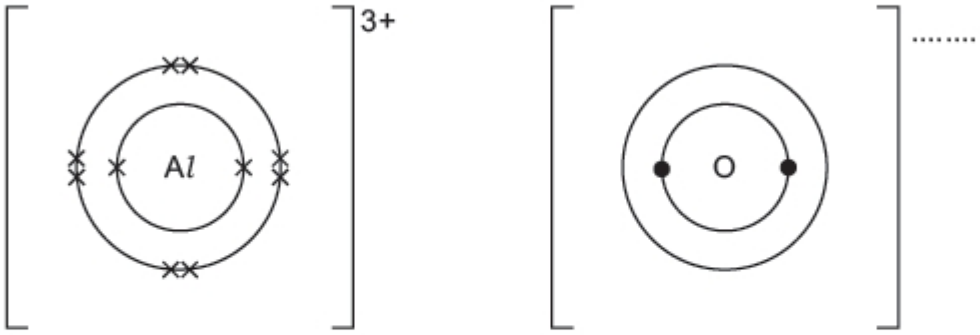
(f) Suggest the identity of a **covalent compound** with a higher melting point than LiCl.

..... [1]

[Total: 14]

(b) Aluminium oxide is an ionic compound with a high melting point.

(i) Complete the dot-and-cross diagram to show the electron arrangement in **one** of the oxide ions present in aluminium oxide. Include the charge on the oxide ion.
One of the aluminium ions is shown.



[2]

(ii) The melting point of aluminium oxide is above 2000 °C.

Explain why aluminium oxide has a high melting point.

.....

.....

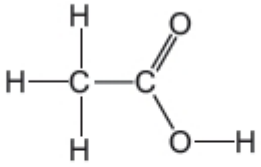
..... [2]

Topic Chem 3 **Q# 36/** IGCSE Chemistry/2017/w/Paper 41/

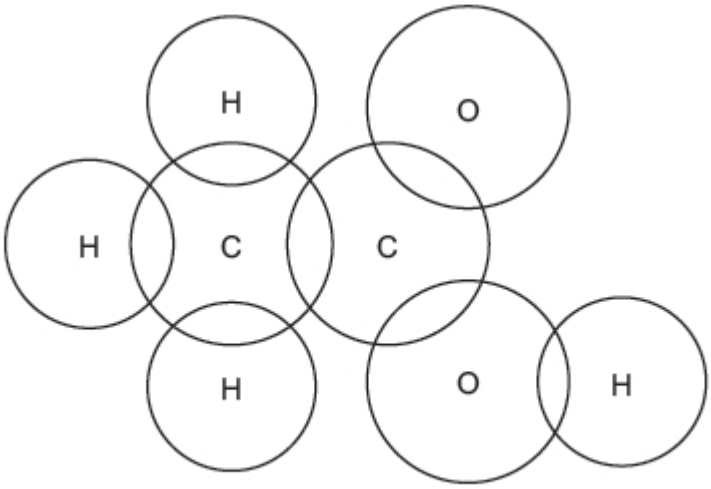
4 **(a)** Ethanol, C_2H_5OH, can be made by fermentation.

(c)

(ii) A molecule of ethanoic acid has the structure shown.



Complete the dot-and-cross diagram to show the electron arrangement in ethanoic acid.
Show outer shell electrons only.



[3]

Topic Chem 3 **Q# 37/** IGCSE Chemistry/2017/w/Paper 41/

1 The table gives information about five particles. The particles are all atoms or ions.

particle	number of protons	number of neutrons	number of electrons
A	6	8	6
B	12	12	12
C	13	14	10
D	8	8	10
E	11	12	11

Answer the following questions using the information in the table.
Each particle may be used once, more than once or not at all.

(a) Which particle, **A**, **B**, **C**, **D** or **E**,

(i) is an atom with atomic number 12,

..... [1]

(ii) is an atom with nucleon number 14,

..... [1]

(iii) is an ion with a positive charge,

..... [1]

(iv) has only **one** electron in its outer shell?

..... [1]

(b) **D** is an ion of an element.

Identify the element and write the formula of **D**.

..... [2]

Topic Chem 3 **Q# 38/** IGCSE Chemistry/2017/s/Paper 43/Q

(c) The boiling point of bromine is 59 °C and the boiling point of iodine is 184 °C.

Explain why iodine has a higher boiling point than bromine.

.....

.....

.....

.....

..... [2]

3 Magnesium is a metal.

(a) Describe the structure and bonding in magnesium.

.....

.....

.....

..... [3]

(b) Why can magnesium conduct electricity when solid?

.....

.....

.....

..... [2]

(c) Why is magnesium malleable?

.....

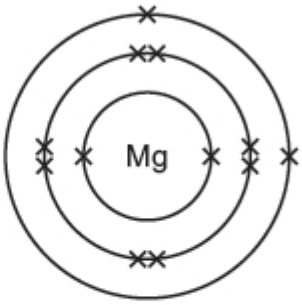
.....

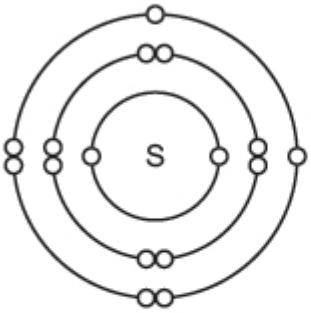
.....

..... [2]

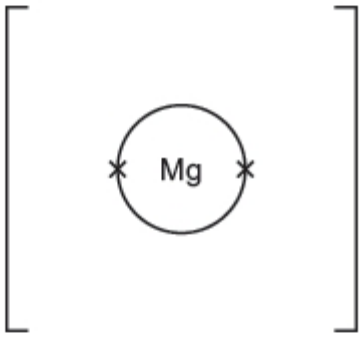
(d) Magnesium reacts with sulfur to form the ionic compound magnesium sulfide, MgS.

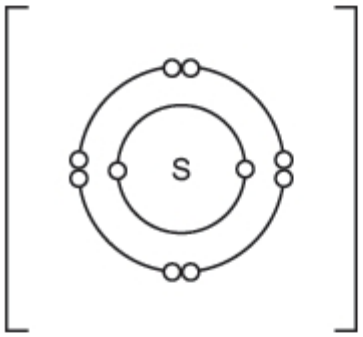
The diagrams show the electronic structures of atoms of magnesium and sulfur.





(i) Complete the diagrams to show the electronic structures of the ions in magnesium sulfide. Show the charges on the ions.





[3]

(ii) Ionic compounds, such as magnesium sulfide, do **not** conduct electricity when solid.
Magnesium sulfide does **not** dissolve in water.
Magnesium sulfide **does** conduct electricity under certain conditions.

State the conditions needed for magnesium sulfide to conduct electricity. Explain why magnesium sulfide conducts electricity under these conditions.

.....

.....

.....

..... [2]

1 Six different atoms can be represented as follows.

$^{3}_{1}A$ $^{3}_{2}D$ $^{12}_{6}E$ $^{13}_{6}G$ $^{14}_{7}J$ $^{19}_{9}L$

(a) Answer the following questions using atoms from the list. Each atom may be used once, more than once or not at all.

Select **one** atom from the six shown which

(i) has exactly seven protons,

..... [1]

(ii) has exactly six neutrons,

..... [1]

(iii) has more protons than neutrons,

..... [1]

(iv) has the electronic structure [2,5],

..... [1]

(b) Two of the six atoms shown are isotopes of each other.

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

.....

..... [2]

(ii) Which **two** of the six atoms shown are isotopes of each other?

..... [1]

(iii) Why do isotopes have identical chemical properties?

.....

..... [1]

Topic Chem 3 **Q# 41/** IGCSE Chemistry/2017/s/Paper 42/Q1

(b) State what is meant by the terms

(i) *element*,

.....

..... [1]

(ii) *compound*,

.....

..... [1]

(iii) *ion*.

.....

..... [1]

Topic Chem 3 **Q# 42/** IGCSE Chemistry/2017/s/Paper 42/

2 Carbon and silicon are elements in Group IV of the Periodic Table. Both carbon and silicon exist as more than one isotope.

(a) Define the term *isotopes*.

.....

..... [2]

(b) Complete the following table which gives information about carbon atoms and silicon atoms.

	carbon	silicon
proton number		
electronic structure		
nucleon number	12	28
number of neutrons in one atom		

[3]

(c) Silicon has a giant structure which is similar to the structure of diamond.

(i) Name the type of bond which is present between silicon atoms in silicon.

..... [1]

(ii) Suggest **two** physical properties of silicon.
Use your knowledge of structure and bonding to explain why silicon has these physical properties.

property 1 .....

reason 1 .....

property 2 .....

reason 2 .....

[4]

(e) Carbon dioxide, CO_2, is a gas at room temperature and pressure, whereas silicon(IV) oxide, SiO_2, is a solid.

(i) Name the type of structure which the following compounds have.

carbon dioxide ..... [1]

silicon(IV) oxide ..... [1]

(ii) Use your knowledge of structure and bonding to explain why carbon dioxide is a gas at room temperature and pressure, whereas silicon(IV) oxide is a solid.

.....

.....

.....

..... [3]

Topic Chem 3 **Q# 43/** IGCSE Chemistry/2017/s/Paper 41/

1 This question is about subatomic particles.

(a) Define the terms

proton number, ...

.....

nucleon number. .....

.....

[3]

(b) Why is the $^{1}_{1}H$ hydrogen atom the **only** atom to have an identical proton number and nucleon number?

.....

..... [1]

(c) Complete the table to show the number of protons, neutrons and electrons in the atoms and ions given.

	number of protons	number of neutrons	number of electrons
^{19}F			9
^{26}Mg	12		
$^{31}P^{3-}$			
$^{87}Sr^{2+}$			

[6]

(d) (i) Write the formula of the compound formed from fluorine and magnesium.

..... [1]

(ii) Write the formula of the compound formed from Sr^{2+} and P^{3-}.

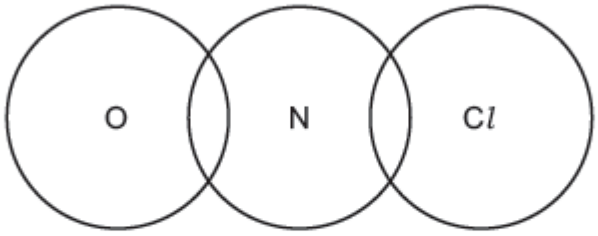
..... [1]

Topic Chem 3 **Q# 44/** IGCSE Chemistry/2017/m/Paper 42/Q3

(e) Nitrosyl chloride, NO*Cl*, is a gas at room temperature. It has the structure shown.

$$O{=}N{-}Cl$$

(i) Complete the dot-and-cross diagram to show the arrangement of the outer shell electrons in nitrosyl chloride.



[2]

(ii) Nitrosyl chloride has a boiling point of –6 °C.

Explain why nitrosyl chloride has a low boiling point.

.....

.....

..... [2]

Topic Chem 3 **Q# 45/** IGCSE Chemistry/2016/w/Paper 43/

2 Beryllium is a metallic element in Group II.

(a) Give the electronic structure of a beryllium atom.

..... [1]

(b) Give the formula of beryllium oxide.

..... [1]

(c) (i) Describe the bonding in a metallic element such as beryllium.
Include a labelled diagram and any appropriate charges in your answer.

.....

.....

..... [3]

(ii) Explain why metallic elements, such as beryllium, are good conductors of electricity.

.....

..... [1]

Topic Chem 3 **Q# 46/** IGCSE Chemistry/2016/w/Paper 43/

1 **(a)** Complete the table.

particle	charge	relative mass
proton	+1	
neutron		1
electron		

[2]

(b) The following are isotopes of carbon.

$^{12}_{6}C$ $^{13}_{6}C$ $^{14}_{6}C$

(i) In terms of numbers of protons, neutrons and electrons, how are these **three** isotopes the same and how are they different?

They are the same because .....

.....

They are different because .....

.....

[3]

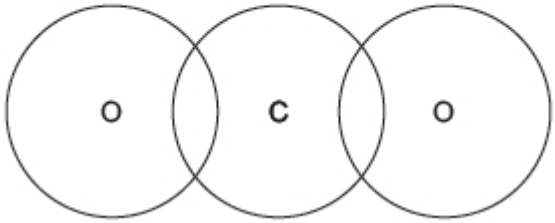
(ii) Why do all isotopes of carbon have the same chemical properties?

..... [1]

(c) Name **two** forms of the element carbon which have giant covalent structures.

..... and ..... [1]

(d) Complete the diagram to show the electron arrangement in a carbon dioxide molecule. Show the outer shell electrons only.



[2]

Topic Chem 3 **Q# 47/** IGCSE Chemistry/2016/w/Paper 43/

4 Silicon(IV) oxide and sodium chloride have different types of bonding and structure.

(a) Name the type of bonding present in

silicon(IV) oxide, ...

sodium chloride. .....

[2]

(b) Name the type of structure present in silicon(IV) oxide.

..... [1]

(c) **(i)** Silicon(IV) oxide has a high melting point. Explain why.

.....

..... [2]

(ii) Silicon(IV) oxide is a poor conductor of electricity. Explain why.

..... [1]

(d) Solid sodium chloride does not conduct electricity. However, it conducts electricity when molten.

Explain why solid sodium chloride does **not** conduct electricity, whereas molten sodium chloride does conduct electricity.

.....

.....

.....

..... [3]

Topic Chem 3 **Q# 48/** IGCSE Chemistry/2016/w/Paper 42/

2 This question is about atoms, ions and isotopes.

(a) Define the term *nucleon number*.

.....

..... [2]

(b) Give the electronic structure of the following atom and ion.

Na .....

P^{3-} .....

[2]

(c) State **one** medical use of radioactive isotopes.

..... [1]

(d) What is meant by the term *relative atomic mass*?

.....

.....

..... [2]

(e) Suggest why the relative atomic mass of chlorine is **not** a whole number.

.....

.....

..... [2]

(f) Aluminium is a metal in Group III.

Describe the bonding in aluminium.
Include a labelled diagram and any appropriate charges in your answer.

[3]

Topic Chem 3 **Q# 49/** IGCSE Chemistry/2016/w/Paper 41/

1 The table gives some information about five substances.

substance	melting point /°C	boiling point /°C	solubility in water	electrical conductivity when molten	electrical conductivity when solid
F	–97	65	very soluble	does not conduct	does not conduct
G	1600	2230	insoluble	does not conduct	does not conduct
H	801	1413	soluble	conducts	does not conduct
I	–57	126	insoluble	does not conduct	does not conduct
J	1085	2562	insoluble	conducts	conducts

(a) Which substance in the table has ionic bonding?

..... [1]

(b) Which substance in the table has a giant covalent structure?

..... [1]

(f) Substance **J** is a metal.

Describe how substance **J** is able to conduct electricity when it is a solid.

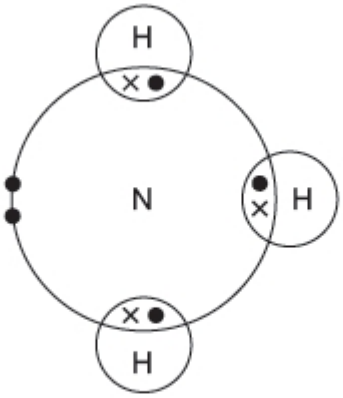
.....

.....

..... [2]

Topic Chem 3 **Q# 50/** IGCSE Chemistry/2016/s/Paper 43/Q6

(c) The diagram shows the electron arrangement in a molecule of ammonia, showing only outer shell electrons.

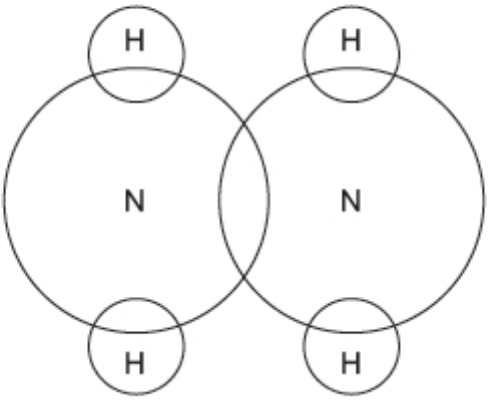


(i) State the type of bonding in ammonia.

..... [1]

(ii) Hydrazine, N_2H_4, is another compound of nitrogen and hydrogen.

Complete the diagram to show the electron arrangement in a molecule of hydrazine, showing only outer shell electrons.



[3]

Topic Chem 3 **Q# 51/** IGCSE Chemistry/2016/s/Paper 43/

4 **(a)** Potassium iodide is an ionic compound.

(i) Describe what happens, in terms of electron loss and gain, when a potassium atom reacts with an iodine atom.

.....

.....

.....

..... [2]

(ii) Describe the structure of solid potassium iodide. You may draw a diagram.

.....

.....

..... [2]

(iii) Explain why potassium iodide has a high melting point.

.....

.....

..... [2]

Topic Chem 3 **Q# 52/** IGCSE Chemistry/2016/s/Paper 42/

1 **(a)** For each of the following, give the name of an element from Period 2 (lithium to neon), which matches the description.
Elements may be used once, more than once or not at all.

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

..... [1]

(v) an element which has atoms with a full outer shell of electrons

..... [1]

(vi) an element which exists as both diamond and graphite

..... [1]

(b) Give the formula of a compound that contains

(i) only boron and oxygen, ... [1]

(ii) only lithium and nitrogen. ..... [1]

3 Gallium is a metallic element in Group III. It has similar properties to aluminium.

(a) (i) Describe the structure and bonding in a metallic element.
You should include a labelled diagram in your answer.

.....

..... [3]

(ii) Explain why metallic elements such as gallium are good conductors of electricity.

..... [1]

(b) Give the formula of

gallium(III) chloride, ...

gallium(III) sulfate. .....
[2]

2 (a) (i) Define the term *atomic number*.

..... [1]

(ii) Define the term *nucleon number*.

.....

..... [2]

(b) The table shows the number of protons, neutrons and electrons in some atoms or ions.

Complete the table. The first line is given as an example.

particle	number of protons	number of electrons	number of neutrons	symbol or formula
A	6	6	6	$^{12}_{6}C$
B	12	12	12	
C	8			$^{16}_{8}O^{2-}$
D	11	10	13	

[6]

(d) Silicon(IV) oxide has a giant structure.

(i) Name the type of bonding in silicon(IV) oxide.

..... [1]

(ii) Give two **physical** properties of silicon(IV) oxide.

.....

..... [2]

(e) Calcium phosphate is used in fertilisers. The bonding in calcium phosphate is ionic. Calcium phosphate contains the phosphate ion, PO_4^{3-}.

(i) What is ionic bonding?

.....

..... [2]

(ii) Deduce the formula of calcium phosphate.

..... [1]

1 Protons, neutrons and electrons are subatomic particles.

(a) Complete the table to show the relative mass and relative charge of a proton, a neutron and an electron.

particle	relative mass	relative charge
proton		
neutron		
electron	$\frac{1}{1840}$	

[3]

(b) Bromine has two isotopes.

(i) Define the term *isotope*.

.....

..... [2]

(ii) Explain why the two isotopes of bromine have the same chemical properties.

.....

..... [2]

(c) The table shows the number of protons, neutrons and electrons in some atoms and ions.

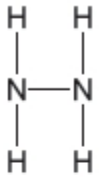
Complete the table.

particle	number of protons	number of neutrons	number of electrons
$^{7}_{3}Li$			
$^{34}_{16}S^{2-}$			
	19	22	18

[5]

Topic Chem 3 **Q# 57/** IGCSE Chemistry/2016/m/Paper 42/Q5

(b) The diagram shows the structure of a hydrazine molecule.



Draw the electron arrangement of a hydrazine molecule. Show the outer shell electrons only.

[2]

Topic Chem 3 **Q# 58/** IGCSE Chemistry/2016/m/Paper 42/

6 Iron pyrite, FeS_2, is known as Fool's Gold because it is a shiny yellow solid which is similar in appearance to gold. Iron pyrite is an ionic compound. Gold is a metallic element.

(a) Iron pyrite, FeS_2, contains positive and negative ions. The positive ion is Fe^{2+}.

Deduce the formula of the negative ion.

..... [1]

(b) A student is provided with a sample of iron pyrite and a sample of gold.

Suggest how the student could distinguish between the two substances.

.....

..... [2]

Topic Chem 3 **Q# 59/** IGCSE Chemistry/2016/m/Paper 42/

1 **(a)** The table below gives information about particles.

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

particle	number of protons	number of electrons	electronic configuration	charge on particle
A	12	10	2,8	2+
B		18	2,8,8	1–
C	18		2,8,8	0
D	8	10		

[4]

(b) Gallium is a Group III element.

Define the term *element*.

.....

.....

..... [1]

(c) The following are gallium atoms.

$^{69}_{31}Ga$ $^{71}_{31}Ga$

Complete the following table.

atom	number of protons	number of neutrons	number of electrons
$^{69}_{31}Ga$			
$^{71}_{31}Ga$			

[3]

[Total: 8]

3 Carbon dioxide and silicon(IV) oxide are oxides of Group IV elements.

(a) Complete the following table.

	carbon dioxide	silicon(IV) oxide
formula		SiO_2
melting point / °C	–56	1610
physical state at 25 °C	gas	
conduction of electricity	non-conductor	
structure		macromolecular

[4]

(b) (i) Name the type of bonds that exist between the atoms in silicon(IV) oxide.

..... [1]

(ii) Explain why silicon(IV) oxide has a very high melting point.

.....

..... [1]

(iii) Explain, in terms of attractive forces between particles, why carbon dioxide has a very low melting point.

.....

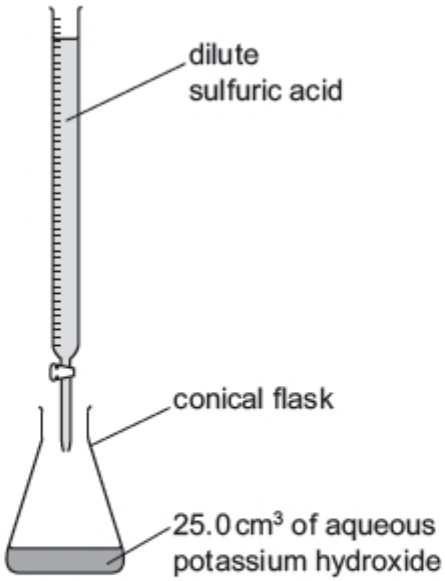
..... [1]

(iv) Explain, in terms of particles, why carbon dioxide is a non-conductor of electricity.

.....

..... [1]

4 **(a)** Dilute sulfuric acid and aqueous potassium hydroxide can be used to make potassium sulfate crystals using a method that includes titration.



A student titrated 25.0 cm^3 of 0.0500 mol/dm^3 aqueous potassium hydroxide with dilute sulfuric acid in the presence of an indicator. The volume of dilute sulfuric acid needed to neutralise the aqueous potassium hydroxide was 20.0 cm^3.

The equation for the reaction is shown.

$$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$$

Determine the concentration of the dilute sulfuric acid.

- Calculate the number of moles of aqueous potassium hydroxide used.

..... mol

- Calculate the number of moles of dilute sulfuric acid needed to neutralise the aqueous potassium hydroxide.

..... mol

- Calculate the concentration of the dilute sulfuric acid.

..... mol/dm^3
[3]

3 Tin is a metallic element in Group IV. Its main ore is cassiterite which is an impure form of tin(IV) oxide, SnO_2.
Tin also occurs in stannite, Cu_2FeSnS_4.

(a) Calculate the relative formula mass, M_r, of Cu_2FeSnS_4.

M_r of Cu_2FeSnS_4 = ... [1]

(b) The M_r of SnO_2 is 151.

Calculate the percentage of tin by mass in SnO_2.

percentage of tin by mass in SnO_2 = ... [1]

(c) The percentage of tin by mass in Cu_2FeSnS_4 is 27.6%.

Use this information and your answer to **(b)** to suggest whether it would be better to extract tin from SnO_2 or Cu_2FeSnS_4.
Explain your answer.

.....

..... [1]

(d) In a titration, a student added 25.0 cm^3 of 0.200 mol/dm^3 aqueous sodium hydroxide to a conical flask. The student then added a few drops of methyl orange to the solution in the conical flask.
Dilute sulfuric acid was then added from a burette to the conical flask. The volume of dilute sulfuric acid needed to neutralise the aqueous sodium hydroxide was 20.0 cm^3.

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

(ii) Determine the concentration of the dilute sulfuric acid in g/dm^3.

- Calculate the number of moles of aqueous sodium hydroxide added to the conical flask.

..... mol

- Calculate the number of moles of dilute sulfuric acid added from the burette.

..... mol

- Calculate the concentration of the dilute sulfuric acid in mol/dm^3.

..... mol/dm^3

- Calculate the concentration of the dilute sulfuric acid in g/dm^3.

..... g/dm^3
[4]

(e) Iron(II) sulfate decomposes when heated strongly.

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

15.20 g of $FeSO_4(s)$ was heated and formed 4.80 g of $Fe_2O_3(s)$.

[M_r, $FeSO_4$ = 152; M_r, Fe_2O_3 = 160]

Calculate the percentage yield for this reaction.

..... % [3]

Topic Chem 4 **Q# 64/** IGCSE Chemistry/2018/w/Paper 42/Q1

(c) Element **X** is a Group I metal. It burns in air to form an oxide $\mathbf{X}_2O$.

Write a chemical equation for this reaction.

..... [2]

Topic Chem 4 **Q# 65/** IGCSE Chemistry/2018/w/Paper 41/Q4

(c) The gas hydrogen sulfide, H_2S, is produced when concentrated sulfuric acid is added to solid potassium iodide.

(d) Dilute sulfuric acid reacts with aqueous sodium hydrogencarbonate in a neutralisation reaction.

$$H_2SO_4(aq) + 2NaHCO_3(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l) + 2CO_2(g)$$

In a titration, 0.200 mol/dm^3 aqueous sodium hydrogencarbonate was used to neutralise 20.0 cm^3 of dilute sulfuric acid of concentration 0.150 mol/dm^3.

(i) Calculate the number of moles of dilute sulfuric acid used in the titration.

..... mol [1]

(ii) Calculate the number of moles of sodium hydrogencarbonate needed to neutralise the dilute sulfuric acid.

..... mol [1]

(iii) Calculate the volume, in cm^3, of 0.200 mol/dm^3 aqueous sodium hydrogencarbonate needed to neutralise the dilute sulfuric acid.

..... cm^3 [1]

Topic Chem 4 **Q# 66/** IGCSE Chemistry/2018/w/Paper 41/Q3

3 (a) Copper(II) nitrate decomposes when heated. Two gases, oxygen and nitrogen dioxide, and a solid are made in the reaction.

Only the first two terms of this equation (which are given) are necessary to answer the questions that follow:

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

(c) A teacher heated 18.8 g of copper(II) nitrate.

(i) Calculate the number of moles of copper(II) nitrate present in the 18.8 g.

..... mol [2]

(ii) Calculate the maximum number of moles of oxygen that can be made by heating 18.8 g of copper(II) nitrate.

..... mol [1]

(iii) Calculate the maximum volume of oxygen at room temperature and pressure, in cm^3, that can be made by heating 18.8 g of copper(II) nitrate.

..... cm^3 [1]

Topic Chem 4 **Q# 67/** IGCSE Chemistry/2018/s/Paper 43/Q3

(f) Another compound of cobalt is $Co(OH)_3$.

Deduce the charge on the cobalt ion in $Co(OH)_3$.

..... [1]

Topic Chem 4 **Q# 68/** IGCSE Chemistry/2018/s/Paper 43/

6 Calcium chlorate(V), $Ca(ClO_3)_2$, is made by reacting calcium hydroxide with chlorine gas.

$$6Ca(OH)_2 + 6Cl_2 \rightarrow Ca(ClO_3)_2 + 5CaCl_2 + 6H_2O$$

(a) 8.88 g of calcium hydroxide and 7200 cm^3 of chlorine gas are mixed together.

(i) How many moles is 8.88 g of calcium hydroxide?

..... mol [2]

(ii) How many moles of chlorine gas is 7200 cm^3?

..... mol [1]

(iii) What is the maximum **number of moles** of calcium chlorate(V) that can be made from 8.88 g of calcium hydroxide and 7200 cm^3 of chlorine gas?

..... mol [1]

(iv) What is the maximum **mass** of calcium chlorate(V) that can be made from 8.88 g of calcium hydroxide and 7200 cm^3 of chlorine gas?

..... g [2]

The experiment is repeated using different amounts of calcium hydroxide and chlorine gas. The maximum mass of calcium chlorate(V) that can be made in the experiment is 4.84 g.

(v) The actual mass of calcium chlorate(V) made in the experiment is 3.63 g.

Calculate the percentage yield.

percentage yield = ... % [1]

Topic Chem 4 **Q# 69/** IGCSE Chemistry/2018/s/Paper 42/

4 Potassium reacts with bromine at room temperature to form potassium bromide.

(a) Write a chemical equation for this reaction. Include state symbols.

..... [3]

Topic Chem 4 **Q# 70/** IGCSE Chemistry/2018/s/Paper 42/

7 Many organic compounds, such as alcohols, carboxylic acids and esters, contain the elements carbon, hydrogen and oxygen only.

(a) Compound **R** has the following composition by mass: C, 60.00%; H, 13.33%; O, 26.67%.

Calculate the empirical formula of compound **R**.

empirical formula = ... [2]

(b) Compound **S** has the empirical formula C_2H_4O and a relative molecular mass of 88.

Calculate the molecular formula of compound **S**.

molecular formula = ... [2]

4 This question is about masses, volumes and moles.

(a) Which term is defined by the following statement?

The average mass of naturally occurring atoms of an element on a scale where the ^{12}C atom has a mass of exactly 12 units.

..... [1]

(b) Butane, C_4H_{10}, has a relative **molecular** mass of 58.
Potassium fluoride, KF, has a relative **formula** mass of 58.

Explain why the term relative molecular mass can be used for butane but **cannot** be used for potassium fluoride.

.....

..... [2]

(c) A 0.095 g sample of gaseous element **Y** occupies 60.0 cm^3 at room temperature and pressure.

- Determine the number of moles of element **Y** in 60.0 cm^3.

moles of element **Y** = ... mol

- Calculate the relative molecular mass of element **Y** and hence suggest the identity of element **Y**.

relative molecular mass = ...

identity of element **Y** = ...
[3]

(d) A 1.68 g sample of phosphorus was burned and formed 3.87 g of an oxide of phosphorus.

Calculate the empirical formula of this oxide of phosphorus.

empirical formula = ... [4]

(e) Another oxide of phosphorus has the empirical formula P_2O_3.
One molecule of this oxide of phosphorus contains four atoms of phosphorus.

Calculate the mass of **one** mole of this oxide of phosphorus.

mass = ... g [2]

Topic Chem 4 **Q# 72/** IGCSE Chemistry/2018/m/Paper 42/Q4

(b) Ammonia reacts with chlorine. The chemical equation is shown.

$$2NH_3(g) + 3Cl_2(g) \rightarrow N_2(g) + 6HCl(g)$$

(i) Calculate the volume of chlorine, measured at room temperature and pressure, needed to react completely with 0.68 g of ammonia.

volume of chlorine = ... cm^3 [3]

3 Limestone rock is mainly calcium carbonate, $CaCO_3$.

(c) Forsterite is another rock which contains a magnesium compound.

A sample of forsterite has the following composition by mass: Mg, 2.73 g; Si, 1.58 g; O, 3.60 g.

Calculate the empirical formula of forsterite.

empirical formula = ... [2]

(c) Silver chloride can be made by reacting aqueous sodium chloride with aqueous silver nitrate. The other product of the reaction is sodium nitrate. The chemical equation for the reaction is shown.

$$NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

A student attempted to make the maximum amount of **sodium nitrate** crystals. The process involved three steps.

(iv) The student started with 20 cm^3 of 0.20 mol/dm^3 $NaCl(aq)$.

- Determine the amount of $NaCl(aq)$ used.

amount of $NaCl(aq)$ used = ... mol

The yield of $NaNO_3$ crystals was 90%.

- Calculate the mass of $NaNO_3$ crystals made.

mass of $NaNO_3$ crystals = ... g
[4]

Topic Chem 4 **Q# 75/** IGCSE Chemistry/2017/w/Paper 42/Q5

(b) Hydrogen can be manufactured using a reversible reaction between methane and steam.

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

At 900 °C, in the presence of a nickel catalyst, the yield of hydrogen is 70%.

(i) What volume of hydrogen is produced from 100 cm^3 of methane under these conditions?

..... cm^3 [2]

Topic Chem 4 **Q# 76/** IGCSE Chemistry/2017/w/Paper 41/

7 Copper(II) oxide reacts with dilute hydrochloric acid.

$$CuO(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$$

6.00 g of copper(II) oxide were added to 50.0 cm^3 of 1.00 mol / dm^3 hydrochloric acid. This was an excess of copper(II) oxide.

(b) (i) Calculate the number of moles of copper(II) oxide added to the hydrochloric acid.

moles of copper(II) oxide = ... mol [2]

(ii) Calculate the number of moles of hydrochloric acid used.

moles of hydrochloric acid = ... mol [1]

(iii) Calculate the mass of copper(II) oxide that did **not** react.

mass of copper(II) oxide that did **not** react = ... g [2]

(c) Crystals of hydrated copper(II) chloride were obtained from the solution at the end of the reaction.

The crystals had the following composition by mass: C*l*, 41.52%; Cu, 37.43%; H, 2.34%; O, 18.71%.

Calculate the empirical formula of the crystals.

empirical formula = ... [2]

Topic Chem 4 **Q# 77/** IGCSE Chemistry/2017/s/Paper 43/

6 Barium carbonate, $BaCO_3$, is an insoluble solid.

(c) Barium carbonate reacts with dilute hydrochloric acid.

$$BaCO_3 + 2HCl \rightarrow BaCl_2 + CO_2 + H_2O$$

9.85 g of barium carbonate were added to 250 cm^3 of 1.00 mol / dm^3 hydrochloric acid. This is an excess of hydrochloric acid.

(i) Calculate how many moles of barium carbonate were used in this experiment.

moles of barium carbonate = ... mol [2]

(ii) Deduce how many moles of carbon dioxide were made when all the barium carbonate had reacted.

moles of carbon dioxide = ... mol [1]

(iii) Calculate the volume of carbon dioxide formed in **(c)(ii)** at room temperature and pressure, in dm^3.

volume of carbon dioxide = ... dm^3 [1]

(iv) Calculate how many moles of hydrochloric acid there were **in excess**.

excess moles of hydrochloric acid = ... mol [2]

Topic Chem 4 **Q# 78/** IGCSE Chemistry/2017/s/Paper 42/Q5

(b) A sample of vanadium chloride was weighed and dissolved in water. An excess of aqueous silver nitrate, acidified with dilute nitric acid, was added. A precipitate of silver chloride was formed. The ionic equation for this reaction is shown.

$$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$$

The mass of silver chloride formed was 2.87 g.

(ii) The relative formula mass of silver chloride, AgCl, is 143.5.

Calculate the number of moles in 2.87 g of AgCl.

moles of AgCl = ... mol [1]

(iii) Use your answer to **(b)(ii)** and the ionic equation to deduce the number of moles of chloride ions, Cl^-, that produced 2.87 g of AgCl.

moles of Cl^- = ... mol [1]

(iv) The amount of vanadium chloride in the sample was 0.01 moles.

Use this and your answer to **(b)(iii)** to deduce the **whole number** ratio of moles of vanadium chloride : moles of chloride ions.
Deduce the formula of vanadium chloride.

moles of vanadium chloride : moles of chloride ions ..... : .....

formula of vanadium chloride .....
[2]

(b) Magnesium sulfate crystals are hydrated. Another student heated some hydrated magnesium sulfate crystals in a crucible and obtained the following results.

mass of hydrated magnesium sulfate crystals = 4.92 g

mass of water removed = 2.52 g

(i) Calculate the number of moles of water removed.

moles of water = ... mol [1]

(ii) Calculate the number of moles of anhydrous magnesium sulfate remaining in the crucible. The M_r of anhydrous magnesium sulfate is 120.

moles of anhydrous magnesium sulfate = ... mol [1]

(iii) Calculate the ratio of moles of anhydrous magnesium sulfate : moles of water. Give your answer as whole numbers.

ratio = ... : ..... [1]

(iv) Suggest the formula of hydrated magnesium sulfate crystals.

formula of hydrated magnesium sulfate crystals = ... [2]

5 When barium carbonate is added to dilute hydrochloric acid, carbon dioxide gas is formed.

A student carried out an experiment to measure the volume of gas formed as a reaction proceeds. The student added a small mass of powdered barium carbonate to an excess of 0.1 mol/dm^3 hydrochloric acid. A graph of the results was drawn.

(c) The total volume of gas collected was 180 cm^3 at room temperature and pressure.

Calculate the mass, in grams, of barium carbonate used.

$$BaCO_3 + 2HCl \rightarrow BaCl_2 + H_2O + CO_2$$

mass of barium carbonate = ... g [3]

(f) The experiment is changed and the mass of powdered barium carbonate is doubled. All other conditions are the same as in the original experiment. The acid is still in excess.

Deduce the volume of gas formed at room temperature and pressure, in cm^3, in this experiment.

volume of gas = ... cm^3 [1]

Topic Chem 4 **Q# 81/** IGCSE Chemistry/2017/m/Paper 42/Q7

(c) Hydrolysis of a polymer gave a compound with the following composition by mass: C, 34.61%; H, 3.85%; O, 61.54%.

(i) Calculate the empirical formula of the compound.

empirical formula = ... [3]

(ii) What additional information is needed to calculate the molecular formula of the compound?

.....

..... [1]

Topic Chem 4 **Q# 82/** IGCSE Chemistry/2017/m/Paper 42/

2 Silver dichromate, $Ag_2Cr_2O_7$, is a red insoluble salt.

Silver dichromate can be made by reacting silver nitrate solution with ammonium dichromate solution. The chemical equation for the reaction is shown.

$$2AgNO_3(aq) + (NH_4)_2Cr_2O_7(aq) \rightarrow 2NH_4NO_3(aq) + Ag_2Cr_2O_7(s)$$

(b) (i) The charge on a silver ion is +1.

Deduce the charge on the dichromate ion in $Ag_2Cr_2O_7$.

..... [1]

(ii) Write the ionic equation for the formation of silver dichromate in this reaction.
State symbols are **not** required.

..... [1]

Topic Chem 4 **Q# 83/** IGCSE Chemistry/2017/m/Paper 42/

6 Barium carbonate decomposes when heated.

$$BaCO_3(s) \rightarrow BaO(s) + CO_2(g)$$

(a) A student heated a 10.0 g sample of barium carbonate until it was fully decomposed.

(i) Calculate the number of moles of barium carbonate the student used.

moles of barium carbonate = ... mol [2]

(ii) Calculate the volume of carbon dioxide gas produced at room temperature and pressure.
Give your answer in dm^3.

volume of carbon dioxide = ... dm^3 [1]

(b) The student added 2.00 g of the barium oxide produced to water.

$$BaO + H_2O \rightarrow Ba(OH)_2$$

Calculate the mass of barium hydroxide that can be made from 2.00 g of barium oxide. The M_r of $Ba(OH)_2$ is 171.

mass of barium hydroxide = ... g [1]

(c) A 1.50 g sample of barium hydroxide was dissolved in water. The total volume of the solution was 100 cm^3.

A 25.0 cm^3 portion of the barium hydroxide solution was titrated against hydrochloric acid. The volume of hydrochloric acid required was 18.75 cm^3.

$$Ba(OH)_2 + 2HCl \rightarrow BaCl_2 + 2H_2O$$

(i) Calculate how many moles of barium hydroxide were in the 25.0 cm^3 portion used in the titration.

moles of barium hydroxide = ... mol [1]

(ii) Calculate the concentration of the hydrochloric acid used.

concentration of hydrochloric acid = ... mol/dm^3 [2]

Topic Chem 4 **Q# 84/** IGCSE Chemistry/2016/w/Paper 43/

3 When lead(II) nitrate is heated, two gases are given off and solid lead(II) oxide remains. The equation for the reaction is shown.

$$2Pb(NO_3)_2(s) \rightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$$

(a) Calculate the M_r of lead(II) nitrate.

..... [1]

(b) 6.62 g of lead(II) nitrate are heated until there is no further change in mass.

(i) Calculate the mass of lead(II) oxide produced.

..... g [2]

(ii) Calculate the volume of oxygen, O_2, produced at room temperature and pressure (r.t.p.).

..... dm^3 [2]

(d) Lead(II) oxide is insoluble. A student adds solid lead(II) oxide to dilute nitric acid until the lead(II) oxide is in excess. Aqueous lead(II) nitrate and water are produced.

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

..... [1]

(ii) How would the student know when the lead(II) oxide is in excess?

..... [1]

5 Chlorine, bromine and iodine are halogens.

(a) Chlorine can be made in the laboratory by heating manganese(IV) oxide with concentrated hydrochloric acid.

$$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$$

Calculate the volume of 8.00 mol / dm³ $HCl(aq)$ needed to react with 3.48 g of MnO_2.

- moles of MnO_2 used

..... mol

- moles of HCl needed

..... mol

- volume of HCl needed

..... cm³

[4]

(b)

(ii) Complete the **ionic** equation for this reaction.

Include state symbols.

$$Cl_2(g) + ...Br^-(aq) \rightarrow ..... + ...$$

[3]

(e) Iodine forms an oxide which has the composition by mass: I, 76.0%; O, 24.0%.

(i) Use this information to determine the empirical formula of this oxide of iodine.

empirical formula ..... [3]

Topic Chem 4 **Q# 86/** IGCSE Chemistry/2016/w/Paper 41/

7 Calcium chloride can be made by reacting calcium carbonate with hydrochloric acid.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

An excess of calcium carbonate was added to 50.0 cm^3 of 0.500 mol/dm^3 hydrochloric acid. The solution was filtered to remove the excess calcium carbonate.

(a) How many moles of HCl were used in this reaction?

..... mol [2]

(b) Deduce the number of moles of carbon dioxide gas made in this reaction.

..... mol [1]

(c) Calculate the mass of carbon dioxide made in this reaction.

..... g [2]

(d) Calculate the volume, in dm^3, of carbon dioxide made in this reaction at room temperature and pressure (r.t.p.).

..... dm^3 [1]

Topic Chem 4 **Q# 87/** IGCSE Chemistry/2016/s/Paper 43/

5 Dilute hydrochloric acid reacts with sodium carbonate solution.

$$2HCl(aq) + Na_2CO_3(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

(a) Explain why effervescence is seen during the reaction.

.....

..... [1]

(b) Dilute hydrochloric acid was titrated with sodium carbonate solution.

- 10.0 cm^3 of 0.100 mol/dm^3 hydrochloric acid were placed in a conical flask.
- A few drops of methyl orange indicator were added to the dilute hydrochloric acid.
- The mixture was titrated with sodium carbonate solution.
- 16.2 cm^3 of sodium carbonate solution were required to react completely with the acid.

(ii) Calculate how many moles of hydrochloric acid were used.

..... mol [1]

(iii) Use your answer to **(b)(ii)** and the equation for the reaction to calculate the number of moles of sodium carbonate that reacted.

..... mol [1]

(iv) Use your answer to **(b)(iii)** to calculate the concentration of the sodium carbonate solution in mol/dm^3.

..... mol/dm^3 [2]

(c) In another experiment, 0.020 mol of sodium carbonate were reacted with excess hydrochloric acid.

Calculate the maximum volume (at r.t.p.) of carbon dioxide gas that could be made in this reaction.

..... dm^3 [3]

Topic Chem 4 **Q# 88/** IGCSE Chemistry/2016/s/Paper 42/

5 **(a)** Hydrocarbons are compounds which contain hydrogen and carbon only.

- 10 cm^3 of a gaseous hydrocarbon, C_xH_y, are burned in 100 cm^3 of oxygen, which is an excess of oxygen.
- After cooling to room temperature and pressure, there is 25 cm^3 of unreacted oxygen, 50 cm^3 of carbon dioxide and some liquid water.

All volumes are measured under the same conditions of temperature and pressure.

(i) What is meant by an *excess* of oxygen?

..... [1]

(ii) What was the volume of oxygen that reacted with the hydrocarbon?

..... [1]

(iii) Complete the table below to express the smallest whole number ratio of

volume of hydrocarbon reacted : volume of oxygen reacted : volume of carbon dioxide produced

	volume of hydrocarbon reacted	volume of oxygen reacted	volume of carbon dioxide produced
smallest whole number ratio of volumes			

[1]

(iv) Use your answer to **(a)(iii)** to find the mole ratio in the equation below. Complete the equation and deduce the formula of the hydrocarbon.

.....$C_xH_y(g)$ + ...$O_2(g)$ → .....$CO_2(g)$ + ...$H_2O(l)$

formula of hydrocarbon = ...

[2]

Topic Chem 4 **Q# 89/** IGCSE Chemistry/2016/s/Paper 41/

2 Period 3 contains the elements sodium to argon. This question asks about the chemistry of each of the Period 3 elements or their compounds.

(a) Sodium nitrate is a white crystalline solid. When heated it melts and the following reaction occurs.

$$2NaNO_3(l) \rightarrow 2NaNO_2(l) + O_2(g)$$

A 3.40 g sample of sodium nitrate is heated.

Calculate the

- number of moles of $NaNO_3$ used,

..... mol

- number of moles of O_2 formed,

..... mol

- volume of O_2 formed, in dm^3 (measured at r.t.p.).

..... dm^3

[3]

(b) A compound X contains carbon, hydrogen and oxygen only.

X contains 54.54% of carbon by mass, 9.09% of hydrogen by mass and 36.37% of oxygen by mass.

(i) Calculate the empirical formula of compound X.

[2]

(ii) Compound X has a relative molecular mass of 88.

Deduce the molecular formula of compound X.

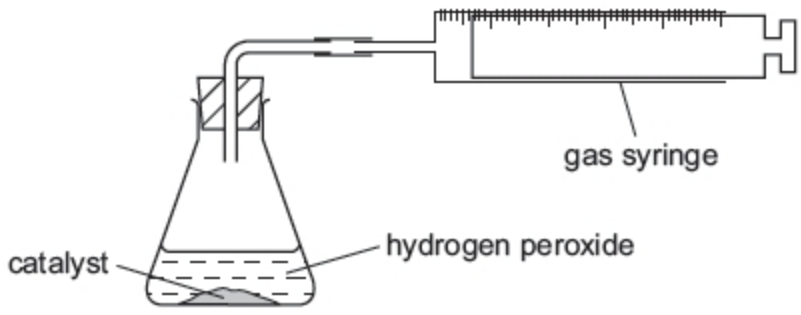
[2]

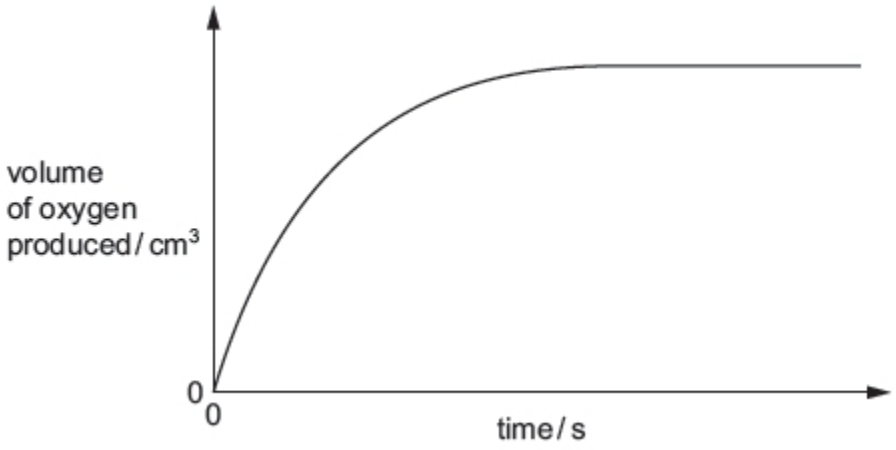
4 Hydrogen peroxide, H_2O_2, decomposes into water and oxygen in the presence of a catalyst, manganese(IV) oxide.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

A student studies the rate of decomposition of hydrogen peroxide using the apparatus shown. The student uses 20 cm^3 of 0.1 mol / dm^3 hydrogen peroxide and 1.0 g of manganese(IV) oxide.

The student measures the volume of oxygen given off at regular time intervals until the reaction stops. A graph of the results is shown.





(c) (i) Calculate the number of moles of hydrogen peroxide used in this experiment.

..... mol [1]

(ii) Use your answer to **(c)(i)** and the equation to calculate the number of moles of oxygen produced in the reaction.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

..... mol [1]

(iii) Calculate the volume (at r.t.p.) of oxygen produced.

..... dm^3 [1]

(iv) What would be the effect on the volume of oxygen produced if the mass of catalyst was increased?

..... [1]

(v) Deduce the volume of oxygen that would be produced if 20 cm^3 of 0.2 mol / dm^3 hydrogen peroxide was used instead of 20 cm^3 of 0.1 mol / dm^3 hydrogen peroxide.

..... dm^3 [1]

2 This question is about electrolysis.

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

.....

..... [2]

(ii) Name the type of particle responsible for the conduction of electricity during electrolysis in:

the metal wires .....

the electrolyte .....

[2]

(b) The table gives information about the products of the electrolysis of two electrolytes. Platinum electrodes are used in each case.

(i) Give **two** reasons why platinum is suitable to use as an electrode.

1 .....

2 .....

[2]

(ii) Complete the table.

electrolyte	observation at the anode (+)	name of product at the anode (+)	observation at the cathode (–)	name of product at the cathode (–)
concentrated aqueous potassium chloride			bubbles of colourless gas	
aqueous copper(II) sulfate	bubbles of colourless gas			

[6]

[Total: 12]

Topic Chem 5 **Q# 93/** IGCSE Chemistry/2018/s/Paper 43/

1 The following are the symbols and formulae of some elements and compounds.

Ar $Ca(OH)_2$ Cl_2 CO_2 Cu Fe SO_2 V_2O_5

Answer the following questions using only the elements or compounds in the list.
Each element or compound may be used once, more than once or not at all.

State which element or compound is used:

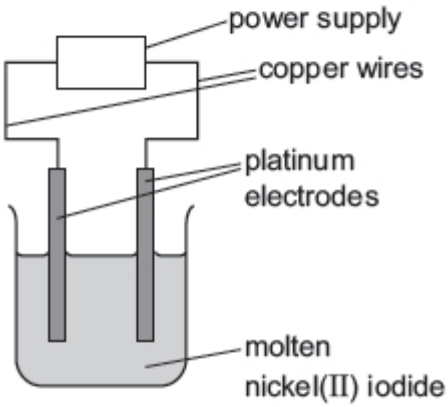
(c) as an electrical conductor in cables ..... [1]

5 **(a)** Nickel(II) iodide crystals are hydrated. A sample of hydrated nickel(II) iodide crystals has the following composition by mass: Ni, 14.01%; I, 60.33%; H, 2.85%; O, 22.81%.

Calculate the empirical formula of the hydrated nickel(II) iodide crystals.

empirical formula = ... [2]

(b) Molten nickel(II) iodide can be electrolysed using the apparatus shown.



During electrolysis, charge is transferred through the copper wires and through the molten nickel(II) iodide.

(i) Name the type of particles which transfer charge through the copper wires.

..... [1]

(ii) Name the type of particles which transfer charge through the molten nickel(II) iodide.

..... [1]

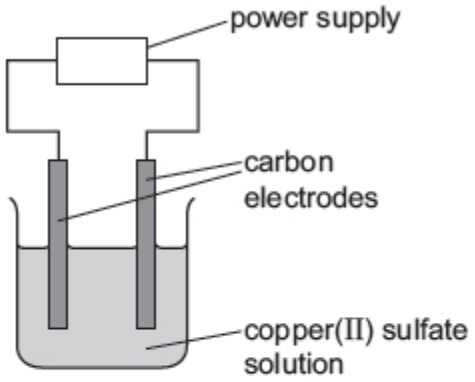
(iii) Predict the products of the electrolysis of molten nickel(II) iodide. Write an ionic half-equation for the formation of **one** of these products.

products.....

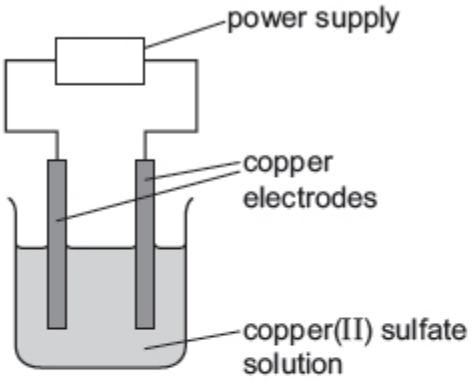
ionic half-equation .....

[3]

(c) A student electrolysed copper(II) sulfate solution using the two sets of apparatus shown.



apparatus **A**



apparatus **B**

In apparatus **A** the student used carbon electrodes.
In apparatus **B** the student used copper electrodes.

The student made the following observations.

apparatus **A**	apparatus **B**
The mass of the negative electrode increased.	The mass of the negative electrode increased.
The mass of the positive electrode stayed the same.	The mass of the positive electrode decreased.
Bubbles were seen at the positive electrode.	No bubbles were seen at the positive electrode.

(i) Explain why the mass of the negative electrode increased in **both** sets of apparatus.

.....

..... [1]

(ii) Name the gas that formed the bubbles seen in apparatus **A**.

..... [1]

(iii) Explain why the mass of the positive electrode decreased in apparatus **B**.

.....

..... [1]

(iv) Suggest what happens to the colour of the solution in apparatus **A** and apparatus **B** as the electrolysis progresses.
Explain your answer.

colour of the solution in apparatus **A** .....

colour of the solution in apparatus **B** .....

explanation .....

.....

.....

[3]

(c) Concentrated aqueous potassium bromide is an electrolyte.

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

.....

..... [2]

(ii) Describe the electrolysis of concentrated aqueous potassium bromide.

Include:
- an ionic half-equation for the reaction at the cathode
- the name of the product at the anode
- the name of the potassium compound formed.

.....

.....

.....

..... [4]

(iii) When molten potassium bromide is electrolysed, the product at the cathode is different.

Name the product at the cathode when molten potassium bromide is electrolysed.

..... [1]

2 This question is about the elements in Period 3 of the Periodic Table.

Na	Mg	A*l*	Si	P	S	C*l*	Ar

For each of the following, identify a Period 3 element which matches the description. Each element may be used once, more than once or not at all.

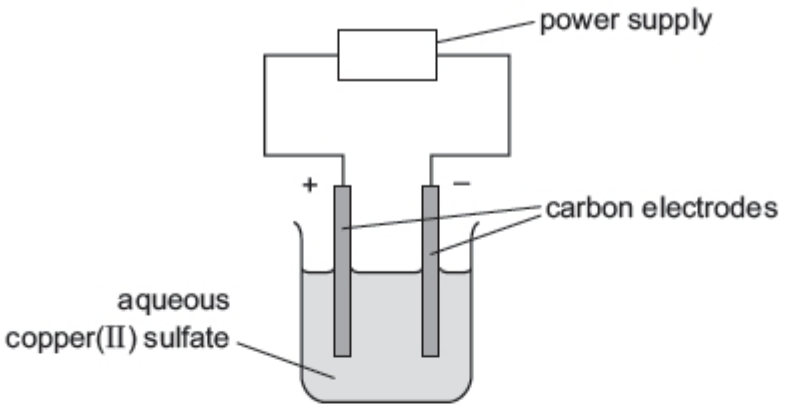
State which Period 3 element:

(b) is extracted from the ore bauxite

..... [1]

Topic Chem 5 **Q# 97/** IGCSE Chemistry/2018/s/Paper 41/Q5

(e) A student electrolyses aqueous copper(II) sulfate using the apparatus shown.



Oxygen gas forms at the positive electrode (anode).

(i) Write an ionic half-equation for the reaction at the negative electrode (cathode). Include state symbols.

..... [3]

(ii) Describe what the student observes at the negative electrode.

..... [1]

(iii) Give **two other** observations which the student makes during the electrolysis.

1 .....

2 .....

[2]

(iv) What difference would the student observe at the positive electrode if the aqueous copper(II) sulfate were replaced by concentrated aqueous copper(II) chloride?

..... [1]

Topic Chem 5 **Q# 98/** IGCSE Chemistry/2018/m/Paper 42/

2 Sodium chloride is a typical ionic compound.

(b) Electrolysis of concentrated aqueous sodium chloride is an important industrial process.

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

.....

..... [2]

(ii) Name the products of the electrolysis of concentrated aqueous sodium chloride.

1 .....

2 .....

3 .....

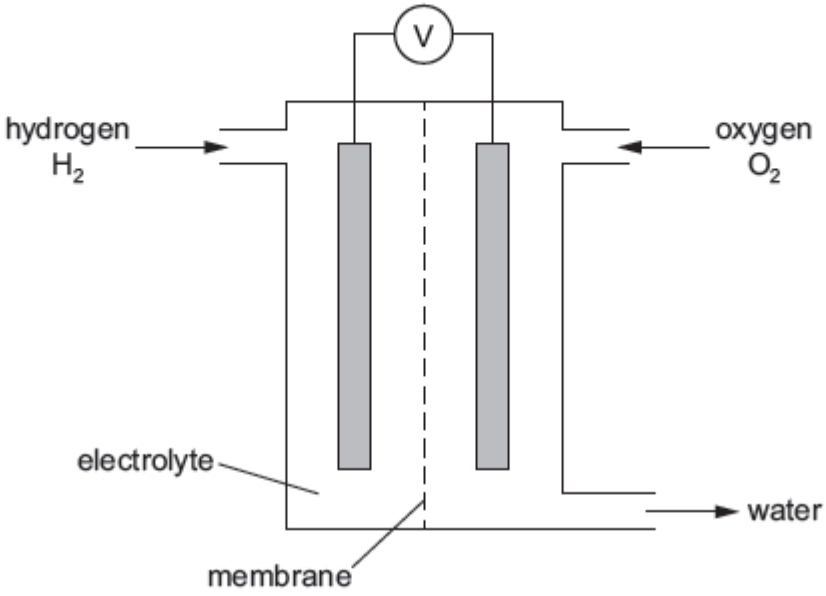
[3]

(iii) Write an ionic half-equation for the reaction at the cathode.
Include state symbols.

..... [2]

Topic Chem 5 **Q# 99/** IGCSE Chemistry/2017/w/Paper 43/

4 Hydrogen and oxygen react together in a hydrogen fuel cell. A hydrogen fuel cell is shown in the diagram.



(b) (i) In a hydrogen fuel cell, the hydrogen molecules are converted into hydrogen ions, H^+, according to the ionic half-equation shown.

$$H_2 \rightarrow 2H^+ + 2e^-$$

What type of reaction does this ionic half-equation represent?

..... [1]

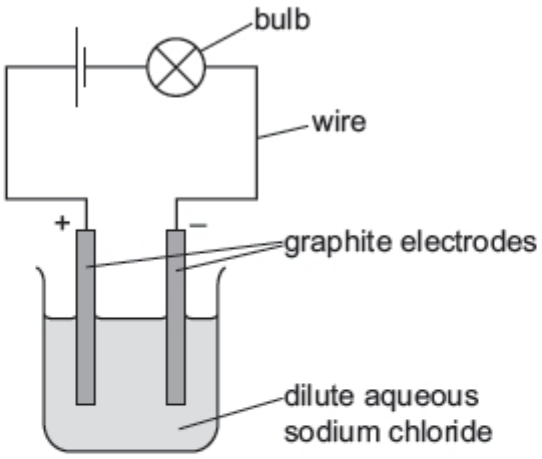
(c) Write a chemical equation for the overall reaction that occurs in a hydrogen fuel cell.

..... [1]

(f) Name the process occurring when electrical energy is used to break down an ionic compound.

..... [1]

4 A student sets up the following electrolysis experiment.



(a) Define the term *electrolysis*.

.....

..... [2]

(b) The student observes bubbles of colourless gas forming at each electrode.

(i) Name the main gas produced at the positive electrode (anode).

..... [1]

(ii) Describe a test for the gas produced in **(b)(i)**.

test .....

result .....
[2]

(iii) Write the ionic half-equation for the reaction taking place at the negative electrode (cathode).

..... [2]

(c) Charge is transferred during electrolysis.

Name the type of particle responsible for the transfer of charge in

the wires, ...

the electrolyte. .....
[2]

(d) The student replaces the dilute aqueous sodium chloride with **concentrated** aqueous sodium chloride.

Suggest **two** differences that the student observes.

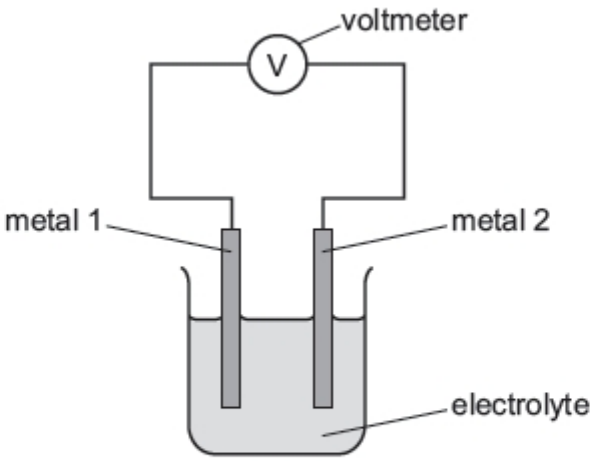
1 .....

2 .....

[2]

Topic Chem 5 **Q# 101/** IGCSE Chemistry/2017/s/Paper 43/

5 The diagram shows a simple cell.



The simple cell was used with different metals as electrodes. The voltages were recorded in the table.

- If the voltage measured is positive then metal 2 is more reactive than metal 1.
- If the voltage measured is negative then metal 1 is more reactive than metal 2.

		metal 2				
		beryllium	cobalt	nickel	silver	vanadium
metal 1	beryllium	0.0 V	–1.6 V	–1.6 V	not measured	–0.7 V
	cobalt		0.0 V	0.0 V	–1.1 V	0.9 V
	nickel			0.0 V	–1.1 V	0.9 V
	silver				0.0 V	2.0 V
	vanadium					0.0 V

- The more reactive metal is oxidised.
- The bigger the difference in reactivity of the metals, the larger the reading on the voltmeter.

(a) In a simple cell using nickel and silver, the nickel is oxidised.

(i) Define *oxidation* in terms of electrons.

..... [1]

(ii) Nickel forms ions with a charge of +2.

Write an ionic half-equation to show the oxidation of nickel.

..... [1]

(iii) What will happen to the mass of the nickel electrode when the nickel is oxidised?

.....

..... [1]

Topic Chem 5 **Q# 102/** IGCSE Chemistry/2016/w/Paper 43/Q4

(e) A **concentrated** aqueous solution of sodium chloride is electrolysed using carbon electrodes.

(i) Name the products formed at the electrodes.

product at the positive electrode (anode) .....

product at the negative electrode (cathode) .....

[2]

(ii) Write an ionic half-equation for the reaction occurring at the negative electrode.

..... [1]

(f) A **dilute** aqueous solution of sodium chloride is electrolysed using carbon electrodes.

Name the main product formed at the positive electrode.

..... [1]

(g) Molten sodium chloride is electrolysed using carbon electrodes.

(i) Name the product formed at the negative electrode.

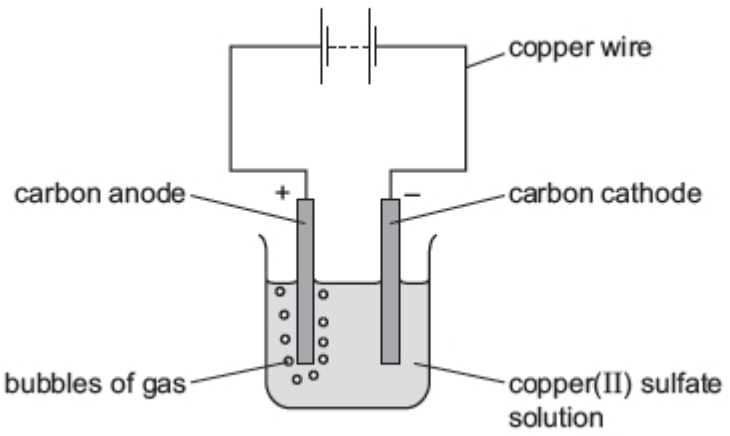
..... [1]

(ii) Write an ionic half-equation for the reaction occurring at the negative electrode.

..... [1]

Topic Chem 5 **Q# 103/** IGCSE Chemistry/2016/w/Paper 41/

5 Copper(II) sulfate solution was electrolysed using the apparatus shown.



(a) A gas was formed at the anode.

Identify this gas

gas ..... [1]

(b) During electrolysis, electricity passes through the copper(II) sulfate solution.

Solid copper(II) sulfate does not conduct electricity.

Explain **both** of these statements.

.....

.....

.....

.....

..... [3]

(c) The electrolysis was repeated using copper electrodes in place of carbon electrodes. The ionic half-equations for the reactions at the two electrodes are shown.

anode $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$

cathode $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

(ii) The masses of the copper electrodes changed during the electrolysis.

State how **and** explain why the masses of the **two** copper electrodes changed.
Use the ionic half-equations to help you.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) Explain why, during the electrolysis, the colour of the copper(II) sulfate solution does **not** change.

.....

.....

..... [1]

(e) Hydrogen can also be manufactured by electrolysis. The electrolyte is concentrated aqueous sodium chloride. The electrodes are inert.

The products of electrolysis are hydrogen, chlorine and sodium hydroxide.

(i) Define the term *electrolysis*.

.....

..... [2]

(ii) Name a substance that can be used as the inert electrodes.

..... [1]

(iii) Write an ionic half-equation for the reaction in which hydrogen is produced.

..... [1]

(iv) Where is hydrogen produced in the electrolytic cell?

..... [1]

(f) The electrolysis of concentrated aqueous sodium chloride can be represented by the following word equation.

sodium chloride + water → sodium hydroxide + hydrogen + chlorine

Construct a chemical equation to represent this reaction. Do not include state symbols.

..... [2]

(g) State one use of

chlorine, ...

sodium hydroxide, ...

hydrogen. .....

[3]

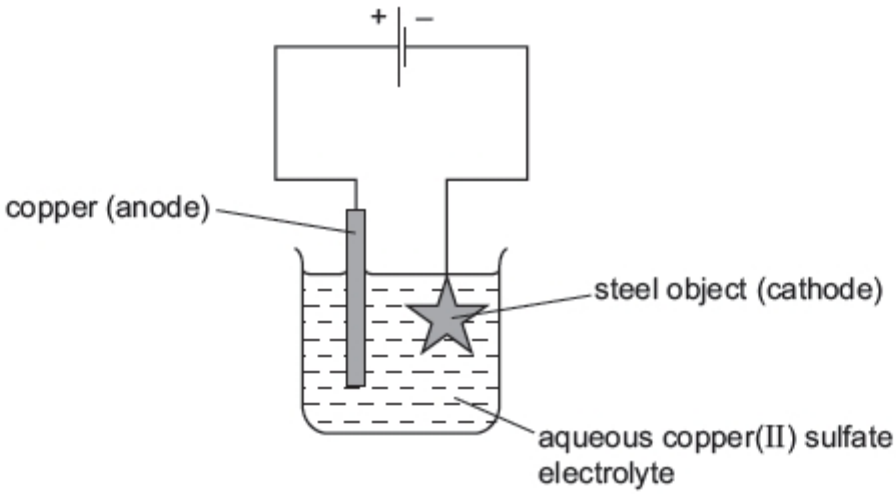
4 Electroplating steel objects with silver involves a three-step process.

step 1 A coating of copper is applied to the object.

step 2 A coating of nickel is applied to the object.

step 3 The coating of silver is applied to the object.

(a) A diagram of the apparatus used for **step 1** is shown.



(ii) Explain why the concentration of copper ions in the electrolyte remains constant throughout **step 1**.

.....

.....

..... [2]

(b) Give **two** changes which would be needed in order to coat nickel onto the object in **step 2**.

.....

.....

.....

..... [2]

Topic Chem 6 **Q# 106/** IGCSE Chemistry/2018/s/Paper 42/

1 Give the name of the process that is used:

(b) to produce lead from molten lead(II) bromide

..... [1]

5 **(a)** The table gives some chemical properties of transition elements and their compounds, and of Group I elements and their compounds.

chemical property	transition elements	Group I elements
ability to act as catalysts	yes	no
exist as coloured compounds	yes	no

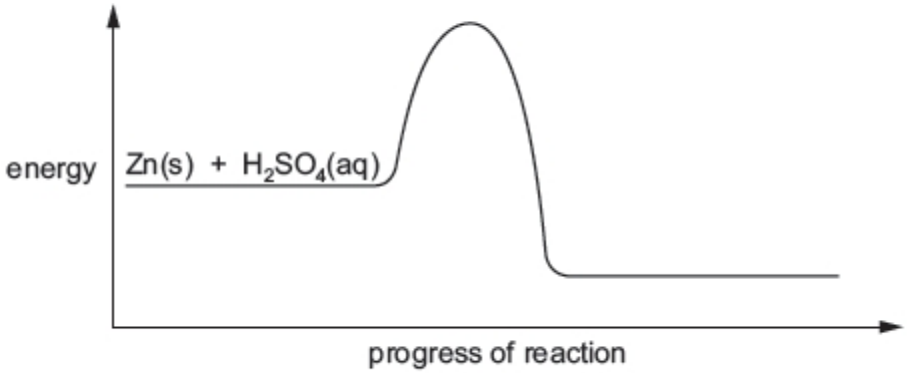
(i) What is meant by the term *catalyst*?

.....

.....

..... [2]

(c) The energy level diagram shows the energy profile for the reaction between zinc and dilute sulfuric acid.



(i) Complete the diagram by adding the formulae of the products. Include state symbols. [3]

(ii) Draw an arrow on the diagram to represent the activation energy. [1]

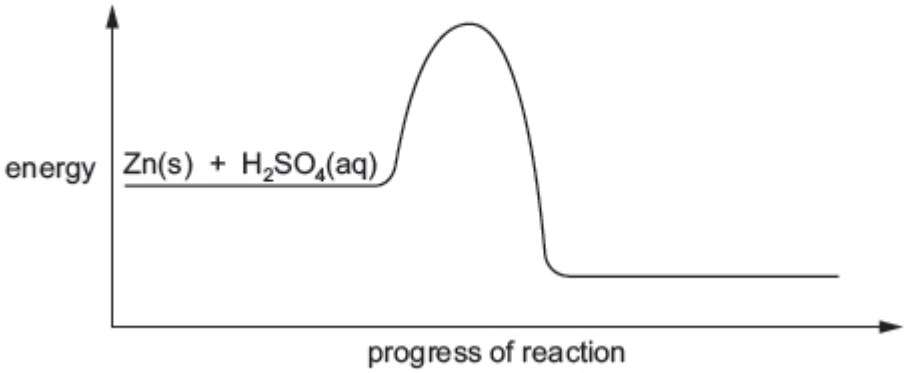
(iii) Is the reaction endothermic or exothermic? Explain your answer.

.....

..... [1]

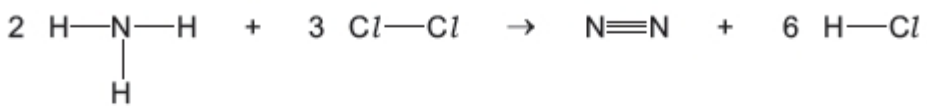
(d) The reaction between zinc and dilute sulfuric acid can be catalysed by the addition of aqueous copper(II) sulfate.

On the diagram, add the energy profile for the catalysed reaction.



[1]

(ii) The chemical equation can be represented as shown.



Use the bond energies in the table to determine the energy change, ΔH, for the reaction between ammonia and chlorine.

bond	bond energy in kJ / mol
N–H	390
C*l*–C*l*	240
N≡N	945
H–C*l*	430

- energy needed to break bonds

..... kJ

- energy released when bonds are formed

..... kJ

- energy change, ΔH, for the reaction between ammonia and chlorine

..... kJ
[3]

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

.....

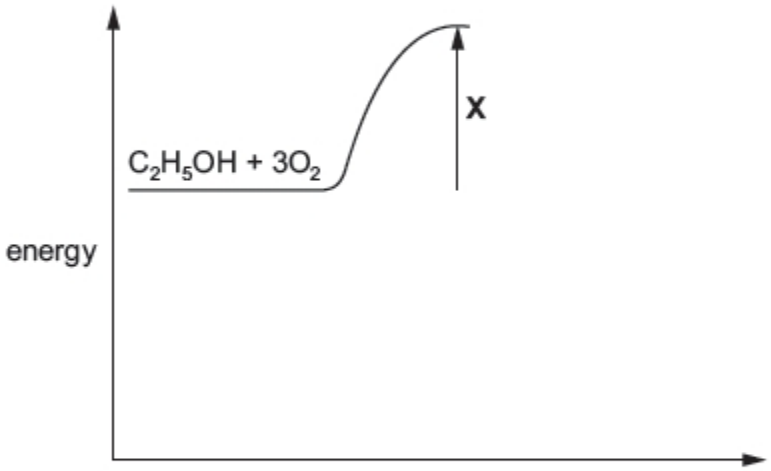
..... [1]

3 The chemical equation for the complete combustion of ethanol, C_2H_5OH, is shown.

$$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$$

The energy released when one mole of ethanol undergoes complete combustion is 1280 kJ.

Part of the energy level diagram for this reaction is shown.



(a) Complete the energy level diagram to show
- the products of the reaction,
- the overall energy change of the reaction.

[3]

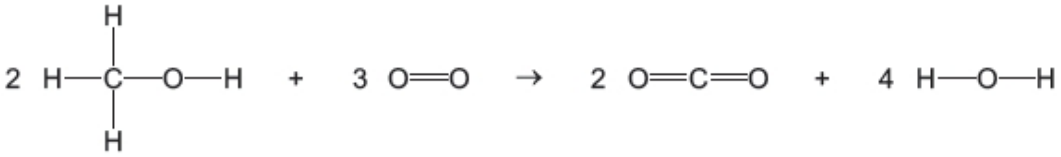
(b) What does **X** represent?

..... [1]

(c) The chemical equation for the complete combustion of methanol, CH_3OH, is shown.

$$2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$$

The equation can be represented as shown.



Use the bond energies in the table to determine the energy change, ΔH, for the complete combustion of **one** mole of methanol.

bond	bond energy in kJ/mol
C–H	410
C–O	360
O–H	460
O=O	500
C=O	805

- energy needed to break bonds

..... kJ

- energy released when bonds are formed

..... kJ

- energy change, ΔH, for the complete combustion of **one** mole of methanol

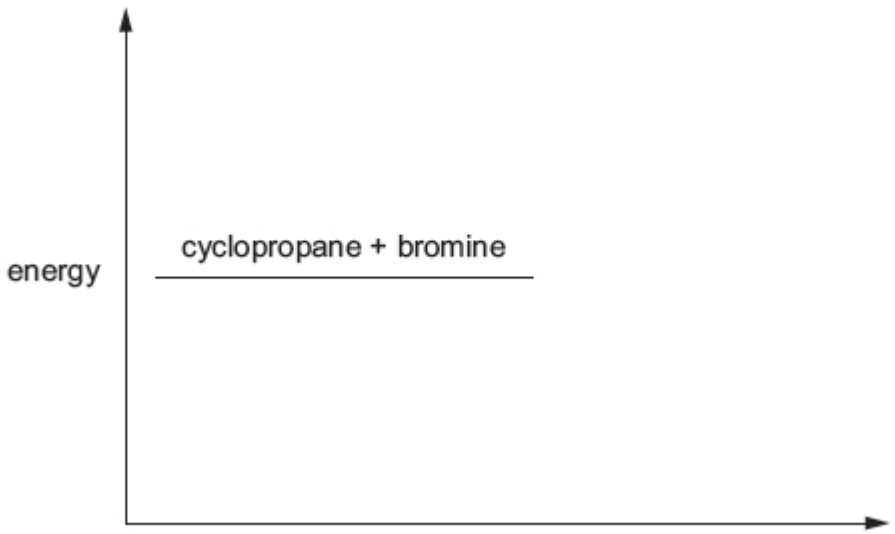
..... kJ/mol
[4]

Topic Chem 6 **Q# 110/** IGCSE Chemistry/2017/s/Paper 43/Q

(b) The reaction of cyclopropane with bromine is exothermic.

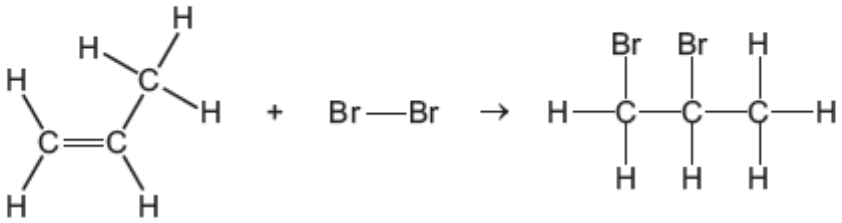
(i) Complete the energy level diagram for this reaction by

- adding the product of the reaction,
- labelling the energy change, ΔH.



[2]

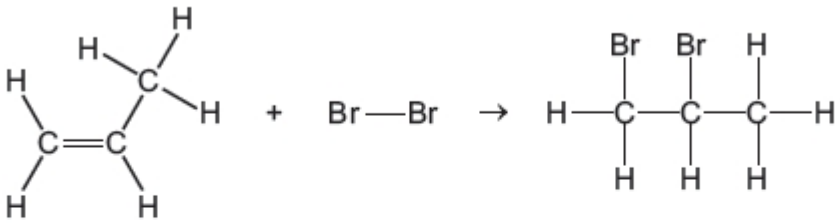
(ii) Propene also reacts with bromine.



Use the bond energies in the table to calculate the energy change, ΔH, for the reaction.

	C–H	C–C	Br–Br	C–Br	C=C
bond energy in kJ/mol	412	348	193	285	611

(ii) Propene also reacts with bromine.

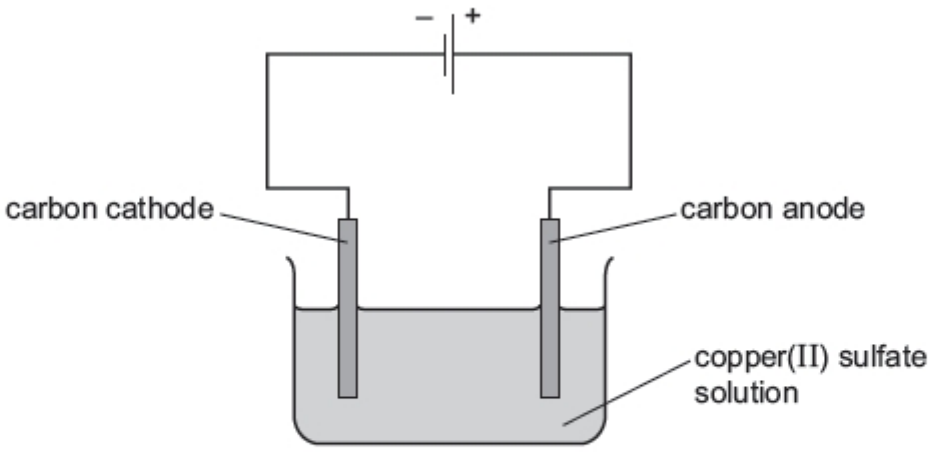


Use the bond energies in the table to calculate the energy change, ΔH, for the reaction.

	C–H	C–C	Br–Br	C–Br	C=C
bond energy in kJ/mol	412	348	193	285	611

energy change = ... kJ/mol [3]

4 Copper(II) sulfate solution was electrolysed using the apparatus shown.



(a) (i) Draw an arrow on the diagram to show the direction of movement of electrons in the wire. Label the arrow **A**. [1]

(ii) Draw an arrow on the diagram to show the direction of movement of positive ions in the copper(II) sulfate solution. Label the arrow **B**. [1]

(b) Oxygen was formed at the anode and copper was formed at the cathode.

(i) The ionic half-equation for the formation of oxygen is shown.

$$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$$

(ii) Write the ionic half-equation for the formation of copper at the cathode.

..... [2]

(c) The electrolysis was repeated using copper electrodes in place of carbon electrodes.

State and explain what happens to the masses of the anode and the cathode during this electrolysis.

.....

.....

.....

.....

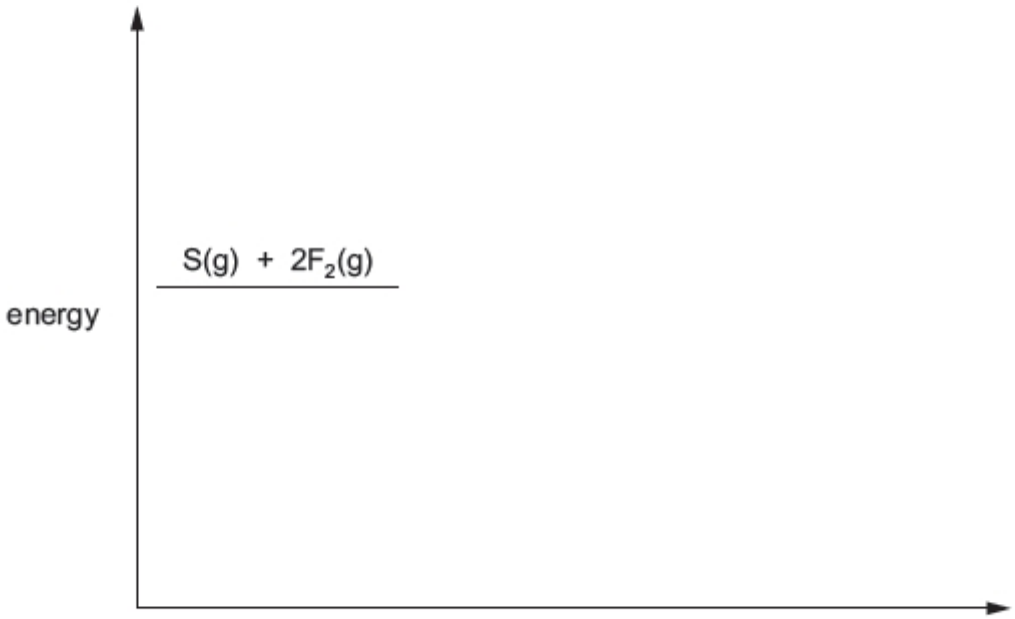
..... [4]

(f) Sulfur tetrafluoride, SF_4, can be made by combining gaseous sulfur with fluorine.

$$S(g) + 2F_2(g) \rightarrow SF_4(g)$$

The reaction is exothermic.

(i) Complete the energy level diagram for this reaction. Include an arrow which clearly shows the energy change during the reaction.

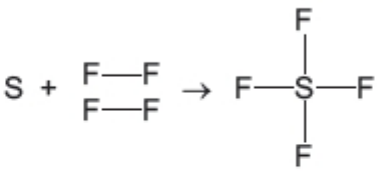


[3]

(ii) During the reaction the amount of energy given out is 780 kJ/mol.

The F–F bond energy is 160 kJ/mol.

Use this information to determine the bond energy, in kJ/mol, of one S–F bond in SF_4.

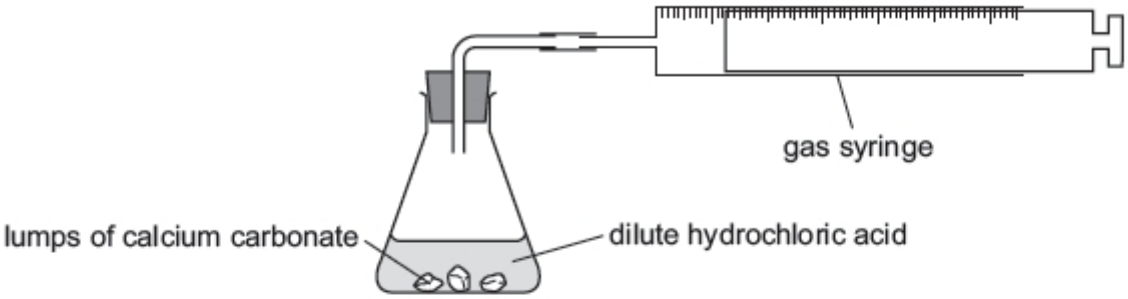


..... kJ/mol [3]

5 A student investigates the rate of reaction between lumps of calcium carbonate and dilute hydrochloric acid using the apparatus shown.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

The calcium carbonate was in excess.



(a) Which measurements should the student make during the reaction to determine the rate of reaction?

.....

..... [2]

(b) What happens to the rate of reaction as the reaction proceeds? Explain your answer.

.....

.....

.....

..... [3]

(c) The student repeated the experiment at a higher temperature. All other conditions were kept the same. The student found that the rate of reaction increased.

Explain, in terms of collisions, why the rate of reaction increased.

.....

.....

.....

.....

..... [4]

(d) Apart from using a higher temperature, suggest **two** other methods of increasing the rate of this reaction.

1 .....

2 .....

[2]

[Total: 11]

Topic Chem 7 **Q# 114/** IGCSE Chemistry/2018/w/Paper 43/Q1

1 Answer the following questions using only the substances in the list.
Each substance may be used once, more than once or not at all.

ammonia	**bauxite**	**carbon dioxide**	**carbon monoxide**
hematite	**oxygen**	**sodium chloride**	**sulfur dioxide**

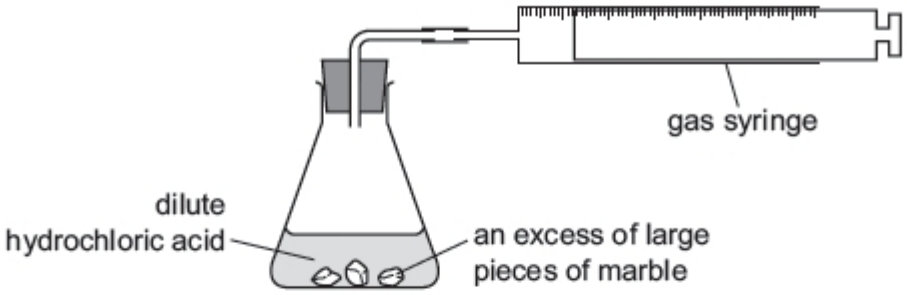
State which substance is:

(g) a reactant in photosynthesis ..... [1]

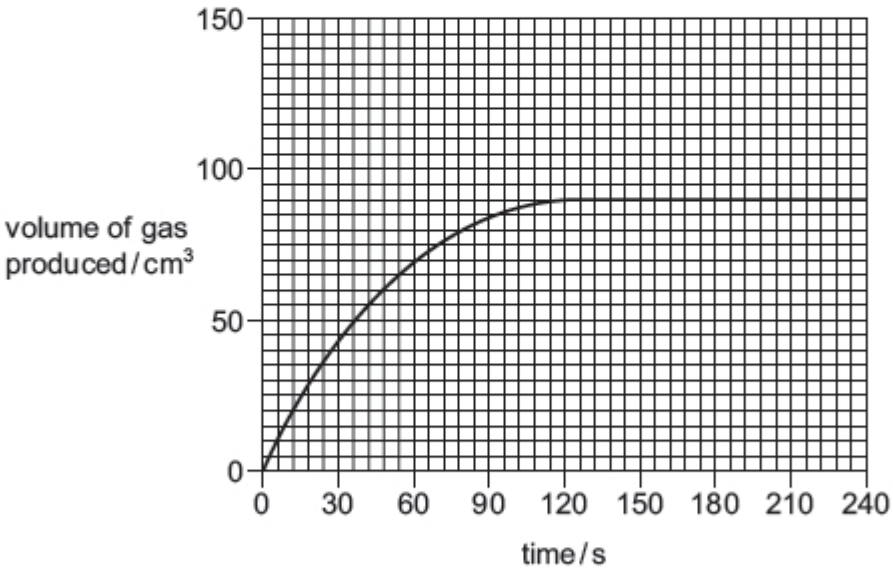
(h) a product of photosynthesis. ..... [1]

Topic Chem 7 **Q# 115/** IGCSE Chemistry/2018/w/Paper 42/Q4

4 A student investigated the progress of the reaction between dilute hydrochloric acid, HC*l*, and an excess of large pieces of marble, $CaCO_3$, using the apparatus shown.



(a) A graph of the volume of gas produced against time is shown.



(i) How does the shape of the graph show that the rate of reaction decreased as the reaction progressed?

.....

..... [1]

(ii) Why did the rate of reaction decrease as the reaction progressed?

..... [1]

(iii) After how many seconds did the reaction finish?

..... s [1]

(b) The experiment was repeated using the same mass of smaller pieces of marble. All other conditions were kept the same.

Draw a graph **on the grid** to show the progress of the reaction using the smaller pieces of marble. [2]

(c) The original experiment was repeated at a higher temperature. All other conditions were kept the same.

Describe and explain, in terms of collisions between particles, the effect of using a higher temperature on the time taken for the reaction to finish.

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

[Total: 10]

Topic Chem 7 **Q# 116/** IGCSE Chemistry/2018/w/Paper 41/Q5

5 Hydrogen gas reacts with iodine gas. The equation is shown.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

The reaction is reversible and can reach equilibrium.

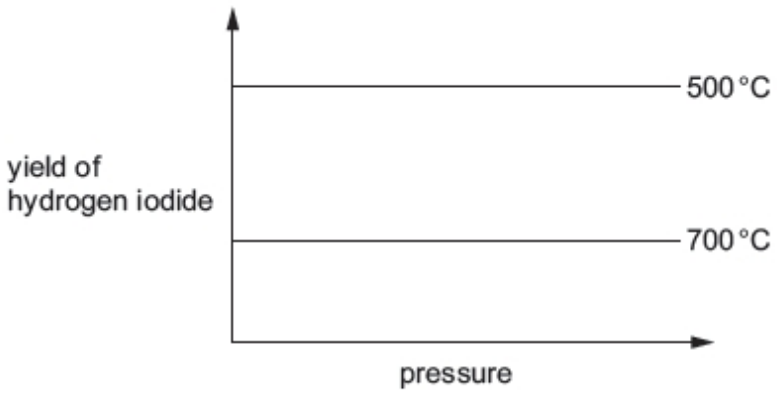
(a) What is meant by the term *equilibrium*?

.....

.....

..... [2]

(b) The graphs show how pressure affects the yield of hydrogen iodide, HI, at two different temperatures.



(i) Explain why the yield at 500 °C does **not** change as the pressure is increased.

.....

..... [1]

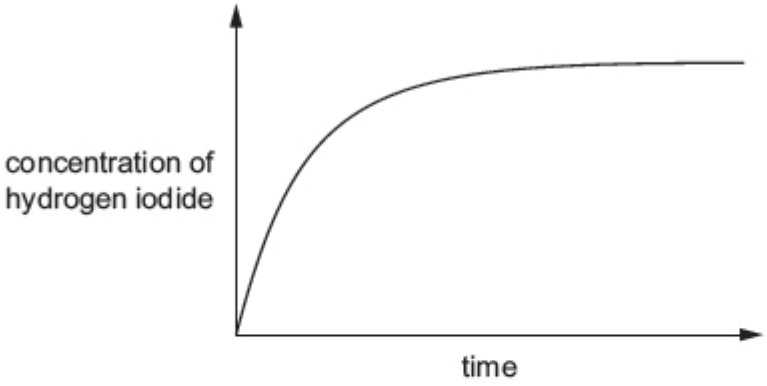
(ii) What can you conclude from the difference in the yield of hydrogen iodide at the **two** temperatures shown? Explain your answer.

.....

.....

..... [2]

(c) The graph shows how the concentration of hydrogen iodide, HI, changes after hydrogen gas and iodine gas are mixed together in a sealed container.



(i) When is the rate of reaction fastest?

..... [1]

(ii) The reaction was repeated at the same temperature and pressure but in the presence of a catalyst.

Draw a graph on the same axes to show how the concentration of hydrogen iodide changes with time in the presence of a catalyst. [2]

(d) A mixture of hydrogen gas and iodine gas is allowed to reach equilibrium.

(i) Increasing the pressure of a gas increases its concentration.

State and explain the effect of increasing the pressure on the **rate** of the forward reaction.

.....

.....

..... [2]

(ii) State and explain the effect of increasing the temperature on the **rate** of the reverse reaction.

.....

.....

.....

.....

..... [3]

Topic Chem 7 **Q# 117/** IGCSE Chemistry/2018/w/Paper 41/Q4

(c) The gas hydrogen sulfide, H_2S, is produced when concentrated sulfuric acid is added to solid potassium iodide.

The reaction involves oxidation.

(i) Define the term *oxidation* in terms of electron transfer.

..... [1]

Topic Chem 7 **Q# 118/** IGCSE Chemistry/2018/s/Paper 43/Q3

(d) Cobalt reacts with dilute hydrochloric acid to make the salt cobalt(II) chloride. Bubbles of hydrogen gas are produced.

(ii) The rate of reaction of cobalt with dilute hydrochloric acid can be made faster by heating the acid or by increasing its concentration.

State **one** other way to make the rate of reaction faster.

..... [1]

(iii) Use collision theory to explain how heating the dilute hydrochloric acid makes the rate of reaction faster.

.....

.....

.....

.....

..... [3]

(e) When cobalt(II) chloride is added to water an equilibrium is established.

$$\underset{\text{blue}}{[CoCl_4]^{2-}} + 6H_2O \rightleftharpoons \underset{\text{pink}}{[Co(H_2O)_6]^{2+}} + 4Cl^-$$

(i) A student adds water to a blue solution containing $[CoCl_4]^{2-}$ ions.

Describe what the student observes. Give a reason for your answer in terms of the position of the equilibrium.

.....

.....

..... [2]

(ii) Another student cools a blue solution containing $[CoCl_4]^{2-}$. The blue solution turns pink.

What does this information indicate about the forward reaction?

.....

..... [1]

Topic Chem 7 **Q# 119/** IGCSE Chemistry/2018/s/Paper 42/Q4

(f) When chlorine gas is passed through aqueous potassium bromide, a redox reaction occurs. The ionic equation is shown.

$$Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$$

(i) Write an ionic half-equation showing what happens to the chlorine molecules, Cl_2, in this reaction.

..... [1]

(ii) Explain why the bromide ions, Br^-, act as reducing agents in this reaction.

..... [1]

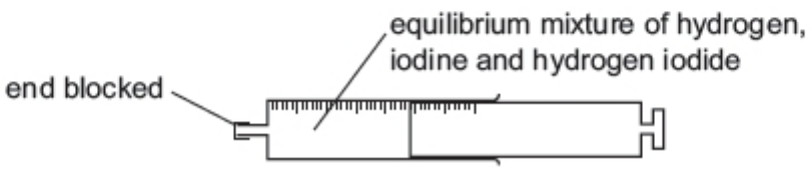
Topic Chem 7 **Q# 120/** IGCSE Chemistry/2018/s/Paper 42/

5 Hydrogen and iodine react together in a reversible reaction. Hydrogen iodide is formed.

$$\underset{\text{colourless gas}}{H_2(g)} + \underset{\text{purple gas}}{I_2(g)} \rightleftharpoons \underset{\text{colourless gas}}{2HI(g)}$$

The forward reaction is exothermic.

A gas syringe containing an equilibrium mixture of hydrogen, iodine and hydrogen iodide gases was sealed and heated to 250 °C. The equilibrium mixture was a pale purple colour.



(a) What is meant by the term *equilibrium*?

.....

.....

..... [2]

(b) The plunger of the gas syringe was pressed in while the end of the gas syringe was blocked. This increased the pressure. The position of the equilibrium did **not** change. The colour of the gaseous mixture turned darker purple.

(i) Give a reason why the position of the equilibrium did **not** change.

..... [1]

(ii) Suggest why the gaseous mixture turned darker purple, even though the position of the equilibrium did **not** change.

..... [1]

(c) The temperature of the gas syringe was increased to 300 °C.

(i) What happened to the **position** of the equilibrium when the temperature of the gas syringe was increased from 250 °C to 300 °C?

..... [1]

(ii) What happened to the **rate** of the forward reaction and the **rate** of the backward reaction when the temperature of the gas syringe was increased from 250 °C to 300 °C?

rate of the forward reaction .....

rate of the backward reaction .....

[2]

Topic Chem 7 **Q# 121/** IGCSE Chemistry/2018/m/Paper 42/Q4

(c) Ammonia reacts with oxygen at high temperatures in the presence of a suitable catalyst to form nitric oxide, NO.

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

(i) Explain how this chemical equation shows ammonia acting as a reducing agent.

.....

..... [1]

(b) The chemical equation shows the equilibrium between dinitrogen tetroxide (N_2O_4, a colourless gas) and nitrogen dioxide (NO_2, a brown gas).

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$
colourless brown

A mixture of dinitrogen tetroxide and nitrogen dioxide is allowed to reach equilibrium in a closed gas syringe.

(i) In chemistry, what is meant by the term *equilibrium*?

.....

.....

..... [2]

(ii) If the equilibrium mixture is heated at constant pressure, a darker brown colour is seen inside the gas syringe.

What does this information indicate about the decomposition of dinitrogen tetroxide? Explain your answer in terms of the position of the equilibrium.

.....

.....

..... [2]

(iii) Suggest what you would see if the pressure on the equilibrium mixture were increased at constant temperature.
Explain your answer in terms of the position of the equilibrium.

.....

.....

..... [2]

5 Some chemical reactions are reversible.

(a) Aqueous potassium chromate(VI), K_2CrO_4, is a yellow solution.

Aqueous potassium dichromate(VI), $K_2Cr_2O_7$, is an orange solution.

The two compounds interconvert when the pH of the solution changes.

$$2K_2CrO_4 + H_2SO_4 \rightleftharpoons K_2Cr_2O_7 + K_2SO_4 + H_2O$$
yellow orange

Solution **Y** is a mixture of aqueous potassium chromate(VI) and aqueous potassium dichromate(VI) at equilibrium.

- Explain, in terms of the position of the equilibrium, what you would **see** if sulfuric acid were added to solution **Y**.

.....

.....

.....

- Explain, in terms of the position of the equilibrium, what you would **see** if sodium hydroxide were added to solution **Y**.

.....

.....

.....

..... [5]

(b) Hydrogen can be manufactured using a reversible reaction between methane and steam.

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

At 900 °C, in the presence of a nickel catalyst, the yield of hydrogen is 70%.

Under different conditions, different yields of hydrogen are obtained.

(ii) If the pressure is increased, the yield of hydrogen becomes less than 70%.

Explain why, in terms of the position of the equilibrium.

.....

..... [1]

(iii) If the temperature is decreased, the yield of hydrogen decreases.

What does this information indicate about the reaction between methane and steam?

..... [1]

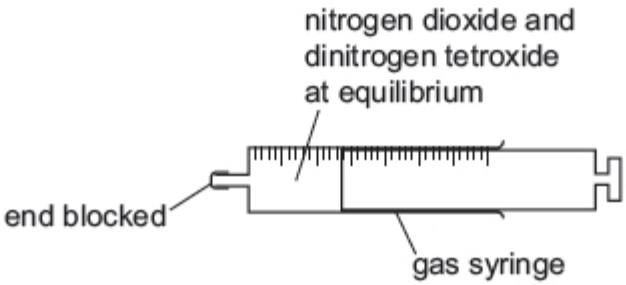
(iv) Why is a catalyst used in this reaction?

..... [1]

(c) Nitrogen dioxide, NO_2, exists in equilibrium with dinitrogen tetroxide, N_2O_4.
Nitrogen dioxide is brown and dinitrogen tetroxide is colourless.

$$2NO_2(g) \rightleftharpoons N_2O_4(g)$$
brown — colourless

(i) A sample of nitrogen dioxide and dinitrogen tetroxide at equilibrium was placed in a closed gas syringe.
The syringe plunger was pushed in. This increased the pressure in the gas syringe. The temperature was kept constant.



State how the colour of the gas in the syringe changed. Explain your answer in terms of the position of the equilibrium.

.....

.....

.....

..... [3]

(ii) A sealed tube containing nitrogen dioxide and dinitrogen tetroxide at equilibrium was cooled in an ice bath at constant pressure. The contents of the tube became paler.

Suggest an explanation for this observation in terms of the position of the equilibrium.

.....

.....

..... [2]

3 **(a)** When magnesium is added to aqueous copper(II) sulfate a reaction occurs. The ionic equation for the reaction is shown.

$$Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$$

(i) Give **one** change you would observe during this reaction.

..... [1]

(ii) Explain why this is a redox reaction.

.....

..... [1]

(iii) Identify the oxidising agent in this reaction. Give a reason for your answer.

.....

..... [2]

7 Copper(II) oxide reacts with dilute hydrochloric acid.

$$CuO(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(l)$$

6.00 g of copper(II) oxide were added to 50.0 cm^3 of 1.00 mol/dm^3 hydrochloric acid. This was an excess of copper(II) oxide.

(a) The rate of the reaction can be increased by increasing the concentration of the hydrochloric acid or by heating it.

(i) In terms of collisions, explain why increasing the concentration of the hydrochloric acid increases the rate of the reaction.

.....

.....

.....

..... [2]

(ii) In terms of collisions, explain why heating the hydrochloric acid increases the rate of the reaction.

.....

.....

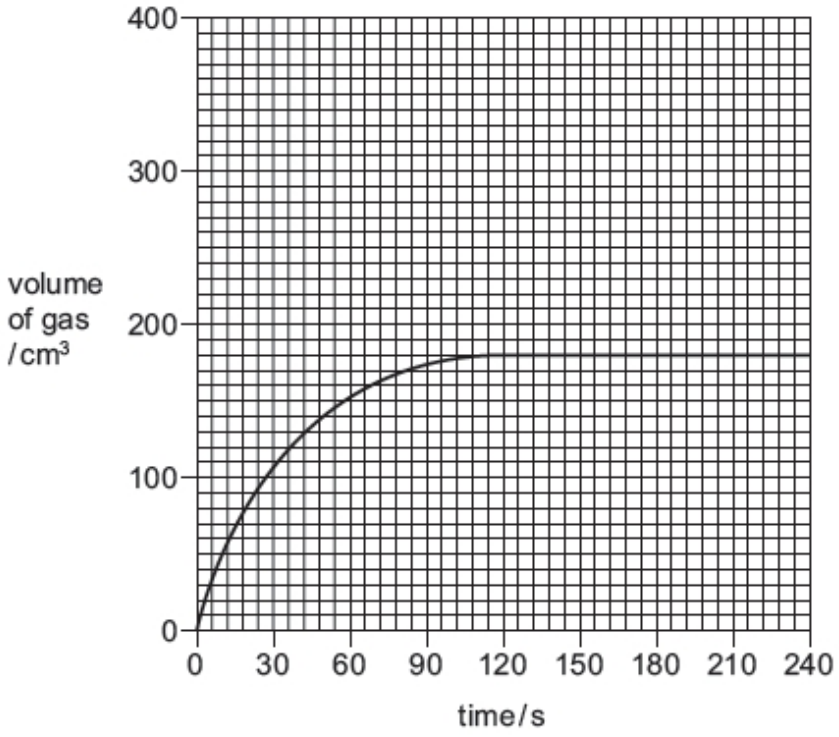
.....

..... [2]

5 When barium carbonate is added to dilute hydrochloric acid, carbon dioxide gas is formed.

A student carried out an experiment to measure the volume of gas formed as a reaction proceeds. The student added a small mass of powdered barium carbonate to an excess of 0.1 mol/dm^3 hydrochloric acid. A graph of the results was drawn.

The graph is shown.



(a) Name the **two** pieces of apparatus needed to take the measurements shown on the graph.

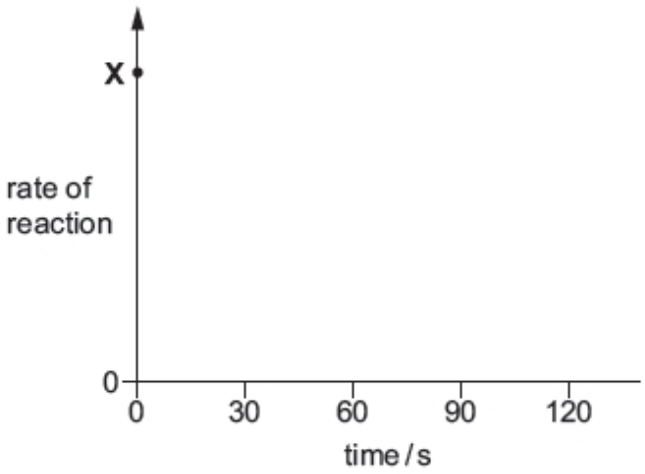
1 .....

2 .....

[1]

(b) On the axes below, sketch a graph to show how the rate of reaction changes as the reaction proceeds.

Assume the initial rate of reaction is represented by the point at **X**.

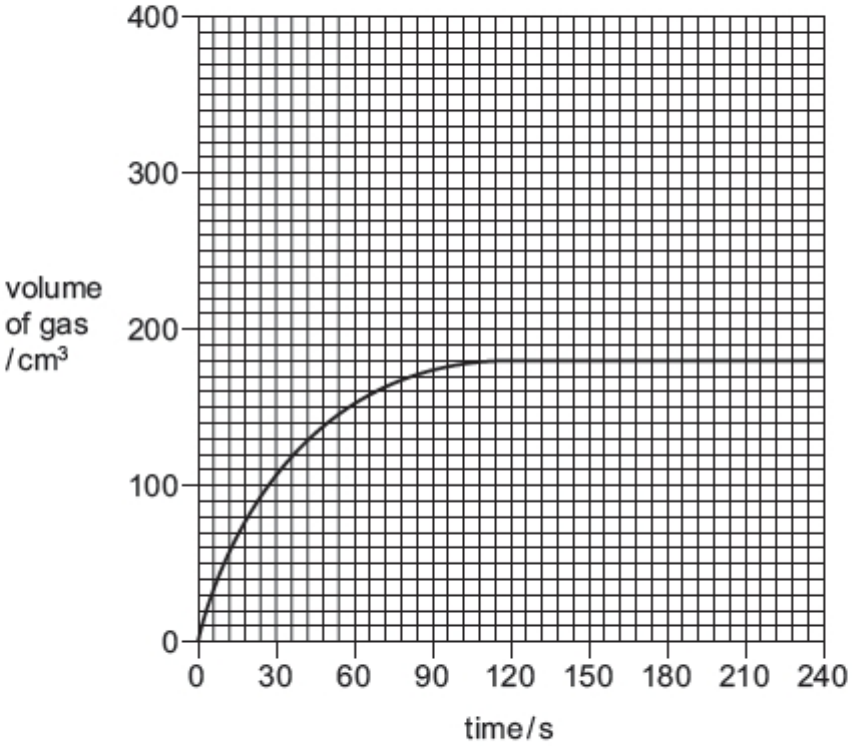


[2]

(d) The original graph has been drawn again.

On the grid, draw the graph expected if the same mass of barium carbonate is added as large lumps instead of as a powder. All other conditions are the same as in the original experiment.

Explain why your graph is different from the original graph.



.....

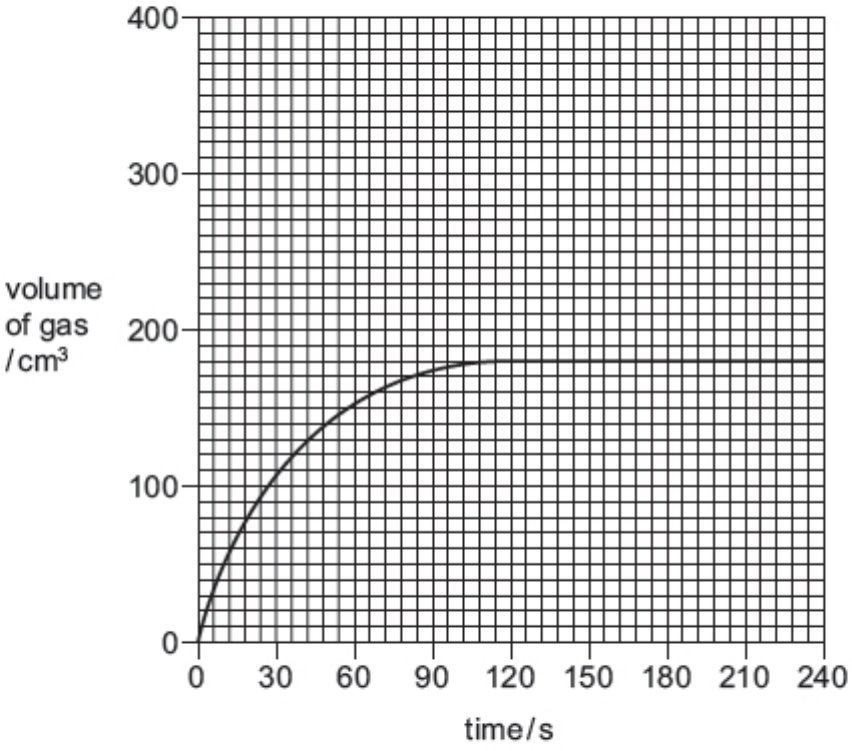
.....

..... [2]

(e) The original graph has been drawn again.

On the grid, draw the graph expected if the concentration of dilute hydrochloric acid is changed from 0.1 mol / dm^3 to 0.2 mol / dm^3. All other conditions are the same as in the original experiment.

Explain, in terms of particles, why your graph is different from the original graph.



.....

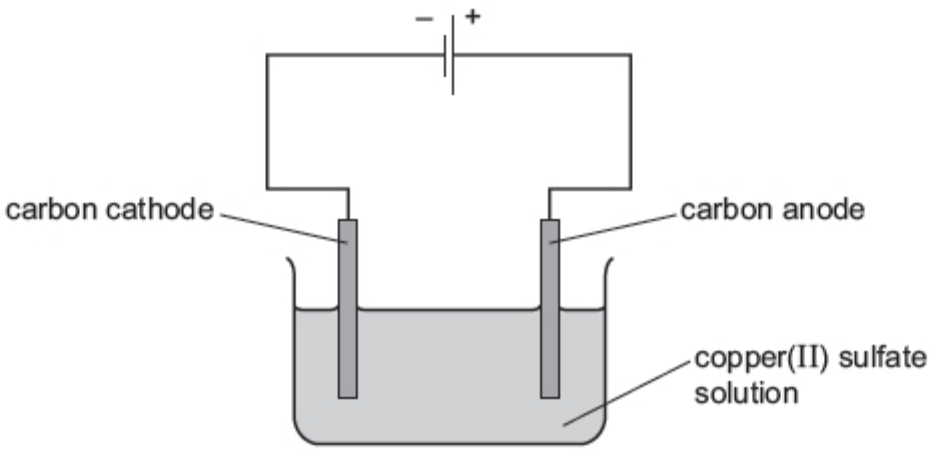
.....

.....

..... [4]

Topic Chem 7 **Q# 128/** IGCSE Chemistry/2017/m/Paper 42/

4 Copper(II) sulfate solution was electrolysed using the apparatus shown.



(b) Oxygen was formed at the anode and copper was formed at the cathode.

(i) The ionic half-equation for the formation of oxygen is shown.

$$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$$

Explain why this reaction is oxidation.

..... [1]

(ii) Write the ionic half-equation for the formation of copper at the cathode.

..... [2]

Topic Chem 7 **Q# 129/** IGCSE Chemistry/2017/m/Paper 42/

3 Nitryl chloride, NO_2Cl, reacts with nitric oxide, NO. The forward reaction is exothermic.

$$NO_2Cl(g) + NO(g) \rightleftharpoons NO_2(g) + NOCl(g)$$

The reaction can reach equilibrium.

(a) What is meant by the term *equilibrium* for a reversible reaction?

.....

.....

..... [2]

(b) Explain why increasing the temperature increases the rate of reaction.

.....

.....

..... [3]

(c) State and explain the effect, if any, of increasing the temperature on the position of equilibrium.

.....

.....

..... [2]

(d) State and explain the effect, if any, of decreasing the pressure on the position of equilibrium.

.....

.....

..... [2]

Topic Chem 7 **Q# 130/** IGCSE Chemistry/2016/w/Paper 41/Q5

(c) The electrolysis was repeated using copper electrodes in place of carbon electrodes. The ionic half-equations for the reactions at the two electrodes are shown.

anode $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$

cathode $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

(i) Which species is reduced during the electrolysis? Explain your answer.

.....

.....

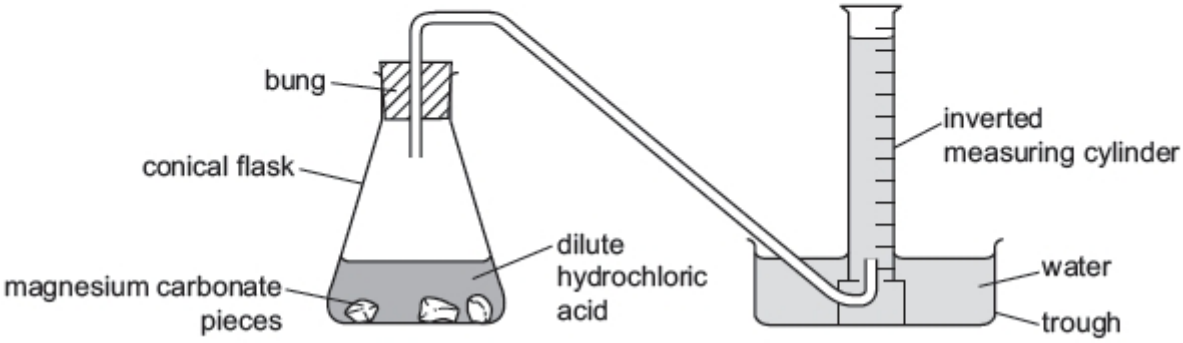
..... [2]

Topic Chem 7 **Q# 131/** IGCSE Chemistry/2016/w/Paper 41/

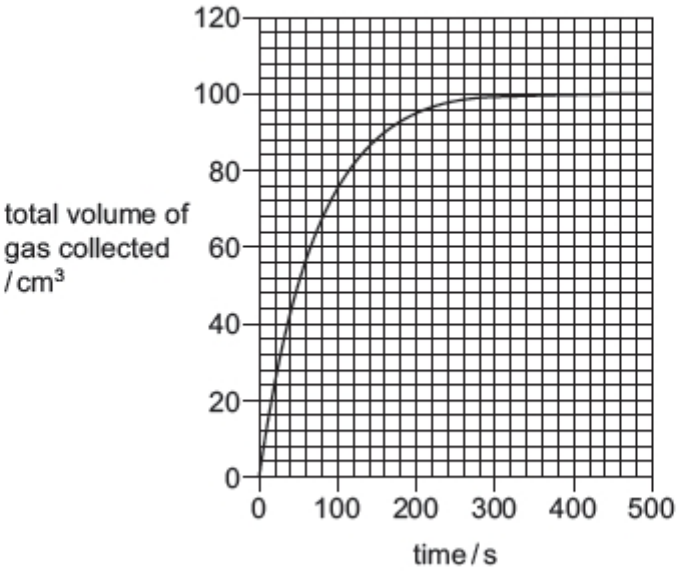
8 Magnesium carbonate reacts with dilute hydrochloric acid.

$$MgCO_3(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l) + CO_2(g)$$

An excess of magnesium carbonate pieces was added to dilute hydrochloric acid. The apparatus in the diagram was used to measure the volume of gas produced. The total volume of gas collected was recorded every 20 seconds.



(a) The results obtained are shown on the graph.



(i) Describe how the rate of this reaction changed during the reaction. Explain why the rate changed in this way.

.....

.....

.....

.....

..... [4]

(ii) The experiment was repeated using the same mass of **powdered** magnesium carbonate with the same volume and concentration of dilute hydrochloric acid.

Explain how the initial rate of reaction and total volume of gas collected would compare to the first experiment.

initial rate of reaction .....

.....

.....

total volume of gas .....

.....

.....

[4]

(b) A piece of magnesium ribbon was cleaned. The experiment was repeated using this clean magnesium ribbon instead of magnesium carbonate.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

This reaction is exothermic.
The rate of the reaction gradually increased over the first 2 minutes.

Explain why the rate of the reaction increased.

.....

.....

.....

.....

.....

.....

..... [5]

Topic Chem 7 **Q# 132/** IGCSE Chemistry/2016/s/Paper 43/Q4

(c) When chlorine gas is bubbled through an aqueous solution of potassium iodide, a redox reaction takes place.

$$2I^- + Cl_2 \rightarrow I_2 + 2Cl^-$$

(ii) Identify the reducing agent in this reaction. Explain your answer.

.....

.....

..... [2]

Topic Chem 7 **Q# 133/** IGCSE Chemistry/2016/s/Paper 42/

1 **(a)** For each of the following, give the name of an element from Period 2 (lithium to neon), which matches the description.
Elements may be used once, more than once or not at all.

(ii) an element which forms an oxide that is a reactant in photosynthesis

..... [1]

(iii) an element that is a product of photosynthesis

..... [1]

Topic Chem 7 **Q# 134/** IGCSE Chemistry/2016/s/Paper 42/

(d) When a sample of steel is added to dilute hydrochloric acid, an aqueous solution of iron(II) chloride, $FeCl_2$, is formed.

When a sample of rust is added to dilute hydrochloric acid, an aqueous solution of iron(III) chloride, $FeCl_3$, is formed.

Solutions of iron(II) chloride and iron(III) chloride were added to solutions of potassium iodide and acidified potassium manganate(VII). The results are shown in the table.

	iron(II) chloride solution	iron(III) chloride solution
potassium iodide solution	no change	solution turns from colourless to brown
acidified potassium manganate(VII) solution	solution turns from purple to colourless	no change

(ii) What **types** of substance cause potassium iodide solution to turn from colourless to brown?

..... [1]

(iii) What **types** of substance cause acidified potassium manganate(VII) solution to turn from purple to colourless?

..... [1]

Topic Chem 7 **Q# 135/** IGCSE Chemistry/2016/s/Paper 42/

4 Hydrogen can be manufactured from methane by steam reforming.

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

The reaction is carried out using a nickel catalyst at temperatures between 700 °C and 1100 °C and using a pressure of one atmosphere.

The forward reaction is endothermic.

(a) What is meant by the term *catalyst*?

.....

..... [2]

(b) Suggest **two** reasons why a temperature lower than 700 °C is not used.

.....

..... [2]

(c) Suggest **one** advantage of using a pressure greater than one atmosphere.

..... [1]

(d) Suggest **one** disadvantage of using a pressure greater than one atmosphere.

..... [1]

Topic Chem 7 **Q# 136/** IGCSE Chemistry/2016/s/Paper 41/Q4(a)

(i) The chemical process taking place on the surface of the object is

$$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$$

Explain whether this process is oxidation or reduction.

.....

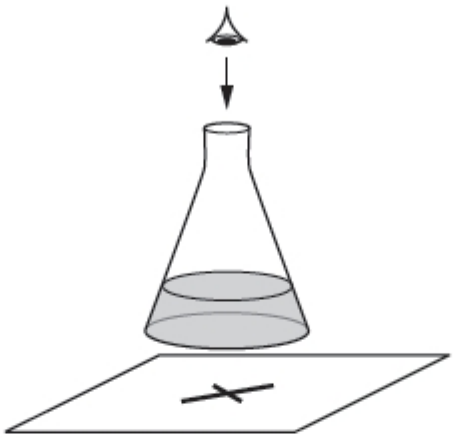
..... [1]

Topic Chem 7 **Q# 137/** IGCSE Chemistry/2016/s/Paper 41/

3 When aqueous sodium thiosulfate and dilute hydrochloric acid are mixed, a precipitate of insoluble sulfur is produced. This makes the mixture difficult to see through.

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow S(s) + 2NaCl(aq) + H_2O(l) + SO_2(g)$$

The time taken for the cross to disappear from view is measured.



A student adds the following volumes of aqueous sodium thiosulfate, dilute hydrochloric acid and distilled water to the conical flask.

The time taken for the formation of the precipitate of sulfur to make the cross disappear from view is recorded.

experiment number	volume of sodium thiosulfate / cm^3	volume of hydrochloric acid / cm^3	volume of distilled water / cm^3	time taken for cross to disappear from view / s
1	10	10	40	56
2	20	10	30	28
3				

(a) State the order in which the aqueous sodium thiosulfate, hydrochloric acid and distilled water should be added to the flask.

.....

..... [1]

(b) In experiment 3 the student wanted the sodium thiosulfate to be double the concentration used in experiment 2.

(i) Complete the table to show the **volumes** which should be used and the **expected** time taken for the cross to disappear from view in experiment 3. [2]

(ii) Use collision theory to explain why increasing the concentration of sodium thiosulfate would change the rate of reaction.

.....

.....

.....

..... [2]

(c) The student repeated experiment 1 at a higher temperature.

Use collision theory to explain why the rate of reaction would increase.

.....

.....

.....

..... [3]

Topic Chem 7 **Q# 138/** IGCSE Chemistry/2016/m/Paper 42/

4 Hydrogen peroxide, H_2O_2, decomposes into water and oxygen in the presence of a catalyst, manganese(IV) oxide.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

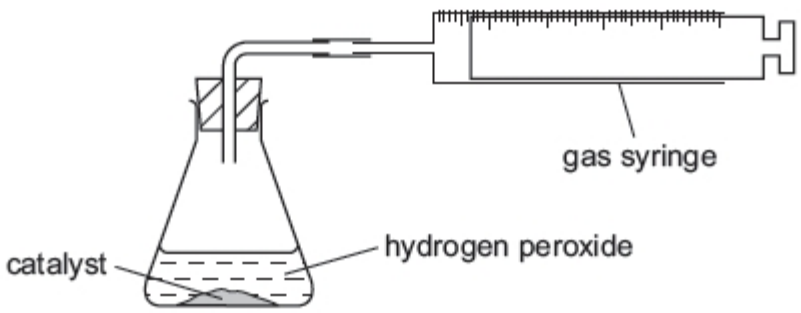
(a) What is meant by the term *catalyst*?

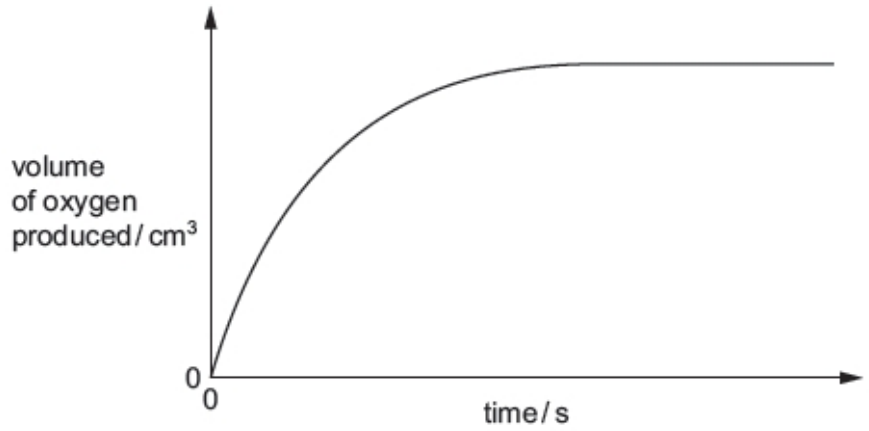
.....

..... [2]

(b) A student studies the rate of decomposition of hydrogen peroxide using the apparatus shown. The student uses 20 cm^3 of 0.1 mol / dm^3 hydrogen peroxide and 1.0 g of manganese(IV) oxide.

The student measures the volume of oxygen given off at regular time intervals until the reaction stops. A graph of the results is shown.





(i) When is the rate of reaction highest?

..... [1]

(ii) Suggest **one** method of increasing the rate of reaction using the same amounts of hydrogen peroxide and manganese(IV) oxide.

..... [1]

(d) The student carries out a second experiment to investigate whether another substance, copper(II) oxide, is a better catalyst than manganese(IV) oxide.

Describe how the second experiment is carried out. You should state clearly how you would make sure that the catalyst is the only variable.

.....

.....

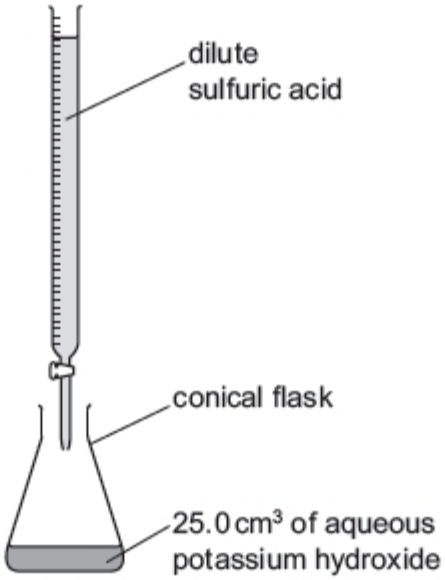
.....

.....

.....

..... [3]

4 **(a)** Dilute sulfuric acid and aqueous potassium hydroxide can be used to make potassium sulfate crystals using a method that includes titration.



A student titrated 25.0 cm^3 of 0.0500 mol/dm^3 aqueous potassium hydroxide with dilute sulfuric acid in the presence of an indicator. The volume of dilute sulfuric acid needed to neutralise the aqueous potassium hydroxide was 20.0 cm^3.

The equation for the reaction is shown.

$$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$$

(b) After the titration has been completed, the conical flask contains an aqueous solution of potassium sulfate and some of the dissolved indicator.

Describe how to prepare a **pure**, dry sample of potassium sulfate crystals from new solutions of dilute sulfuric acid and aqueous potassium hydroxide of the same concentrations as used in the titration. Include a series of key steps in your answer.

.....

.....

.....

.....

.....

.....

..... [5]

(c) Potassium hydrogensulfate, $KHSO_4$, is an acid salt. It dissolves in water to produce an aqueous solution, **X**, containing K^+, H^+ and SO_4^{2-} ions.

Describe what you would see when the following experiments are done.

(i) Magnesium ribbon is added to an excess of solution **X**.

.....

..... [2]

(ii) A flame test is done on solution **X**.

..... [1]

(iii) An aqueous solution containing barium ions is added to solution **X**.

..... [1]

(d) Dilute sulfuric acid reacts with bases, metals and carbonates.

Write chemical equations for the reaction of dilute sulfuric acid with each of the following:

(i) magnesium hydroxide

..... [2]

(ii) zinc

..... [2]

(iii) sodium carbonate

..... [2]

Topic Chem 8 **Q# 140/** IGCSE Chemistry/2018/w/Paper 43/Q3f

(i) Describe a test for oxygen.

test .....

result .....

[2]

Topic Chem 8 **Q# 141/** IGCSE Chemistry/2018/w/Paper 43/Q1

1 Answer the following questions using only the substances in the list.
Each substance may be used once, more than once or not at all.

ammonia	**bauxite**	**carbon dioxide**	**carbon monoxide**
hematite	**oxygen**	**sodium chloride**	**sulfur dioxide**

State which substance is:

(a) an element ..... [1]

(c) Dilute sulfuric acid is used to make salts known as sulfates.

A method consisting of three steps is used to make zinc sulfate from zinc carbonate.

step 1 Add an excess of zinc carbonate to 20 cm^3 of 0.4 mol/dm^3 dilute sulfuric acid until the reaction is complete.

step 2 Filter the mixture.

step 3 Heat the filtrate until a saturated solution forms and then allow it to crystallise.

(ii) State **two** observations which would show that the reaction is complete in **step 1**.

1 .....

2 .....

[2]

(iii) Why is it important to add an excess of zinc carbonate in **step 1**?

..... [1]

(iv) What is meant by the term *saturated solution* in **step 3**?

.....

..... [2]

(v) The equation for the reaction is shown.

$$ZnCO_3(s) + H_2SO_4(aq) \rightarrow ZnSO_4(.....) + H_2O(l) + CO_2(g)$$

Complete the equation by inserting the state symbol for zinc sulfate. [1]

(vi) Name another zinc compound which could be used to make zinc sulfate from dilute sulfuric acid using this method.

..... [1]

(vii) Suggest why this method would **not** work to make barium sulfate from barium carbonate and dilute sulfuric acid.

..... [1]

(d) In a titration, a student added 25.0 cm^3 of 0.200 mol/dm^3 aqueous sodium hydroxide to a conical flask. The student then added a few drops of methyl orange to the solution in the conical flask.
Dilute sulfuric acid was then added from a burette to the conical flask. The volume of dilute sulfuric acid needed to neutralise the aqueous sodium hydroxide was 20.0 cm^3.

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

(i) What was the colour of the methyl orange in the aqueous sodium hydroxide?

..... [1]

Topic Chem 8 **Q# 143/** IGCSE Chemistry/2018/w/Paper 42/Q2

(c) Calcium reacts with cold water to form two products:

- a colourless gas, **P**, which 'pops' with a lighted splint
- a weakly alkaline solution, **Q**, which turns milky when carbon dioxide is bubbled through it.

(i) Name gas **P**.

..... [1]

(ii) Identify the ion responsible for making solution **Q** alkaline.

..... [1]

(iii) Suggest the pH of solution **Q**.

..... [1]

(iv) Write a chemical equation for the reaction of calcium with cold water.

..... [2]

(e) Aqueous magnesium chloride is added to aqueous silver nitrate. A white precipitate forms.

Write an **ionic** equation for this reaction. Include state symbols.

..... [2]

Topic Chem 8 **Q# 144/** IGCSE Chemistry/2018/w/Paper 41/Q1

1 The following formulae represent different substances.

Al Ag $CaCO_3$ CH_4 Cl_2 Cu SO_2

Answer the following questions using only these substances.
Each substance may be used once, more than once or not at all.

State which substance is:

(e) a gas which bleaches damp litmus paper ..... [1]

Topic Chem 8 **Q# 145/** IGCSE Chemistry/2018/w/Paper 41/Q1

1 The following formulae represent different substances.

Al Ag $CaCO_3$ CH_4 Cl_2 Cu SO_2

Answer the following questions using only these substances.
Each substance may be used once, more than once or not at all.

State which substance is:

(f) a gas which contributes to climate change. ..... [1]

Topic Chem 8 **Q# 146/** IGCSE Chemistry/2018/s/Paper 43/Q6

(c) Chloric(V) acid, $HClO_3$, is a strong acid. It can be made from calcium chlorate(V).

(i) What colour is methyl orange indicator in chloric(V) acid?

..... [1]

(ii) Define the term *acid* in terms of proton transfer.

..... [1]

(iii) Complete the chemical equation to show $HClO_3$ behaving as an acid in water.

$$HClO_3 + H_2O \rightarrow \text{.....} + \text{.....}$$

[1]

Topic Chem 8 **Q# 147/** IGCSE Chemistry/2018/s/Paper 43/Q4

(f) Ethanoic acid, CH_3COOH, is a weak acid. It reacts with copper(II) carbonate to form the salt copper(II) ethanoate, $Cu(CH_3COO)_2$.

(i) What is meant by the term *weak* when applied to acids?

..... [1]

(ii) Describe how a crystalline sample of copper(II) ethanoate can be prepared starting with ethanoic acid and copper(II) carbonate.

.....

.....

.....

.....

.....

..... [3]

(iii) Write the word equation for the reaction between ethanoic acid and copper(II) carbonate.

..... [1]

Topic Chem 8 **Q# 148/** IGCSE Chemistry/2018/s/Paper 43/Q3

(d) Cobalt reacts with dilute hydrochloric acid to make the salt cobalt(II) chloride. Bubbles of hydrogen gas are produced.

(i) Describe a test for hydrogen.

test .....

result .....

[2]

Topic Chem 8 **Q# 149/** IGCSE Chemistry/2018/s/Paper 42/Q8

(b) Nitrates decompose when heated.

(iii) When the hydrated copper(II) nitrate crystals are heated, steam is produced. When the steam condenses on a cool surface, it turns into a colourless liquid.

Anhydrous cobalt(II) chloride is used to show that the colourless liquid contains water.

How does the colour of the anhydrous cobalt(II) chloride change?

from ..... to .....

[2]

Topic Chem 8 **Q# 150/** IGCSE Chemistry/2018/s/Paper 42/

6 **(a)** All sodium salts are soluble in water. All nitrates are soluble in water. Barium carbonate is insoluble in water.

Describe how you would make a pure, dry sample of barium carbonate by precipitation.
Include:

- the names of the starting materials
- full practical details
- a chemical equation.

.....

.....

.....

.....

.....

..... [5]

Topic Chem 8 **Q# 151/** IGCSE Chemistry/2018/m/Paper 42/

1 This question is about gases.

(a) The following substances are gases at room temperature.

letter	A	B	C	D	E	F	G	H
substance	SO_2	Ar	CO	Cl_2	NH_3	CO_2	CH_4	C_3H_8

Identify, by letter:

(iii) a gas which bleaches damp litmus paper ..... [1]

Topic Chem 8 **Q# 152/** IGCSE Chemistry/2018/m/Paper 42/

4 Ammonia is an important chemical.

(a) Ammonia is a base.

(i) In chemistry, what is meant by the term *base*?

.....

..... [1]

(ii) Write a word equation to show ammonia behaving as a base.

.....

..... [2]

Topic Chem 8 **Q# 153/** IGCSE Chemistry/2018/m/Paper 42/

(c) Silver chloride can be made by reacting aqueous sodium chloride with aqueous silver nitrate. The other product of the reaction is sodium nitrate. The chemical equation for the reaction is shown.

$$NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

A student attempted to make the maximum amount of **sodium nitrate** crystals. The process involved three steps.

step 1 The student added aqueous sodium chloride to aqueous silver nitrate and stirred. Neither reagent was in excess.

step 2 The student filtered the mixture. The student then washed the residue and added the washings to the filtrate.

step 3 The student obtained sodium nitrate crystals from the filtrate.

(i) Describe what the student observed in **step 1**.

..... [1]

(ii) Why was the residue washed in **step 2**?

.....

..... [1]

(iii) Give the names of the **two** processes which occurred in **step 3**.

1 .....

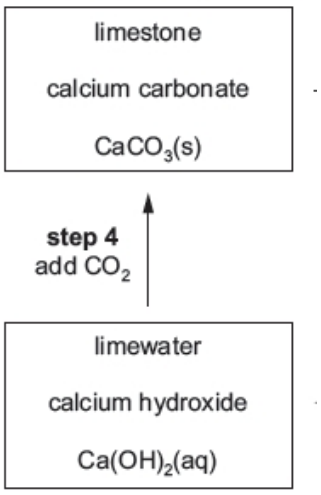
2 .....

[2]

Topic Chem 8 **Q# 154/** IGCSE Chemistry/2018/m/Paper 42/

3 Limestone rock is mainly calcium carbonate, $CaCO_3$.

(a) The 'limestone cycle' is shown. Each step is numbered.



(vi) Explain why **step 4** is a neutralisation reaction. Refer to the substances reacting in your answer.

.....

..... [2]

(b) Dolomite is a similar rock to limestone. Dolomite contains magnesium carbonate, $MgCO_3$.

Write a chemical equation for the reaction between magnesium carbonate and dilute nitric acid.

..... [2]

Topic Chem 8 **Q# 155/** IGCSE Chemistry/2017/w/Paper 43/Q3

(d) (i) When iron is added to dilute sulfuric acid, an aqueous solution of iron(II) sulfate is formed as one of the products.

Write a chemical equation for the reaction.

..... [1]

(ii) When iron(III) oxide is added to dilute sulfuric acid, an aqueous solution of iron(III) sulfate is formed as one of the products.

Write a chemical equation for the reaction.

..... [3]

(e) Aqueous sodium hydroxide, aqueous potassium iodide and aqueous acidified potassium manganate(VII) are added to aqueous solutions of iron(II) sulfate and iron(III) sulfate.

- Iron(II) ions, Fe^{2+}, are reducing agents in aqueous solution.
- Iron(III) ions, Fe^{3+}, are oxidising agents in aqueous solution.

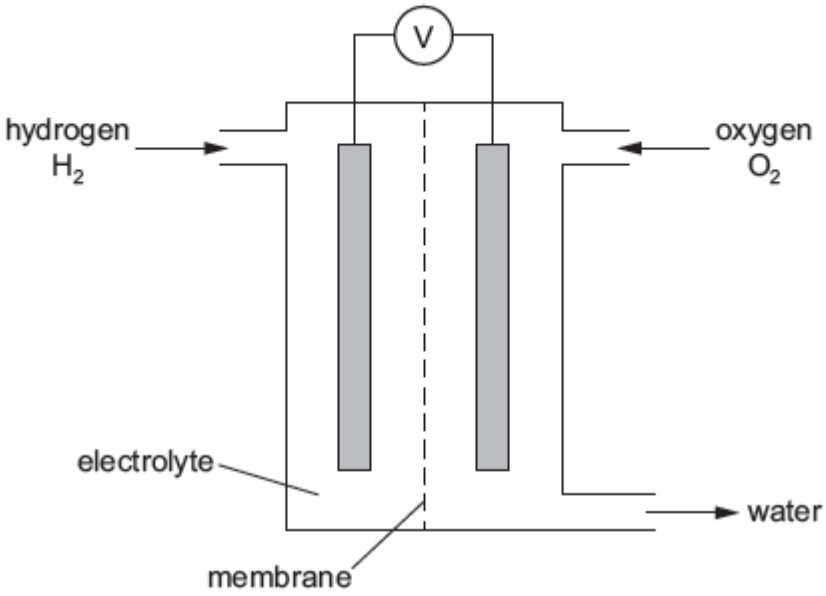
Complete the table.

reagent	observations with aqueous iron(II) sulfate	observations with aqueous iron(III) sulfate
aqueous sodium hydroxide	green precipitate	
aqueous potassium iodide		
aqueous acidified potassium manganate(VII)		no change

[4]

Topic Chem 8 **Q# 156/** IGCSE Chemistry/2017/w/Paper 43/

4 Hydrogen and oxygen react together in a hydrogen fuel cell. A hydrogen fuel cell is shown in the diagram.



(ii) What **type** of substance reacts by donating hydrogen ions, H^+?

..... [1]

Topic Chem 8 **Q# 157/** IGCSE Chemistry/2017/w/Paper 41/Q5

(b) Copper(II) carbonate reacts with dilute nitric acid. One of the products of the reaction is a solution of copper(II) nitrate.

(i) Describe tests for copper(II) ions and nitrate ions. Include the results of the tests.

copper(II) ions .....

.....

.....

nitrate ions .....

.....

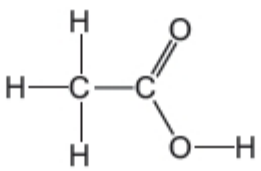
.....

[4]

Topic Chem 8 **Q# 158/** IGCSE Chemistry/2017/w/Paper 41/

4 **(a)** Ethanol, C_2H_5OH, can be made by fermentation.

(ii) A molecule of ethanoic acid has the structure shown.



(d) Ethanoic acid is a weak acid.

(i) When referring to an acid, what is meant by the term *weak*?

.....

..... [1]

(ii) Describe how you could show that ethanoic acid is a weaker acid than hydrochloric acid.

.....

.....

.....

..... [3]

Topic Chem 8 **Q# 159/** IGCSE Chemistry/2017/s/Paper 43/

6 Barium carbonate, $BaCO_3$, is an insoluble solid.

(b) Aqueous sodium carbonate is added to aqueous barium nitrate.

(i) Write a chemical equation for the reaction of aqueous sodium carbonate with aqueous barium nitrate.

..... [2]

(ii) Describe how a pure sample of barium carbonate could be obtained from the resulting mixture.

.....

.....

.....

..... [3]

Topic Chem 8 **Q# 160/** IGCSE Chemistry/2017/s/Paper 42/Q4

(b) Copper(II) oxide is a basic oxide but zinc oxide is an amphoteric oxide. Both oxides are insoluble in water.

You are provided with a mixture of solid copper(II) oxide and solid zinc oxide. Describe how you would obtain a sample of copper(II) oxide from this mixture.

.....

.....

.....

..... [3]

Topic Chem 8 **Q# 161/** IGCSE Chemistry/2017/s/Paper 42/Q3

(c) Nitrogen(II) oxide can be reacted with oxygen and water to produce nitric acid as the only product.

Write a chemical equation for this reaction.

..... [2]

(d) Describe how you would prepare a pure dry sample of copper(II) nitrate crystals in the laboratory using dilute nitric acid and solid copper(II) carbonate.
Include a series of key steps in your answer.
You should include a chemical equation for the reaction.

.....

.....

.....

.....

.....

.....

.....

..... [6]

Topic Chem 8 **Q# 162/** IGCSE Chemistry/2017/s/Paper 42/Q2

(f) Silicon(IV) oxide is an acidic oxide. When silicon(IV) oxide reacts with alkalis, the salts formed contain the ion SiO_3^{2-}.

Write a chemical equation for the reaction between silicon(IV) oxide and aqueous sodium hydroxide.

..... [2]

Topic Chem 8 **Q# 163/** IGCSE Chemistry/2017/s/Paper 41/

2 Some oxides of some elements are listed.

CO CO_2 Na_2O MgO Al_2O_3

SiO_2 P_4O_{10} SO_2 Cl_2O_7 Cr_2O_3

(a) Answer the following questions using only oxides from the list. Each oxide may be used once, more than once or not at all.

Give the formula of an oxide

(i) which is the main cause of acid rain, ...

(ii) which would give a solution of pH 14 when added to water, ...

(v) which is amphoteric, ...

(vi) which is neutral. .....

[4]

(b) Amphoteric oxides and neutral oxides are different from each other.

(i) What is meant by the term *amphoteric oxide*?

.....

..... [1]

(ii) What is meant by the term *neutral oxide*?

.....

..... [1]

Topic Chem 8 **Q# 164/** IGCSE Chemistry/2017/s/Paper 41/

3 Magnesium sulfate and lead(II) sulfate are examples of salts.

(a) A student prepared magnesium sulfate crystals starting from magnesium carbonate. The student carried out the experiment in four steps.

step 1 The student added excess magnesium carbonate to a small volume of dilute sulfuric acid until no more magnesium carbonate would react.

step 2 The student filtered the mixture.

step 3 The student heated the filtrate obtained from **step 2** until it was saturated.

step 4 The student allowed the hot filtrate to cool to room temperature and then removed the crystals which formed.

(i) How did the student know when the reaction had finished in **step 1**?

..... [1]

(ii) Name the residue in **step 2**.

..... [1]

(c) Lead(II) sulfate, $PbSO_4$, is insoluble.

Describe how you would prepare a pure dry sample of lead(II) sulfate crystals starting from solutions of lead(II) nitrate and sodium sulfate.
Include a series of key steps in your answer.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(d) Write the ionic equation for the reaction which takes place between solutions of lead(II) nitrate and sodium sulfate.
Include state symbols.

..... [2]

Topic Chem 8 **Q# 165/** IGCSE Chemistry/2017/m/Paper 42/

2 Silver dichromate, $Ag_2Cr_2O_7$, is a red insoluble salt.

Silver dichromate can be made by reacting silver nitrate solution with ammonium dichromate solution. The chemical equation for the reaction is shown.

$$2AgNO_3(aq) + (NH_4)_2Cr_2O_7(aq) \rightarrow 2NH_4NO_3(aq) + Ag_2Cr_2O_7(s)$$

(a) Describe how you could obtain pure dry solid silver dichromate after mixing silver nitrate solution and ammonium dichromate solution.

.....

.....

.....

..... [3]

(c) Dilute aqueous sodium hydroxide was added to the ammonium nitrate solution made in the reaction. The mixture was then warmed and damp Universal Indicator paper was held above the mixture.

State and explain what would happen to the Universal Indicator paper.

.....

.....

..... [2]

Topic Chem 8 **Q# 166/** IGCSE Chemistry/2016/w/Paper 43/Q5

(f) Sulfuric acid reacts with a hydrocarbon called benzene to produce benzenesulfonic acid, $C_6H_5SO_3H$. Benzenesulfonic acid is a strong acid which ionises to produce hydrogen ions, H^+, and benzenesulfonate ions, $C_6H_5SO_3^-$.

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

..... [1]

(ii) Describe how to show that a 1 mol / dm^3 solution of benzenesulfonic acid is a strong acid.

.....

..... [2]

(iii) Write a chemical equation for the reaction between benzenesulfonic acid and sodium carbonate, Na_2CO_3.

..... [2]

Topic Chem 8 **Q# 167/** IGCSE Chemistry/2016/w/Paper 43/Q4(g)

(iii) Chlorine is produced at the positive electrode.

Give the test for chlorine.

test .....

result .....

[2]

Topic Chem 8 **Q# 168/** IGCSE Chemistry/2016/w/Paper 43/

3 When lead(II) nitrate is heated, two gases are given off and solid lead(II) oxide remains. The equation for the reaction is shown.

$$2Pb(NO_3)_2(s) \rightarrow 2PbO(s) + 4NO_2(g) + O_2(g)$$

(c) Describe a test for oxygen.

test .....

result .....

[2]

(d) Lead(II) oxide is insoluble. A student adds solid lead(II) oxide to dilute nitric acid until the lead(II) oxide is in excess. Aqueous lead(II) nitrate and water are produced.

(iii) Write a chemical equation for the reaction.

..... [1]

Topic Chem 8 **Q# 169/** IGCSE Chemistry/2016/w/Paper 43/

2 Beryllium is a metallic element in Group II.

(d) Beryllium hydroxide is amphoteric.
Beryllium hydroxide reacts with acids. The salts formed contain positive beryllium ions.

(i) Give the formula of the positive beryllium ion.

..... [1]

(ii) Write a chemical equation for the reaction between beryllium hydroxide and hydrochloric acid.

..... [2]

(iii) Beryllium hydroxide also reacts with alkalis. The salts formed contain beryllate ions, BeO_2^{2-}.

Suggest a chemical equation for the reaction between beryllium hydroxide and sodium hydroxide solution.

..... [2]

Topic Chem 8 **Q# 170/** IGCSE Chemistry/2016/w/Paper 42/Q5

The oxide of iodine referred to in this question is IO_2

(ii) The oxide of iodine in **(e)(i)** dissolves in water.

Predict and explain the effect of adding Universal Indicator to an aqueous solution of this oxide of iodine.

effect on Universal Indicator .....

explanation .....

[2]

Topic Chem 8 **Q# 171/** IGCSE Chemistry/2016/w/Paper 42/

4 Dilute nitric acid behaves as a typical acid in some reactions but **not** in other reactions.

(a) Dilute nitric acid behaves as a typical acid when reacted with copper(II) oxide and with copper(II) carbonate.

Describe what you would **see** if excess dilute nitric acid is added separately to solid samples of copper(II) carbonate and copper(II) oxide followed by warming the mixtures.

copper(II) carbonate

.....

.....

copper(II) oxide

.....

.....

[4]

(b) When dilute nitric acid is added to pieces of copper and heated, a reaction takes place and copper(II) nitrate is formed.

(i) Part of the chemical equation for the reaction between copper and dilute nitric acid is shown.

Complete the chemical equation by inserting the formula of copper(II) nitrate and balancing the equation.

.....$Cu(s)$ + $8HNO_3(aq)$ → .....(aq) + $4H_2O(l)$ + $2NO(g)$

[2]

(ii) How is the reaction of dilute nitric acid with copper different from that of a typical metal with a typical acid?

.....

..... [1]

Topic Chem 8 **Q# 172/** IGCSE Chemistry/2016/w/Paper 41/Q5

(a) A gas was formed at the anode.

The gas is oxygen, give the test for this gas:

test .....

result of test ..... [2]

Topic Chem 8 **Q# 173/** IGCSE Chemistry/2016/s/Paper 43/Q5

(i) What colour would the methyl orange indicator be in the hydrochloric acid?

..... [1]

Topic Chem 8 **Q# 174/** IGCSE Chemistry/2016/s/Paper 43/Q4

(b) Potassium iodide and lead nitrate are both soluble. Lead iodide is insoluble.

(i) Describe how a pure dry sample of lead iodide could be made from solid potassium iodide and solid lead nitrate.

.....

.....

.....

.....

.....

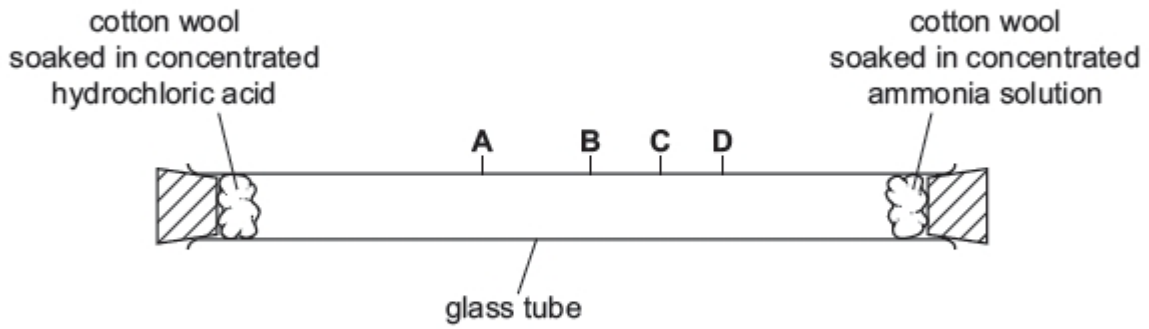
..... [4]

(ii) Write an ionic equation for the formation of lead iodide, PbI_2, when potassium iodide and lead nitrate react with each other.
State symbols are **not** required.

..... [2]

6 Concentrated ammonia solution gives off ammonia gas. Concentrated hydrochloric acid gives off hydrogen chloride gas. Ammonia, NH_3, and hydrogen chloride, HCl, are both colourless gases. Ammonia reacts with hydrogen chloride to make the white solid ammonium chloride.

Apparatus is set up as shown.



After ten minutes a white solid forms in the tube where the gases meet.

(a) (i) Write the chemical equation for the reaction of ammonia with hydrogen chloride.

..... [1]

(b) Some of the white solid is removed from the tube and dissolved in water.

Describe how the white solid could be tested to show it contains,

(i) ammonium ions,

test .....

.....

result .....

.....

[3]

(ii) chloride ions.

test .....

.....

result .....

.....

[3]

(v) Describe a test for chlorine.

test .....

result .....

[2]

Topic Chem 8 **Q# 177/** IGCSE Chemistry/2016/s/Paper 42/

3 Gallium is a metallic element in Group III. It has similar properties to aluminium.

(c) Gallium(III) oxide, Ga_2O_3, is amphoteric.

(i) Write the chemical equation for the reaction between gallium(III) oxide and dilute nitric acid to form a salt and water only.

..... [2]

(ii) The reaction between gallium(III) oxide and sodium hydroxide solution forms only water and a salt containing the negative ion $Ga_2O_4^{2-}$.

Write the chemical equation for this reaction.

..... [2]

Topic Chem 8 **Q# 178/** IGCSE Chemistry/2016/s/Paper 42/

(d) When a sample of steel is added to dilute hydrochloric acid, an aqueous solution of iron(II) chloride, $FeCl_2$, is formed.

When a sample of rust is added to dilute hydrochloric acid, an aqueous solution of iron(III) chloride, $FeCl_3$, is formed.

(i) Aqueous sodium hydroxide is added to the solutions of iron(II) chloride and iron(III) chloride.

Complete the table below, showing the observations you would expect to make.

	iron(II) chloride solution	iron(III) chloride solution
aqueous sodium hydroxide		

[2]

Solutions of iron(II) chloride and iron(III) chloride were added to solutions of potassium iodide and acidified potassium manganate(VII). The results are shown in the table.

	iron(II) chloride solution	iron(III) chloride solution
potassium iodide solution	no change	solution turns from colourless to brown
acidified potassium manganate(VII) solution	solution turns from purple to colourless	no change

(iv) Which **ion** in iron(III) chloride solution causes potassium iodide solution to turn from colourless to brown?

..... [1]

(v) Which **ion** in iron(II) chloride solution causes acidified potassium manganate(VII) solution to turn from purple to colourless?

..... [1]

Topic Chem 8 **Q# 179/** IGCSE Chemistry/2016/s/Paper 41/Q5

(d) Dilute sulfuric acid is a typical acid.

A student adds excess dilute sulfuric acid to a sample of solid copper(II) carbonate in a test-tube.

(i) Give **three** observations the student would make.

.....

.....

..... [2]

(ii) Give the **names** of all products formed.

.....

..... [1]

Topic Chem 8 **Q# 180/** IGCSE Chemistry/2016/s/Paper 41/Q2

(b) Magnesium reacts slowly with warm water to form a base, magnesium hydroxide.

(i) Explain what is meant by the term *base*.

..... [1]

(c) Aluminium oxide is amphoteric. It is insoluble in water.

Describe experiments to show that aluminium oxide is amphoteric.

.....

.....

.....

..... [3]

(g) Chlorine and compounds of chlorine are important in water treatment and in laboratory testing for water.

(ii) A compound of chlorine is used in the laboratory to test for the presence of water.

Name the compound of chlorine used in this test and describe the colour change seen in a positive result of this test.

name of compound .....

colour change from ..... to .....

[3]

Topic Chem 8 **Q# 181/** IGCSE Chemistry/2016/m/Paper 42/Q3

(c) Suggest a chemical equation for the reaction between sodium hydroxide solution and carbon dioxide.

..... [2]

Topic Chem 8 **Q# 182/** IGCSE Chemistry/2016/m/Paper 42/Q2

(d) When rubidium is added to cold water a reaction occurs.

(ii) What would be the colour of the solution if methyl orange was added to it after the reaction?

..... [1]

Topic Chem 8 **Q# 183/** IGCSE Chemistry/2016/m/Paper 42/

5 This question is about compounds of nitrogen.

(c) Hydrazine is a base.

(i) Define the term *base*.

..... [1]

(ii) Complete the chemical equation to show that hydrazine acts as a base when added to water.

$N_2H_4 + H_2O \rightarrow$ ..... + ... [1]

Topic Chem 9 **Q# 184/** IGCSE Chemistry/2018/w/Paper 42/Q2

2 Magnesium, calcium and strontium are Group II elements.

(a) Complete the table to show the arrangement of electrons in a calcium atom.

shell number	1	2	3	4
number of electrons				

[1]

(b) Describe how the arrangement of electrons in a strontium atom is:

(i) similar to the arrangement of electrons in a calcium atom

.....

.....

(ii) different from the arrangement of electrons in a calcium atom.

.....

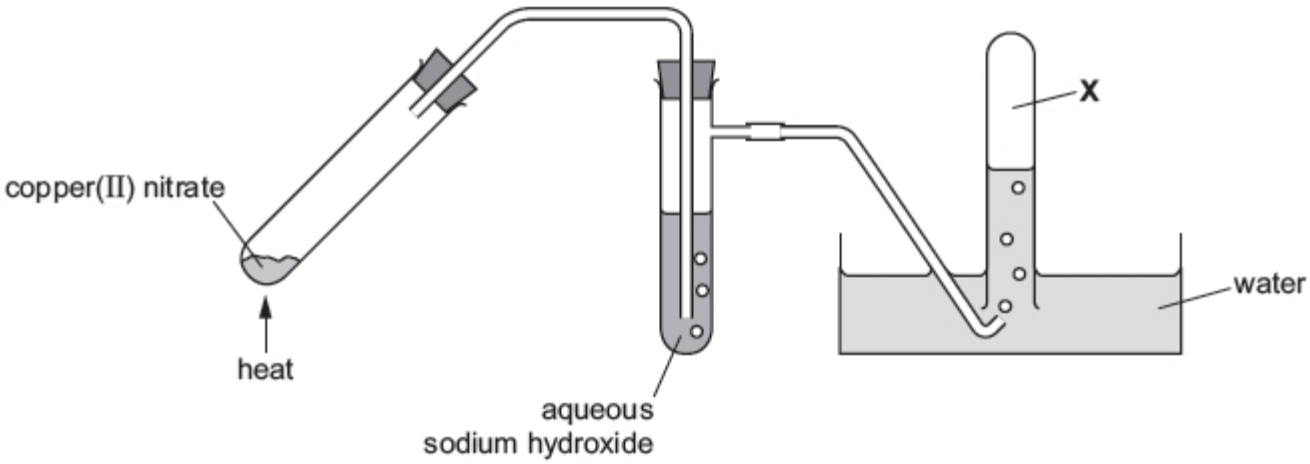
.....

[2]

Topic Chem 9 **Q# 185/** IGCSE Chemistry/2018/w/Paper 41/Q3

3 **(a)** Copper(II) nitrate decomposes when heated. Two gases, oxygen and nitrogen dioxide, and a solid are made in the reaction.

A sample of copper(II) nitrate was decomposed using the apparatus shown.



(ii) Only oxygen gas is collected at **X**.

Explain why.

.....

..... [1]

(d) A sample of copper(II) nitrate was dissolved in water to form an aqueous solution.

The aqueous solution was split into three portions. A separate test was done on each portion as shown.

test	reagent added	result
1	aqueous sodium hydroxide	light blue precipitate forms
2	zinc powder	solution changes from blue to colourless and a brown solid forms
3		ammonia gas is produced

(i) Give the formula of the light blue precipitate formed in **test 1**.

..... [1]

(ii) Explain the changes seen in **test 2**.

.....

.....

.....

..... [3]

(iii) Identify the **two** reagents that must be added to the aqueous copper(II) nitrate in **test 3**.

1 .....

2 .....

[2]

(e) Copper(II) nitrate can be made by reacting copper(II) carbonate with nitric acid. One of the products is carbon dioxide.

(i) Write a chemical equation for the reaction of copper(II) carbonate with nitric acid.

..... [2]

Topic Chem 9 **Q# 186/** IGCSE Chemistry/2018/w/Paper 41/Q2

2 The table gives some information about four different particles, **A**, **B**, **C** and **D**.

particle	number of electrons	number of neutrons	number of protons	electronic structure	charge on particle
A	11	12	11	2,8,1	0
B		14	11	2,8,1	0
C	18	20		2,8,8	0
D	18	20	17		

(c) Element **Z** is in the same group of the Periodic Table as **A** and is less reactive than **A**.

State the identity of element **Z**.

..... [1]

(d) **C** is unreactive.

Use information from the table to explain why.

..... [1]

Topic Chem 9 **Q# 187/** IGCSE Chemistry/2018/s/Paper 43/

1 The following are the symbols and formulae of some elements and compounds.

Ar $Ca(OH)_2$ Cl_2 CO_2 Cu Fe SO_2 V_2O_5

Answer the following questions using only the elements or compounds in the list.
Each element or compound may be used once, more than once or not at all.

State which element or compound is used:

(d) as an inert atmosphere in lamps ..... [1]

Topic Chem 9 **Q# 188/** IGCSE Chemistry/2018/s/Paper 43/

3 Cobalt is a transition element. Potassium is in Group I of the Periodic Table.

(a) State **one** physical property that is similar for cobalt and potassium.

..... [1]

(b) (i) State **one** physical property that is different for cobalt and potassium.

..... [1]

(ii) Describe how the physical property given in **(b)(i)** is different for cobalt compared to potassium.

..... [1]

(c) When a small piece of potassium is added to cold water, the potassium floats and disappears as it reacts.

Give **two** other observations that would be made when a small piece of potassium is added to cold water.

1 .....

2 .....

[2]

Topic Chem 9 **Q# 189/** IGCSE Chemistry/2018/s/Paper 42/

2 This question is about the elements in Period 3 of the Periodic Table.

Na	Mg	Al	Si	P	S	Cl	Ar

For each of the following, identify a Period 3 element which matches the description. Each element may be used once, more than once or not at all.

State which Period 3 element:

(c) is soft, metallic and stored in oil

..... [1]

(d) is a green gas at room temperature and pressure

..... [1]

(e) provides an inert atmosphere in lamps

..... [1]

Topic Chem 9 **Q# 190/** IGCSE Chemistry/2018/s/Paper 41/

2 Flerovium, F*l*, atomic number 114, was first made in research laboratories in 1998.

(a) Flerovium was made by bombarding atoms of plutonium, Pu, atomic number 94, with atoms of element **Z**.

- The nucleus of **one** atom of plutonium combined with the nucleus of **one** atom of element **Z**.
- This formed the nucleus of **one** atom of flerovium.

Suggest the identity of element **Z**.

..... [1]

(b) In which period of the Periodic Table is flerovium?

..... [1]

(c) Predict the number of outer shell electrons in an atom of flerovium.

..... [1]

Topic Chem 9 **Q# 191/** IGCSE Chemistry/2018/s/Paper 41/

5 **(a)** The table gives some chemical properties of transition elements and their compounds, and of Group I elements and their compounds.

chemical property	transition elements	Group I elements
ability to act as catalysts	yes	no
exist as coloured compounds	yes	no

(ii) Give **one** other chemical property shown by transition elements which is **not** shown by Group I elements.

..... [1]

(b) Give **two** physical properties shown by transition elements which are **not** shown by Group I elements.

1 .....

2 .....

[2]

Topic Chem 9 **Q# 192/** IGCSE Chemistry/2018/m/Paper 42/Q4

(c) Ammonia reacts with oxygen at high temperatures in the presence of a suitable catalyst to form nitric oxide, NO.

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

(ii) Suggest a suitable catalyst for the reaction from the list of metals. Give a reason for your answer.

aluminium **calcium** **platinum** **potassium** **sodium**

suitable catalyst .....

reason .....

[2]

Topic Chem 9 **Q# 193/** IGCSE Chemistry/2018/m/Paper 42/

1 This question is about gases.

(a) The following substances are gases at room temperature.

letter	A	B	C	D	E	F	G	H
substance	SO_2	Ar	CO	Cl_2	NH_3	CO_2	CH_4	C_3H_8

Identify, by letter:

(iv) a gas which is used as an inert atmosphere in lamps ..... [1]

Topic Chem 9 **Q# 194/** IGCSE Chemistry/2017/s/Paper 43/

1 Six different atoms can be represented as follows.

$^{3}_{1}A$ $^{3}_{2}D$ $^{12}_{6}E$ $^{13}_{6}G$ $^{14}_{7}J$ $^{19}_{9}L$

(a) Answer the following questions using atoms from the list. Each atom may be used once, more than once or not at all.

(v) is an atom of an element from Group VII of the Periodic Table,

..... [1]

(vi) is an atom of a noble gas.

..... [1]

Topic Chem 9 **Q# 195/** IGCSE Chemistry/2017/s/Paper 42/

4 Nickel, copper and zinc are three consecutive elements in the Periodic Table.

(a) Nickel and copper are transition elements.

State **three** chemical properties of transition elements.

.....

.....

..... [3]

Topic Chem 9 **Q# 196/** IGCSE Chemistry/2017/s/Paper 42/

5 **(a)** The elements in Group VII are known as the halogens. Some halogens react with aqueous solutions of halides.

(i) Complete the table by adding a ✓ to indicate when a reaction occurs and a ✗ to indicate when no reaction occurs.

	aqueous potassium chloride	aqueous potassium bromide	aqueous potassium iodide
chlorine	✗	✓	
bromine		✗	
iodine			✗

[3]

(ii) Write a chemical equation for the reaction between chlorine and aqueous potassium bromide.

..... [1]

(c) Astatine is at the bottom of Group VII. Use your knowledge of the properties of the halogens to

(i) predict the physical state of astatine at room temperature and pressure,

..... [1]

(ii) write a chemical equation for the reaction between sodium and astatine.

..... [2]

Topic Chem 9 **Q# 197/** IGCSE Chemistry/2017/s/Paper 41/

2 Some oxides of some elements are listed.

CO CO_2 Na_2O MgO Al_2O_3

SiO_2 P_4O_{10} SO_2 Cl_2O_7 Cr_2O_3

(a) Answer the following questions using only oxides from the list. Each oxide may be used once, more than once or not at all.

Give the formula of an oxide

(iii) which is coloured, ...

Topic Chem 9 **Q# 198/** IGCSE Chemistry/2016/w/Paper 42/Q5

(b) A student bubbled chlorine gas into a test-tube containing aqueous potassium bromide.

(i) Describe the colour change seen in the test-tube.

from ..... to .....

[2]

Topic Chem 9 **Q# 199/** IGCSE Chemistry/2016/s/Paper 43/Q4

(c) When chlorine gas is bubbled through an aqueous solution of potassium iodide, a redox reaction takes place.

$$2I^- + Cl_2 \rightarrow I_2 + 2Cl^-$$

(i) State the colour change expected in this reaction.

start colour .....

end colour .....

[2]

Topic Chem 9 **Q# 200/** IGCSE Chemistry/2016/s/Paper 42/

1 **(a)** For each of the following, give the name of an element from Period 2 (lithium to neon), which matches the description.
Elements may be used once, more than once or not at all.

(vii) an element that reacts vigorously with cold water

..... [1]

(viii) a soft metallic element which is stored in oil

..... [1]

Topic Chem 9 **Q# 201/** IGCSE Chemistry/2016/s/Paper 41/Q4

(c) Copper, nickel and silver are transition elements.
Typical physical properties of transition elements are a high density and a high melting point.

Give **three** different properties of transition metals which are not typical of other metals.

.....

.....

..... [3]

Topic Chem 9 **Q# 202/** IGCSE Chemistry/2016/s/Paper 41/Q2

(h) Argon is an unreactive noble gas.

(i) Explain why argon is unreactive.

..... [1]

(ii) Give **one** use of argon.

..... [1]

2 Rubidium, Rb, is a Group I element. It has similar physical and chemical properties to the other elements in Group I.

(a) Predict how many electrons there are in the outer shell of a rubidium atom.

..... [1]

(b) Predict **one** physical property of rubidium which is the same as that of a transition element such as iron.

..... [1]

(c) Predict **two** physical properties of rubidium which are different to those of a transition element such as iron.

.....

..... [2]

(d) When rubidium is added to cold water a reaction occurs.

(i) Suggest **two** observations that would be made when rubidium is added to cold water.

.....

..... [2]

(iii) Write a chemical equation for the reaction between rubidium and water.

..... [2]

(iv) Put the Group I elements, caesium, lithium, potassium, rubidium and sodium in their order of reactivity with water. Put the most reactive element first.

most reactive ⟶ least reactive

[1]

(v) Suggest **one** safety measure that should be used when rubidium is added to cold water.

..... [1]

(e) The phosphate ion has the formula PO_4^{3-}.

Deduce the formula of rubidium phosphate.

..... [1]

Topic Chem 10 **Q# 204/** IGCSE Chemistry/2018/w/Paper 43/Q3

3 Tin is a metallic element in Group IV. Its main ore is cassiterite which is an impure form of tin(IV) oxide, SnO_2.
Tin also occurs in stannite, Cu_2FeSnS_4.

(d) Tin can be extracted by heating tin(IV) oxide with carbon. Carbon monoxide is the other product.

Write a chemical equation for this reaction.

..... [2]

(e) The position of tin in the reactivity series is shown.

iron	most reactive
tin	↑
copper	least reactive

A student added iron to a solution containing Sn^{2+} ions.

The student then separately added tin to a solution containing Cu^{2+} ions.

Complete the ionic equations. If there is no reaction write 'no reaction'.

$Fe + Sn^{2+} \rightarrow$ .....

$Sn + Cu^{2+} \rightarrow$ .....

[2]

(f) Copper(II) nitrate, $Cu(NO_3)_2$, decomposes when it is heated. The only solid product is copper(II) oxide, CuO. There are two gaseous products. One of the gaseous products is oxygen.

(ii) Name the other gaseous product. Describe its appearance.

name .....

appearance .....

[2]

(iii) Write a chemical equation for the thermal decomposition of copper(II) nitrate.

..... [1]

Topic Chem 10 **Q# 205/** IGCSE Chemistry/2018/w/Paper 43/Q1

1 Answer the following questions using only the substances in the list.
Each substance may be used once, more than once or not at all.

ammonia	**bauxite**	**carbon dioxide**	**carbon monoxide**
hematite	**oxygen**	**sodium chloride**	**sulfur dioxide**

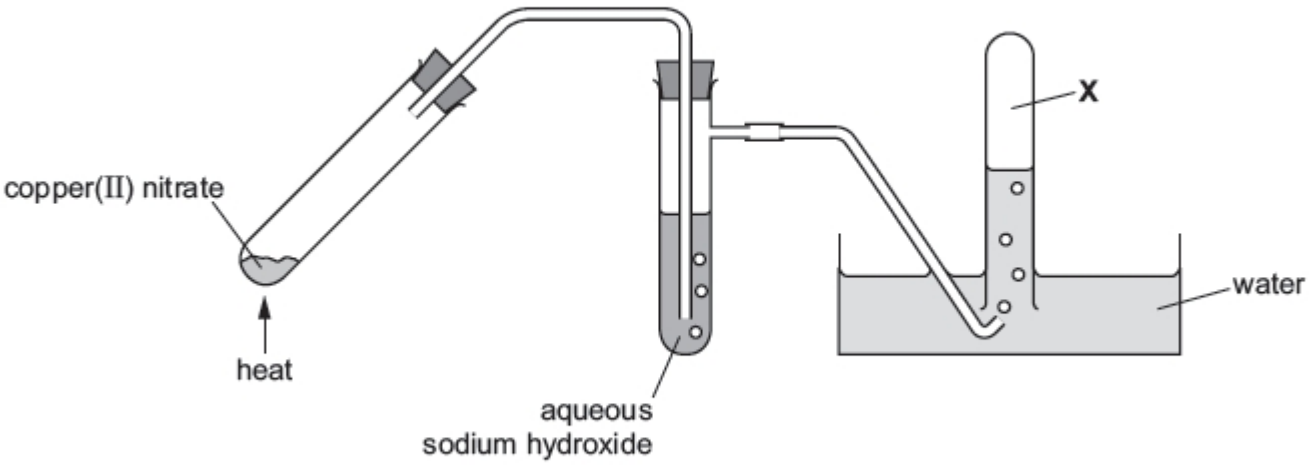
State which substance is:

(b) an ore of iron ..... [1]

Topic Chem 10 **Q# 206/** IGCSE Chemistry/2018/w/Paper 41/Q3

3 **(a)** Copper(II) nitrate decomposes when heated. Two gases, oxygen and nitrogen dioxide, and a solid are made in the reaction.

A sample of copper(II) nitrate was decomposed using the apparatus shown.



(i) Complete the chemical equation for the reaction.

$$2Cu(NO_3)_2 \rightarrow O_2 + \text{.....}NO_2 + \text{.....} \quad [2]$$

Topic Chem 10 **Q# 207/** IGCSE Chemistry/2018/w/Paper 41/Q1

1 The following formulae represent different substances.

Al Ag $CaCO_3$ CH_4 Cl_2 Cu SO_2

Answer the following questions using only these substances.
Each substance may be used once, more than once or not at all.

State which substance is:

(a) used to make food containers ..... [1]

(b) added to a blast furnace to remove impurities during the production of iron ..... [1]

Topic Chem 10 **Q# 208/** IGCSE Chemistry/2018/s/Paper 43/Q6

(b) Calcium chlorate(V) undergoes thermal decomposition.

The only products are calcium chloride and a colourless gas.

(i) What must be done to calcium chlorate(V) to make it thermally decompose?

..... [1]

(ii) Write a chemical equation for the thermal decomposition of calcium chlorate(V).

..... [2]

(b) Aluminium is extracted from its ore by electrolysis.

(i) Name the main ore of aluminium.

..... [1]

(ii) Why is aluminium **not** extracted from its ore by reduction with carbon?

..... [1]

(iii) The main ore of aluminium contains aluminium oxide. Aluminium oxide is dissolved in molten cryolite before it is electrolysed.

Give **two** reasons, other than cost, why cryolite is used.

1 .....

2 .....

[2]

(iv) The reaction at the anode during the extraction of aluminium by electrolysis is shown.

$$2O^{2-} \rightarrow O_2 + 4e^-$$

Is this process oxidation or reduction?
Give a reason for your answer.

..... [1]

(v) During the extraction of aluminium by electrolysis, carbon dioxide is formed at the anode.

Explain how carbon dioxide is formed at the anode.

.....

..... [2]

(c) When a piece of zinc metal is added to copper(II) sulfate solution there is an immediate reaction.

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

When a piece of aluminium metal is added to copper(II) sulfate solution the initial reaction is very slow.

(i) Explain why zinc metal reacts with copper(II) sulfate.

..... [1]

(ii) What type of reaction is this?

..... [1]

(iii) Explain why the initial reaction between aluminium metal and copper(II) sulfate is very slow.

..... [1]

Topic Chem 10 **Q# 210/** IGCSE Chemistry/2018/s/Paper 42/Q8

(b) Nitrates decompose when heated.

(i) Write a chemical equation for the decomposition of sodium nitrate when it is heated.

..... [2]

(ii) The unbalanced chemical equation for the decomposition of hydrated copper(II) nitrate crystals is shown.

Balance the chemical equation for this reaction.

$2Cu(NO_3)_2.3H_2O(s) \rightarrow$ .....$CuO(s)$ + ...$NO_2(g)$ + $O_2(g)$ + ...$H_2O(g)$

[2]

Topic Chem 10 **Q# 211/** IGCSE Chemistry/2018/s/Paper 41/

3 This question is about iron.

(a) Three of the raw materials added to a blast furnace used to extract iron from hematite are coke, hematite and limestone.

Name **one** other raw material added to the blast furnace.

..... [1]

(b) A series of reactions occurs in a blast furnace during the extraction of iron from hematite.

Describe these reactions.
Include:

- **one** chemical equation for the reduction of hematite
- **one** chemical equation for the formation of slag.

.....

.....

.....

.....

.....

.....

.....

..... [5]

(c) The iron extracted from hematite using a blast furnace is impure.

Identify the main impurity in this iron and explain how it is removed in the steel-making process.

main impurity .....

how it is removed .....

.....

.....

[3]

Topic Chem 10 **Q# 212/** IGCSE Chemistry/2018/m/Paper 42/

(c) Silver chloride can be made by reacting aqueous sodium chloride with aqueous silver nitrate. The other product of the reaction is sodium nitrate. The chemical equation for the reaction is shown.

$$NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

A student attempted to make the maximum amount of **sodium nitrate** crystals. The process involved three steps.

(v) Write a chemical equation for the action of heat on sodium nitrate crystals.

..... [2]

Topic Chem 10 **Q# 213/** IGCSE Chemistry/2017/w/Paper 43/Q3c

(iii) Iron containing a small amount of carbon is known as steel.

Explain why steel is less malleable than iron.

.....

..... [2]

Topic Chem 10 **Q# 214/** IGCSE Chemistry/2017/w/Paper 43/

1 Substances can be classified as elements, compounds or mixtures.

State whether each of the following is an element, a compound or a mixture.

(a) brass ..... [1]

Topic Chem 10 **Q# 215/** IGCSE Chemistry/2017/w/Paper 43/

5 **(a)** **(i)** Name the products formed when sodium nitrate is heated.

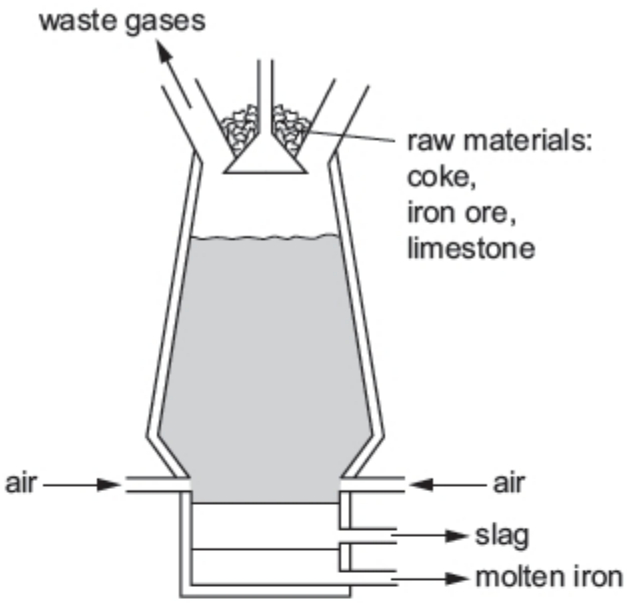
..... [2]

(ii) When copper(II) nitrate, $Cu(NO_3)_2$, undergoes thermal decomposition, three products are formed. One of the products is nitrogen dioxide, NO_2.

Write a chemical equation for the thermal decomposition of copper(II) nitrate.

..... [2]

3 Iron is extracted from its ore using coke in a blast furnace.



(a) Name the ore of iron which is mainly iron(III) oxide.

..... [1]

(b) Describe the reactions occurring in the blast furnace.

In your answer, include

- **two** reasons for using coke in the blast furnace,
- a chemical equation for the reduction of iron(III) oxide,
- an explanation for using limestone in the blast furnace.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

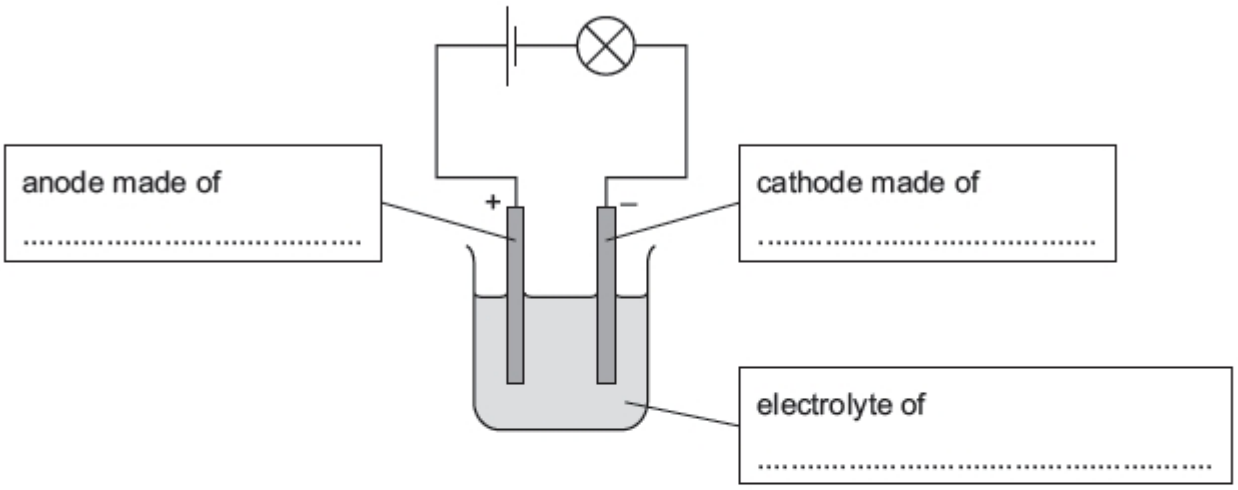
..... [6]

Topic Chem 10 **Q# 217/** IGCSE Chemistry/2017/w/Paper 42/Q4

(e) The student has a small piece of impure copper. The main impurities in the copper are small quantities of silver and zinc.

The student uses electrolysis to extract pure copper from the small piece of impure copper.

(i) Complete the labels on the diagram of the student's electrolysis experiment.



[3]

(ii) Use your knowledge of the reactivity series to suggest what happens to the silver and zinc impurities. Explain your answers.

silver impurities .....

.....

.....

zinc impurities .....

.....

.....

[3]

Topic Chem 10 **Q# 218/** IGCSE Chemistry/2017/w/Paper 41/

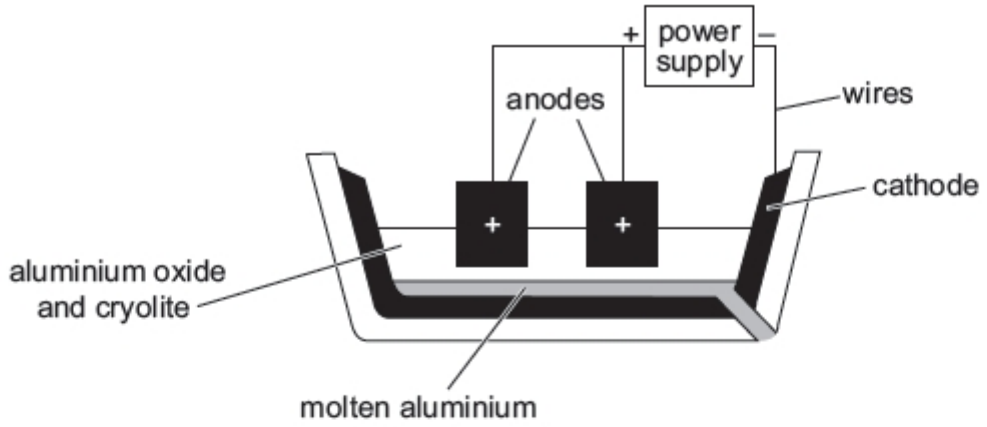
6 Aluminium is extracted from aluminium oxide by electrolysis.

(a) Why is aluminium **not** extracted by heating aluminium oxide with carbon?

.....

..... [1]

(c) Aluminium can be extracted by electrolysis using the apparatus shown.



(i) Name the type of particle responsible for the transfer of charge in

the wires, ...

the electrolyte. .....

[2]

(ii) Give **two** reasons why cryolite is used.

1 .....

2 .....

[2]

(iii) Write the ionic half-equation for the formation of aluminium during the electrolysis.

..... [1]

(iv) Explain how carbon dioxide gas is formed at the anodes.

.....

.....

..... [3]

(d) When a piece of aluminium is placed in dilute hydrochloric acid, there is no immediate visible reaction.
If the aluminium is left in the dilute hydrochloric acid for several hours, bubbles start to form.

Explain why aluminium does **not** react immediately with dilute hydrochloric acid.

.....

..... [1]

Topic Chem 10 **Q# 219/** IGCSE Chemistry/2017/w/Paper 41/

3 **(a)** When magnesium is added to aqueous copper(II) sulfate a reaction occurs.
The ionic equation for the reaction is shown.

$$Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$$

(iv) A redox reaction occurs when magnesium is heated with iron(III) oxide.

Write a chemical equation for the reaction between magnesium and iron(III) oxide.

..... [2]

Topic Chem 10 **Q# 220/** IGCSE Chemistry/2017/w/Paper 41/

5 **(a)** Solid copper(II) carbonate undergoes thermal decomposition. One of the products of the thermal decomposition is copper(II) oxide.

(i) State the colour change of the solid seen during the reaction.

start colour .....

end colour .....

[1]

(ii) Write a chemical equation for the thermal decomposition of copper(II) carbonate.

..... [1]

(b) Copper(II) carbonate reacts with dilute nitric acid. One of the products of the reaction is a solution of copper(II) nitrate.

(ii) Copper(II) nitrate undergoes thermal decomposition.

Balance the chemical equation for the thermal decomposition of copper(II) nitrate.

$$\text{.....}Cu(NO_3)_2 \rightarrow \text{.....}CuO + \text{.....}NO_2 + \text{.....}O_2$$

[1]

Topic Chem 10 **Q# 221/** IGCSE Chemistry/2017/s/Paper 43/

6 Barium carbonate, $BaCO_3$, is an insoluble solid.

(a) When barium carbonate is heated strongly, it undergoes thermal decomposition. One of the products is barium oxide.

(i) Write a chemical equation for the thermal decomposition of barium carbonate.

..... [1]

(ii) Suggest the pH of the solution formed when barium oxide is added to water.

..... [1]

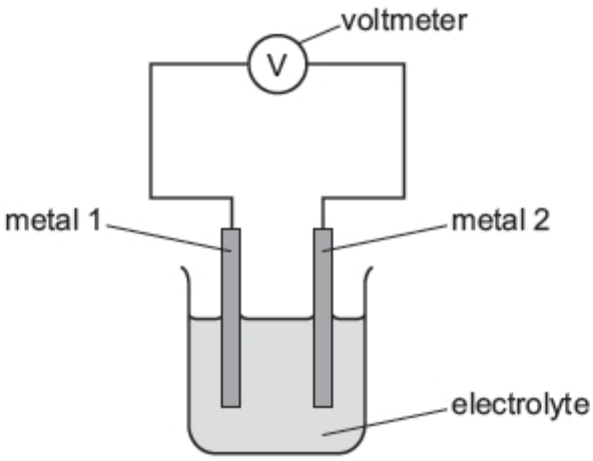
(iii) Barium nitrate decomposes on heating in the same way as magnesium nitrate decomposes.

Name the **two** gaseous products formed when barium nitrate is heated.

.....

..... [2]

5 The diagram shows a simple cell.



The simple cell was used with different metals as electrodes. The voltages were recorded in the table.

- If the voltage measured is positive then metal 2 is more reactive than metal 1.
- If the voltage measured is negative then metal 1 is more reactive than metal 2.

		metal 2				
		beryllium	cobalt	nickel	silver	vanadium
metal 1	beryllium	0.0 V	–1.6 V	–1.6 V	not measured	–0.7 V
	cobalt		0.0 V	0.0 V	–1.1 V	0.9 V
	nickel			0.0 V	–1.1 V	0.9 V
	silver				0.0 V	2.0 V
	vanadium					0.0 V

- The more reactive metal is oxidised.
- The bigger the difference in reactivity of the metals, the larger the reading on the voltmeter.

(a) In a simple cell using nickel and silver, the nickel is oxidised.

(b) Use the data in the table to answer the following questions.

(i) Which of the metals in the table is the most reactive?
Explain your answer.

.....

..... [2]

(ii) State which **two** different metals have the same reactivity.

..... [1]

(iii) Predict the voltage produced by a simple cell with beryllium as metal 1 and silver as metal 2.

.....

..... [2]

(c) Describe how the simple cell in the diagram can be used to show that magnesium is more reactive than beryllium. Explain your answer.

.....

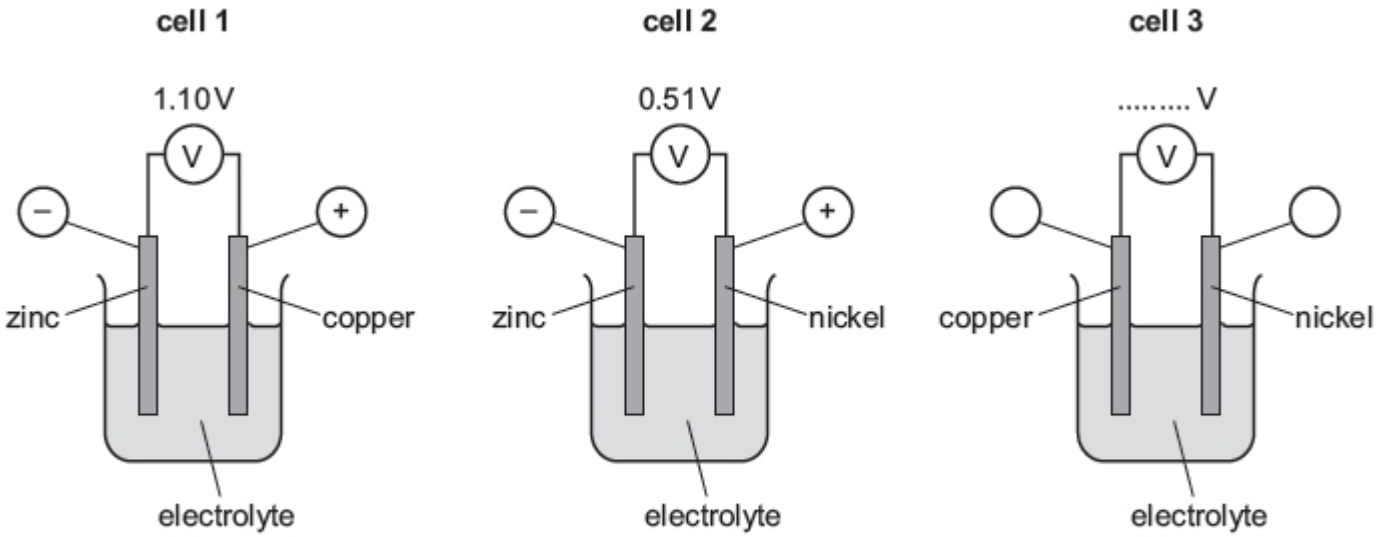
.....

.....

..... [2]

Topic Chem 10 **Q# 223/** IGCSE Chemistry/2017/s/Paper 42/Q4

(c) Three cells are set up each using two metals.



(i) Write the ionic half-equation for the reaction occurring at the zinc electrode in **cell 1**.

..... [2]

(ii) Put the **three** metals, copper, nickel and zinc, in order of reactivity.

most reactive .....

↓ .....

least reactive .....

[1]

(iii) Complete the labelling in **cell 3** by writing the polarity (+/–) of each electrode in the circles and calculating the reading on the voltmeter. [2]

Topic Chem 10 **Q# 224/** IGCSE Chemistry/2017/s/Paper 41/

2 Some oxides of some elements are listed.

CO CO_2 Na_2O MgO Al_2O_3

SiO_2 P_4O_{10} SO_2 Cl_2O_7 Cr_2O_3

(a) Answer the following questions using only oxides from the list. Each oxide may be used once, more than once or not at all.

Give the formula of an oxide

(iv) which is the major impurity in iron ore, ...

[1]

Topic Chem 10 **Q# 225/** IGCSE Chemistry/2017/s/Paper 41/

4 Zinc is a very important metal.

(a) Zinc is extracted from its ore, zinc blende. Zinc blende contains zinc sulfide, ZnS.

Zinc sulfide is converted to zinc oxide in an industrial process.

(i) Describe how zinc sulfide is converted to zinc oxide in this industrial process.

.....

..... [1]

(ii) Write the chemical equation for this reaction.

..... [2]

(b) Zinc oxide is then reduced in a furnace.

(i) Name the substance added to the furnace to reduce the zinc oxide.

..... [1]

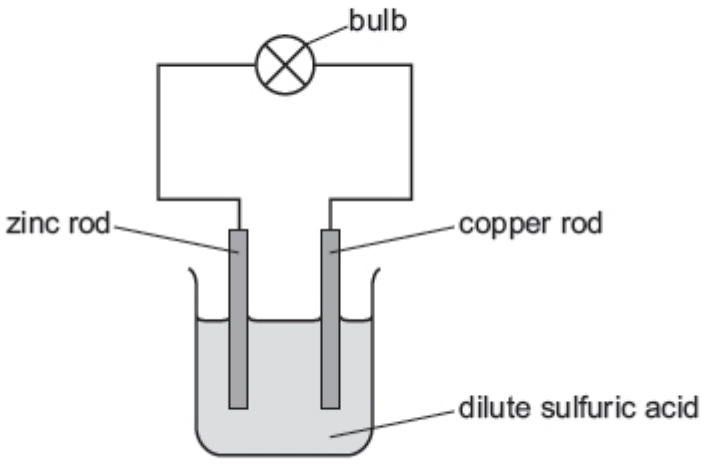
(ii) Describe how the pure zinc is removed from the furnace and collected.

.....

.....

..... [2]

(c) When rods of zinc and copper are placed into dilute sulfuric acid as shown, electricity is generated.



(i) Write the ionic half-equation for the reaction occurring at the zinc rod.

..... [2]

(ii) Write the ionic half-equation for the reaction occurring at the copper rod.

..... [2]

(iii) The copper rod was replaced by an iron rod.

Suggest the change, if any, in the intensity of the light emitted from the bulb and give a reason for your answer.

change .....

reason .....

.....

[2]

Topic Chem 10 **Q# 226/** IGCSE Chemistry/2017/m/Paper 42/Q2

(e) Ammonium dichromate, $(NH_4)_2Cr_2O_7$, undergoes thermal decomposition.
The products are chromium(III) oxide, nitrogen and water.

(i) What is meant by *thermal decomposition*?

.....

..... [2]

(ii) Write a chemical equation for the thermal decomposition of ammonium dichromate.

..... [2]

5 Iron is extracted from its ore using a blast furnace.

(a) In the blast furnace, coke burns in oxygen to produce heat energy and carbon dioxide.

How is this carbon dioxide converted into carbon monoxide in the blast furnace?

..... [1]

(b) Calcium carbonate added to the blast furnace decomposes to form calcium oxide.
Calcium oxide removes silicon(IV) oxide impurities from the iron in a neutralisation reaction.

Write a chemical equation for the reaction of calcium oxide with silicon(IV) oxide. Suggest why it is a neutralisation reaction.

.....

.....

..... [3]

(c) The main impurity in iron obtained from the blast furnace is carbon.

(i) Why must the high levels of carbon be lowered before the iron becomes a useful material?

..... [1]

(ii) How is the carbon removed from the iron?

.....

..... [1]

(d) Zinc is extracted from its ore. The ore contains zinc sulfide. The zinc sulfide is roasted in air to produce zinc oxide and sulfur dioxide.

Zinc is then obtained from the zinc oxide using a blast furnace.

(i) Give the name of the ore of zinc that contains zinc sulfide.

..... [1]

(ii) Write a chemical equation for the reaction that takes place when zinc sulfide is roasted in air.

..... [1]

(iv) The temperature inside the blast furnace in which zinc is extracted is about 1000 °C.

The table gives some information about substances in the blast furnace in which zinc is extracted.

substance	melting point / °C	boiling point / °C
carbon	sublimes at 4330 °C	
silicon(IV) oxide	1610	2230
zinc	420	907

Use the data in the table to explain why the zinc obtained does **not** contain high levels of impurities such as silicon(IV) oxide and carbon.

.....

.....

..... [2]

Topic Chem 10 **Q# 228/** IGCSE Chemistry/2016/w/Paper 42/

6 Aluminium is a very important metal.

Aluminium is extracted from its ore, bauxite, by electrolysis. Bauxite is an impure form of aluminium oxide, Al_2O_3.

(a) Describe how aluminium is extracted from **bauxite**. Include an ionic half-equation for the reaction at each electrode.

description .....

.....

.....

.....

.....

.....

.....

.....

ionic half-equation for the anode reaction .....

ionic half-equation for the cathode reaction.....

[5]

(b) Explain why the anodes have to be replaced regularly.

.....

..... [2]

(c) Give **two** uses of aluminium and give a reason why aluminium is suitable for each use.

use 1 .....

reason .....

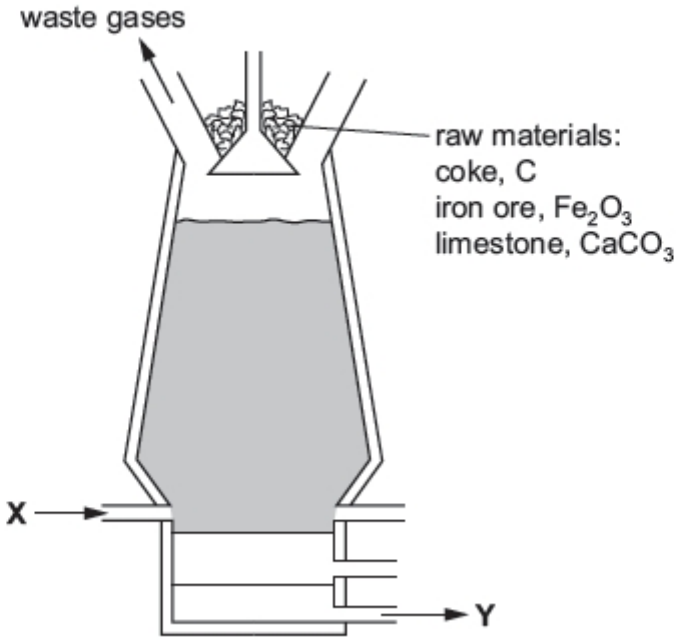
use 2 .....

reason .....

[4]

Topic Chem 10 **Q# 229/** IGCSE Chemistry/2016/s/Paper 43/

1 The diagram shows a blast furnace.



(a) The following equations represent reactions which take place in the blast furnace.

A $C + O_2 \rightarrow CO_2$

B $CaCO_3 \rightarrow CaO + CO_2$

C $CaO + SiO_2 \rightarrow CaSiO_3$

D $CO_2 + C \rightarrow 2CO$

E $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

(i) Which reaction is used to increase the temperature inside the blast furnace? ..... [1]

(ii) Which reaction is an example of thermal decomposition? ..... [1]

(iii) In which reaction is carbon both oxidised and reduced? ..... [1]

(iv) Which equation shows the removal of an impurity from the iron? ..... [1]

(v) Which equation shows the reaction of an acidic substance with a basic substance?

..... [1]

(b) Use the diagram of the blast furnace to help you answer these questions.

(i) What enters the blast furnace at **X**?

..... [1]

(ii) What leaves the blast furnace at **Y**?

..... [1]

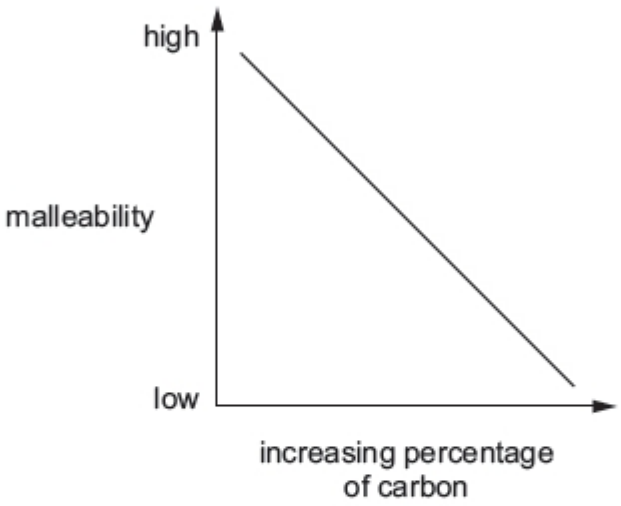
(iii) Name **two** waste gases that leave the blast furnace.

1. .....

2. .....

[2]

(c) The graph shows how the malleability of iron changes as the percentage of carbon in the iron changes.



(i) Describe how the malleability of iron changes as the percentage of carbon changes.

.....

..... [1]

(ii) Iron obtained from the blast furnace contains high levels of carbon.

Explain how the amount of carbon in the iron can be decreased.

.....

.....

..... [2]

Topic Chem 10 **Q# 230/** IGCSE Chemistry/2016/s/Paper 42/

3 Gallium is a metallic element in Group III. It has similar properties to aluminium.

(d) Alloys of gallium and other elements are often more useful than the metallic element itself.

Suggest **two** reasons why alloys of gallium are more useful than the metallic element.

.....

..... [2]

Topic Chem 10 **Q# 231/** IGCSE Chemistry/2016/s/Paper 42/

6 Zinc is extracted from an ore called zinc blende, which consists mainly of zinc sulfide, ZnS.

(a) (i) The zinc sulfide in the ore is first converted into zinc oxide.

Describe how zinc oxide is made from zinc sulfide.

.....

..... [1]

(ii) Write a chemical equation for the reaction in **(a)(i)**.

..... [2]

(b) Zinc oxide is converted into zinc. Zinc oxide and coke are fed into a furnace. Hot air is blown into the bottom of the furnace.

Zinc has a melting point of 420 °C and a boiling point of 907 °C. The temperature inside the furnace is over 1000 °C.

(i) Explain how zinc oxide is converted into zinc. Your answer should include details of how the heat is produced and equations for all the reactions you describe.

.....

.....

.....

.....

..... [3]

(ii) Explain why the zinc produced inside the furnace is a gas.

..... [1]

(iii) State the name of the physical change for conversion of gaseous zinc into molten zinc.

..... [1]

Topic Chem 10 **Q# 232/** IGCSE Chemistry/2016/s/Paper 41/Q2(b)

(ii) Write a chemical equation for the reaction between magnesium and warm water.

..... [2]

Topic Chem 11 **Q# 233/** IGCSE Chemistry/2018/w/Paper 43/Q3

(g) Iron does not rust when it is completely coated with zinc. When the zinc is scratched, the iron still does not rust.

(i) Explain why the iron does **not** rust when it is completely coated with zinc.

..... [1]

(ii) Explain why the iron still does **not** rust when the zinc is scratched.

.....

.....

.....

.....

.....

..... [3]

Topic Chem 11 **Q# 234/** IGCSE Chemistry/2018/w/Paper 43/Q1

1 Answer the following questions using only the substances in the list.
Each substance may be used once, more than once or not at all.

ammonia	**bauxite**	**carbon dioxide**	**carbon monoxide**
hematite	**oxygen**	**sodium chloride**	**sulfur dioxide**

State which substance is:

(d) used to manufacture fertilisers ..... [1]

Topic Chem 11 **Q# 235/** IGCSE Chemistry/2018/w/Paper 43/Q1

1 Answer the following questions using only the substances in the list.
Each substance may be used once, more than once or not at all.

ammonia	**bauxite**	**carbon dioxide**	**carbon monoxide**
hematite	**oxygen**	**sodium chloride**	**sulfur dioxide**

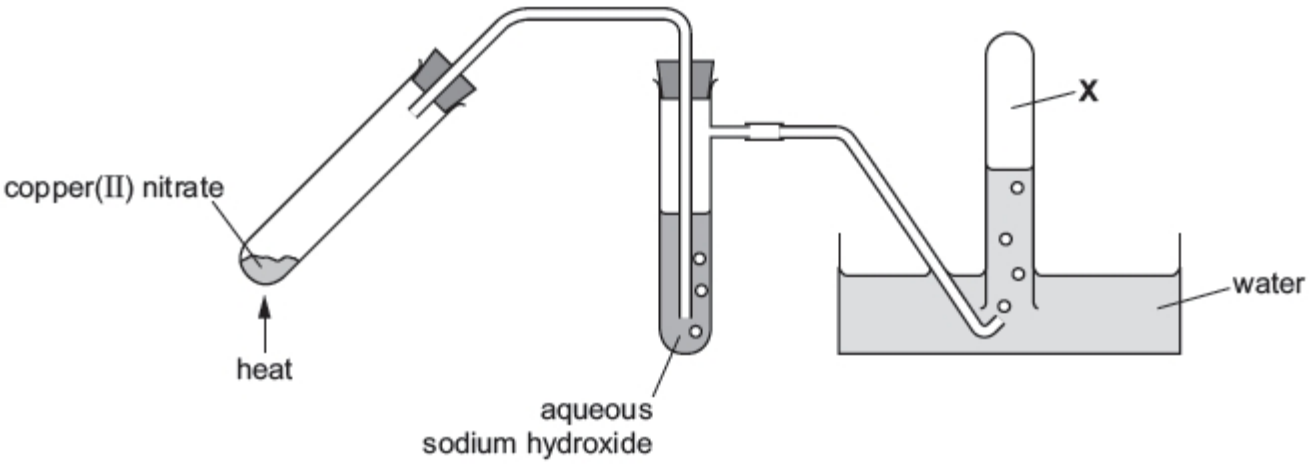
State which substance is:

(e) a toxic gas produced during the incomplete combustion of hydrocarbons

..... [1]

3 **(a)** Copper(II) nitrate decomposes when heated. Two gases, oxygen and nitrogen dioxide, and a solid are made in the reaction.

A sample of copper(II) nitrate was decomposed using the apparatus shown.



(b) Nitrogen dioxide and other oxides of nitrogen are formed in car engines.

Explain how nitrogen dioxide is formed in car engines.

.....

.....

.....

..... [2]

(ii) Carbon dioxide is added to the air by living things.

Name the chemical process by which living things add carbon dioxide to the air.

..... [1]

(iii) Carbon dioxide is removed from the air by plants.

Name the chemical process by which plants remove carbon dioxide from the air.

..... [1]

1 The following are the symbols and formulae of some elements and compounds.

Ar $Ca(OH)_2$ Cl_2 CO_2 Cu Fe SO_2 V_2O_5

Answer the following questions using only the elements or compounds in the list.
Each element or compound may be used once, more than once or not at all.

State which element or compound is used:

(a) to kill bacteria in drinking water ..... [1]

Topic Chem 11 **Q# 238/** IGCSE Chemistry/2018/s/Paper 42/

2 This question is about the elements in Period 3 of the Periodic Table.

Na	Mg	Al	Si	P	S	Cl	Ar

For each of the following, identify a Period 3 element which matches the description. Each element may be used once, more than once or not at all.

State which Period 3 element:

(g) is non-metallic and an important component of fertilisers.

..... [1]

Topic Chem 11 **Q# 239/** IGCSE Chemistry/2018/m/Paper 42/

1 This question is about gases.

(a) The following substances are gases at room temperature.

letter	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
substance	SO_2	Ar	CO	Cl_2	NH_3	CO_2	CH_4	C_3H_8

Identify, by letter:

(i) a gas which combines with water to form acid rain ..... [1]

(v) **two** gases which are found in clean dry air ..... [2]

Topic Chem 11 **Q# 240/** IGCSE Chemistry/2018/m/Paper 42/

1 This question is about gases.

(c) Air is a mixture. Nitrogen and oxygen are the two most common gases in air.

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

.....

..... [1]

(ii) State the percentage of oxygen, to the nearest whole number, in clean dry air.

..... [1]

(iii) Describe the steps in the industrial process which enables nitrogen and oxygen to be separated from clean dry air.

Use scientific terms in your answer.

.....

.....

.....

.....

.....

.....

..... [3]

(iv) Which physical property of nitrogen and oxygen allows them to be separated?

..... [1]

Topic Chem 11 **Q# 241/** IGCSE Chemistry/2017/w/Paper 43/

(a) Name the process by which oxygen is obtained from air.

..... [1]

(d) Hydrogen fuel cells are being developed as alternatives to petrol engines in cars.

(i) Give **one** advantage of hydrogen fuel cells compared to petrol engines.

..... [1]

(ii) Give **one** disadvantage of hydrogen fuel cells compared to petrol engines.

..... [1]

(e) Some fuel cells use ethanol, C_2H_5OH, instead of hydrogen. Carbon dioxide and water are products of the reaction in an ethanol fuel cell.

(i) Write a chemical equation for the overall reaction occurring in an ethanol fuel cell.

..... [2]

(ii) State an environmental problem caused by the release of carbon dioxide into the atmosphere.

..... [1]

Topic Chem 11 **Q# 242/** IGCSE Chemistry/2017/w/Paper 43/

7 **(a)** Carbon and silicon are elements in Group IV of the Periodic Table.
Carbon dioxide from the air moves into green plants and is converted into carbohydrates.

(i) Name the process by which carbon dioxide molecules move through the air into green plants.

..... [1]

(ii) Explain why silicon(IV) oxide **cannot** move through the air in the same way that carbon dioxide can.

..... [1]

(iii) Name the process by which carbon dioxide is converted into glucose, $C_6H_{12}O_6$, in green plants. Give **two** conditions required for this process to occur. Write a chemical equation for the reaction which occurs.

name of process .....

condition 1 .....

condition 2 .....

chemical equation .....

[5]

Topic Chem 11 **Q# 243/** IGCSE Chemistry/2017/w/Paper 41/Q3

3 **(a)** When magnesium is added to aqueous copper(II) sulfate a reaction occurs.
The ionic equation for the reaction is shown.

$$Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$$

(b) The metal iron and the alloy steel are commonly used materials. A problem with them is that they rust.

(i) How does painting iron and steel prevent rusting?

.....

..... [1]

(ii) Magnesium blocks can be attached to the bottom of steel boats.

Explain how the magnesium blocks prevent the whole of the bottom of the boat from rusting.

.....

.....

.....

..... [2]

(iii) Replacing the magnesium blocks with copper blocks does not prevent rusting.

Explain why the copper blocks do **not** prevent rusting.

.....

..... [1]

Topic Chem 11 **Q# 244/** IGCSE Chemistry/2017/s/Paper 43/Q4

(c) Car engines produce carbon monoxide and oxides of nitrogen.

(i) Name an environmental problem that is caused by the release of oxides of nitrogen into the air.

..... [1]

(ii) Explain how carbon monoxide and oxides of nitrogen are formed in car engines.

carbon monoxide .....

.....

oxides of nitrogen .....

.....

[3]

(iii) State **one** adverse effect of carbon monoxide on human health.

..... [1]

(iv) Describe and explain how catalytic converters remove oxides of nitrogen from car engine exhaust fumes. You are advised to include a chemical equation in your answer.

.....

.....

.....

.....

.....

..... [3]

Topic Chem 11 **Q# 245/** IGCSE Chemistry/2017/s/Paper 42/Q2

(d) Samples of air taken from industrial areas are found to contain small amounts of carbon monoxide.

(i) Explain how this carbon monoxide is formed.

.....

..... [2]

(ii) State why carbon monoxide should **not** be inhaled.

..... [1]

Topic Chem 11 **Q# 246/** IGCSE Chemistry/2017/s/Paper 42/

1 **(a)** State the name of the process that is used to

(i) separate oxygen from liquid air,

..... [1]

Topic Chem 11 **Q# 247/** IGCSE Chemistry/2017/s/Paper 42/

3 This question is about nitrogen and some of its compounds.

(a) Nitrogen in the air can be converted into ammonia by the Haber process. The chemical equation for the reaction is shown.

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

(i) State the temperature and pressure used in the Haber process.

temperature .....

pressure .....

[2]

(ii) Name the catalyst used in the Haber process.

..... [1]

(b) The ammonia produced in the Haber process can be oxidised to nitrogen(II) oxide at 900 °C. The reaction is exothermic.

(i) Balance the chemical equation for this reaction.

$$4NH_3 + ...O_2 \rightleftharpoons .....NO + ...H_2O$$

[2]

(ii) Suggest a reason, other than cost, why a temperature greater than 900 °C is **not** used.

..... [1]

(iii) Suggest a reason why a temperature less than 900 °C is **not** used.

..... [1]

(d) Zinc is extracted from its ore. The ore contains zinc sulfide. The zinc sulfide is roasted in air to produce zinc oxide and sulfur dioxide.

(iii) Suggest why the sulfur dioxide should **not** be released into the atmosphere.

.....

..... [2]

3 Clean, dry air contains a small amount of carbon dioxide.

(a) The percentages of the **other** gases present in clean, dry air are shown in the table.

Complete the table by inserting the names of these gases.

name of gas	percentage present
	78
	21
	1

[2]

(b) Oxides of nitrogen are atmospheric pollutants which can cause acid rain.

Describe the formation of oxides of nitrogen and suggest how they can cause acid rain.

.....

.....

.....

..... [3]

(c) Methane contributes to the greenhouse effect.

State **two** sources of methane.

1 .....

2 .....

[2]

(d) Combustion and respiration add carbon dioxide to the atmosphere.

Name **one** natural process which removes carbon dioxide from the atmosphere.

..... [1]

4 **(a)** Ammonia, NH_3, is made by reacting nitrogen with hydrogen in the Haber process.

(i) Write a chemical equation for the formation of ammonia in the Haber process.

..... [2]

(ii) Name the raw materials from which nitrogen and hydrogen are obtained.

nitrogen .....

hydrogen .....

[2]

(iii) State the temperature and pressure used in the Haber process. Include the units.

temperature .....

pressure .....

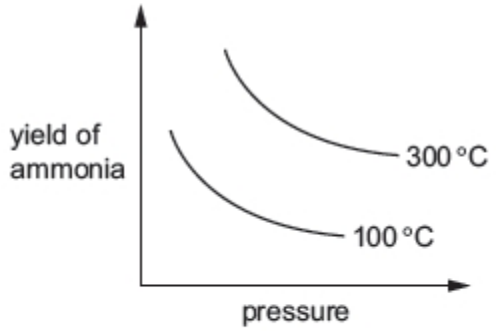
[2]

(b) Ammonia is also made when ammonium carbonate decomposes.

$$(NH_4)_2CO_3(s) \rightleftharpoons 2NH_3(g) + H_2O(g) + CO_2(g)$$

The reaction is reversible and can reach a position of equilibrium.

The graph shows how the yield of ammonia at equilibrium changes with temperature and pressure.



(i) What is meant by the term *equilibrium* for a reversible reaction?

.....

.....

..... [2]

(ii) Using information from the graph, explain whether the reaction is endothermic or exothermic.

.....

..... [1]

(iii) State and explain the effect of increasing the pressure on the yield of ammonia in this reaction.

.....

.....

.....

.....

..... [3]

Topic Chem 11 **Q# 251/** IGCSE Chemistry/2016/s/Paper 43/

3 Clean dry air contains mainly nitrogen and oxygen.

(a) Name **two** other gases that are in clean dry air.

.....

..... [2]

(b) Air often contains pollutants.

Identify **three** common gaseous pollutants in air and state how each of these pollutants are produced.

pollutant gas 1 .....

how it is produced .....

.....

pollutant gas 2 .....

how it is produced .....

.....

pollutant gas 3 .....

how it is produced .....

.....

[6]

Topic Chem 11 **Q# 252/** IGCSE Chemistry/2016/s/Paper 42/

(c) Rusting of steel can be prevented by coating the steel with a layer of zinc.

Explain, in terms of electron transfer, why steel does **not** rust even if the layer of zinc is scratched so that the steel is exposed to air and water.

.....

.....

.....

.....

..... [4]

Topic Chem 11 **Q# 253/** IGCSE Chemistry/2016/s/Paper 41/Q2

(g) Chlorine and compounds of chlorine are important in water treatment and in laboratory testing for water.

(i) Chlorine is added to water to make the water safe to drink.

Explain why adding chlorine makes water safe to drink.

..... [1]

Topic Chem 11 **Q# 254/** IGCSE Chemistry/2016/m/Paper 42/

5 This question is about compounds of nitrogen.

(a) (i) Describe the Haber Process giving reaction conditions and a chemical equation. Reference to rate and yield is not required.

.....

.....

.....

.....

..... [5]

(ii) Give **one** use of ammonia.

..... [1]

(d) Nitrogen dioxide is an atmospheric pollutant.

(i) State **one** environmental problem caused by nitrogen dioxide.

..... [1]

(ii) Explain how oxides of nitrogen, such as nitrogen dioxide, are formed in car engines.

.....

..... [2]

Topic Chem 12 **Q# 255/** IGCSE Chemistry/2018/w/Paper 43/Q1

1 Answer the following questions using only the substances in the list.
Each substance may be used once, more than once or not at all.

ammonia	**bauxite**	**carbon dioxide**	**carbon monoxide**
hematite	**oxygen**	**sodium chloride**	**sulfur dioxide**

State which substance is:

(c) used to bleach wood pulp ..... [1]

Topic Chem 12 **Q# 256/** IGCSE Chemistry/2018/w/Paper 42/Q3

3 Sulfur is an important element.

(a) Explain how burning fossil fuels containing sulfur leads to the formation of acid rain.

.....

.....

..... [2]

(b) Sulfuric acid is manufactured by the Contact process. One step in the Contact process involves a reversible reaction in which sulfur trioxide, SO_3, is formed.

(i) Write a chemical equation for this reversible reaction. Include the correct symbol to show that the reaction is reversible.

..... [2]

(ii) State the conditions and name the catalyst used in this reversible reaction.

temperature .....

pressure .....

catalyst .....

[3]

(iii) Describe how the sulfur trioxide formed is converted into sulfuric acid in the next steps of the Contact process.

.....

.....

..... [2]

4 **(a)** Sulfuric acid is made industrially by a four-step process.

step 1 Sulfur is burned in air to produce sulfur dioxide.

step 2 Sulfur dioxide is converted into sulfur trioxide.

step 3 Sulfur trioxide is reacted with concentrated sulfuric acid to produce oleum.

step 4 Oleum is reacted with water to produce concentrated sulfuric acid.

(i) Some sulfur is obtained by mining.

Name **one** other major source of sulfur.

..... [1]

(ii) What is the name of the process by which sulfuric acid is made industrially?

..... [1]

(iii) Describe the conversion of sulfur dioxide into sulfur trioxide in **step 2**.

In your answer, include:
- a chemical equation for the reaction
- the essential reaction conditions.

.....

.....

.....

.....

.....

.....

..... [5]

(b) When concentrated sulfuric acid is added to glucose, $C_6H_{12}O_6$, a black solid is produced. The concentrated sulfuric acid acts as a dehydrating agent.

(i) What is removed from the glucose in this reaction?

..... [1]

(ii) Name the black solid produced in this reaction.

..... [1]

Topic Chem 12 **Q# 258/** IGCSE Chemistry/2018/w/Paper 41/Q1

1 The following formulae represent different substances.

Al Ag $CaCO_3$ CH_4 Cl_2 Cu SO_2

Answer the following questions using only these substances.
Each substance may be used once, more than once or not at all.

State which substance is:

(d) a cause of acid rain ..... [1]

Topic Chem 12 **Q# 259/** IGCSE Chemistry/2018/s/Paper 43/

1 The following are the symbols and formulae of some elements and compounds.

Ar $Ca(OH)_2$ Cl_2 CO_2 Cu Fe SO_2 V_2O_5

Answer the following questions using only the elements or compounds in the list.
Each element or compound may be used once, more than once or not at all.

State which element or compound is used:

(b) as a food preservative ..... [1]

Topic Chem 12 **Q# 260/** IGCSE Chemistry/2018/s/Paper 43/

1 The following are the symbols and formulae of some elements and compounds.

Ar $Ca(OH)_2$ Cl_2 CO_2 Cu Fe SO_2 V_2O_5

Answer the following questions using only the elements or compounds in the list.
Each element or compound may be used once, more than once or not at all.

State which element or compound is used:

(f) as a catalyst in the Contact process. ..... [1]

Topic Chem 12 **Q# 261/** IGCSE Chemistry/2018/s/Paper 42/

2 This question is about the elements in Period 3 of the Periodic Table.

Na	Mg	Al	Si	P	S	Cl	Ar

For each of the following, identify a Period 3 element which matches the description. Each element may be used once, more than once or not at all.

State which Period 3 element:

(f) forms **two** different oxides during the Contact process

..... [1]

5 Sulfuric acid can be manufactured from the raw materials sulfur, air and water. The process can be divided into four stages.

stage 1 converting sulfur into sulfur dioxide

stage 2 converting sulfur dioxide into sulfur trioxide

stage 3 converting sulfur trioxide into oleum, $H_2S_2O_7$

stage 4 converting oleum into sulfuric acid

stage 1

(a) (i) Describe how sulfur is converted into sulfur dioxide.

..... [1]

(ii) Write a chemical equation for the conversion of sulfur into sulfur dioxide.

..... [1]

stage 2

(b) Sulfur dioxide is converted into sulfur trioxide according to the following equation.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3$$

The reaction is carried out at a temperature of 450 °C and a pressure of 1–2 atmospheres using a catalyst. The energy change, ΔH, for the reaction is –196 kJ / mol.

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

..... [1]

(ii) Name the catalyst used in this reaction.

..... [1]

(iii) Why is a catalyst used?

..... [1]

(iv) If a temperature higher than 450 °C were used, what would happen to the amount of sulfur trioxide produced? Give a reason for your answer.

.....

..... [2]

(v) Suggest a reason why a temperature lower than 450 °C is **not** used.

.....

..... [1]

(vi) If a pressure higher than 1–2 atmospheres were used, what would happen to the amount of sulfur trioxide produced? Give a reason for your answer.

.....

..... [2]

stage 3

(c) (i) What is added to sulfur trioxide to convert it into oleum?

..... [1]

(ii) Write a chemical equation for the conversion of sulfur trioxide into oleum.

..... [1]

stage 4

(d) (i) What is added to oleum to convert it into sulfuric acid?

..... [1]

(ii) Write a chemical equation for the conversion of oleum into sulfuric acid.

..... [1]

(e) Give **one** use of sulfuric acid.

..... [1]

Topic Chem 12 **Q# 263/** IGCSE Chemistry/2016/s/Paper 41/

5 Sulfuric acid is produced by the Contact process. The steps of the Contact process are shown.

starting material **step 1** → sulfur dioxide **step 2** → sulfur trioxide **step 3** → oleum **step 4** → sulfuric acid

(a) Sulfur is a common starting material for the Contact process.

Name a source of sulfur.

..... [1]

(b) Describe **step 2**, giving reaction conditions and a chemical equation. Reference to reaction rate and yield is not required.

.....

.....

.....

.....

.....

.....

..... [5]

(c) **Step 3** involves adding sulfur trioxide to concentrated sulfuric acid to form oleum.

Complete the chemical equation for this reaction.

$H_2SO_4 + SO_3 \rightarrow$ .....

[1]

(e) Concentrated sulfuric acid has different properties to dilute sulfuric acid.

When concentrated sulfuric acid is added to glucose, $C_6H_{12}O_6$, steam is given off and a black solid is formed.

(i) Name the black solid.

..... [1]

(ii) What type of reaction has occurred?

..... [1]

Topic Chem 12 **Q# 264/** IGCSE Chemistry/2016/m/Paper 42/

6 Iron pyrite, FeS_2, is known as Fool's Gold because it is a shiny yellow solid which is similar in appearance to gold. Iron pyrite is an ionic compound. Gold is a metallic element.

(c) Sulfur dioxide is produced on a large scale by heating iron pyrite strongly in air. The iron pyrite reacts with oxygen in the air producing iron(III) oxide, Fe_2O_3, and sulfur dioxide.

(i) Construct a chemical equation for the reaction between iron pyrite and oxygen.

..... [2]

(ii) Give **one** use of sulfur dioxide.

..... [1]

Topic Chem 13 **Q# 265/** IGCSE Chemistry/2018/s/Paper 43/

1 The following are the symbols and formulae of some elements and compounds.

Ar $Ca(OH)_2$ Cl_2 CO_2 Cu Fe SO_2 V_2O_5

Answer the following questions using only the elements or compounds in the list.
Each element or compound may be used once, more than once or not at all.

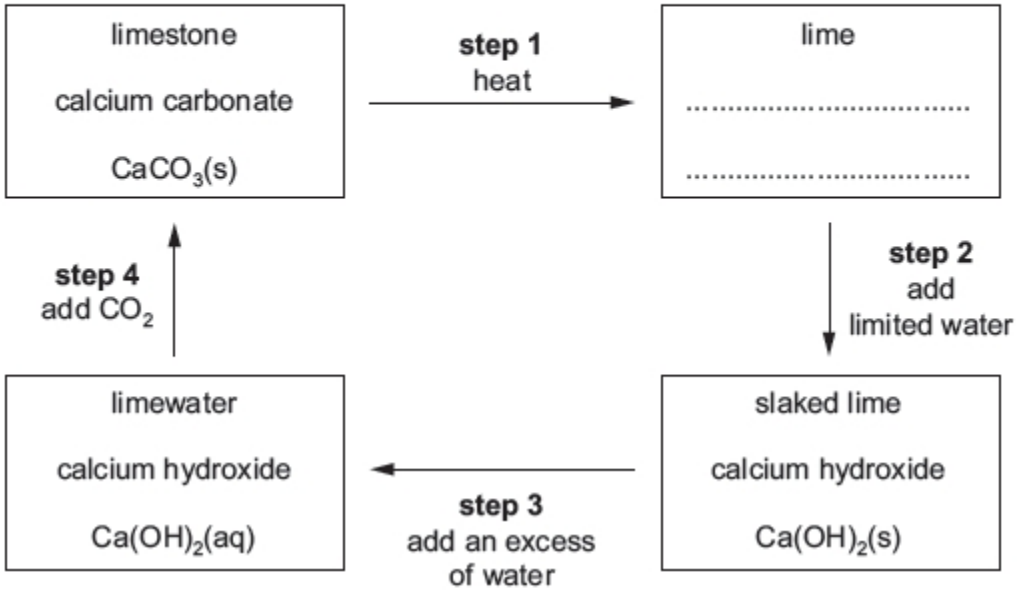
State which element or compound is used:

(e) to neutralise excess acidity in soil ..... [1]

Topic Chem 13 **Q# 266/** IGCSE Chemistry/2018/m/Paper 42/

3 Limestone rock is mainly calcium carbonate, $CaCO_3$.

(a) The 'limestone cycle' is shown. Each step is numbered.



(i) Complete the box to give the chemical name and formula of lime. [2]

(ii) Which step involves a physical change?

..... [1]

(iii) What type of reaction is **step 1**?

..... [1]

(iv) Suggest how **step 2** could be reversed.

..... [1]

(v) Write a chemical equation for **step 4**.

..... [1]

6 **(a)** Ethanol can be manufactured by fermentation and by hydration.

(i) Describe these **two** processes of ethanol manufacture.

In each case you should:
- identify the reactants
- give the reaction conditions
- write a chemical equation for the reaction which produces ethanol.

fermentation .....

.....

.....

.....

.....

hydration .....

.....

.....

.....

.....

[6]

(ii) Give **two** advantages of ethanol manufacture by fermentation compared to by hydration.

1 .....

2 .....

[2]

(iii) State **two** major uses of ethanol.

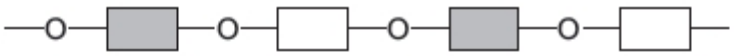
1 .....

2 .....

[2]

(b) The structures of some polymers are shown.

A



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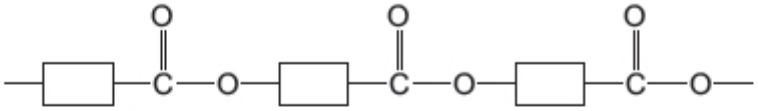

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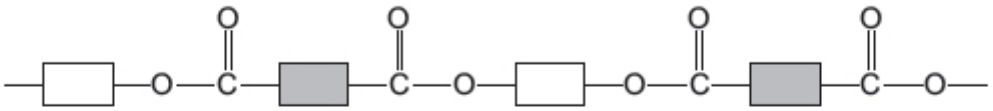

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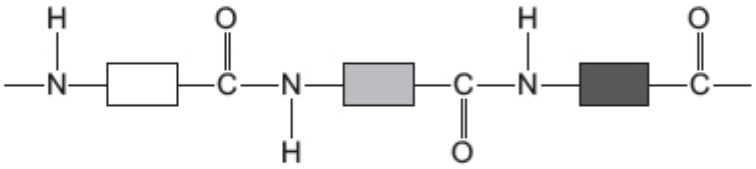

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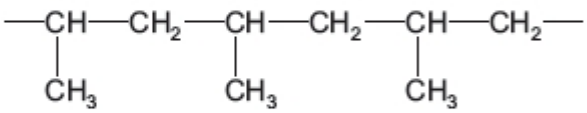


Answer the following questions about these polymers.
Each polymer may be used once, more than once or not at all.

State which polymer, **A**, **B**, **C**, **D** or **E**, represents:

(i) an addition polymer ..... [1]

(ii) a protein ..... [1]

(iii) a polyester made from only **one** monomer ..... [1]

(iv) *Terylene* ..... [1]

(v) a complex carbohydrate. ..... [1]

[Total: 15]

Topic Chem 14 **Q# 268/** IGCSE Chemistry/2018/w/Paper 42/Q5

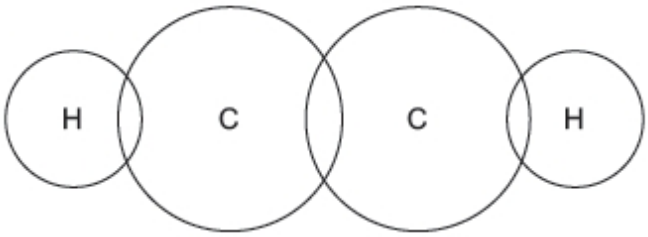
5 Alkynes are a homologous series of unsaturated hydrocarbons.
All members contain a C≡C triple bond.

(a) Complete the table showing information about the first **three** alkynes.

formula	C_2H_2	C_3H_4	
structure	H–C≡C–H	H–C≡C–CH_3	H–C≡C–CH_2–CH_3
name	ethyne		butyne

[2]

(b) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of ethyne, H–C≡C–H. Show outer shell electrons only.



[2]

(c) Compounds in the same homologous series have the same general formula.

(i) Give **two** other characteristics of members of a homologous series.

1 .....

2 .....

[2]

(ii) Use the information in the table in **(a)** to deduce the general formula of alkynes.

..... [1]

(d) Alkynes are unsaturated.

Describe a test for unsaturation.

test .....

result .....

[2]

(e) (i) Name an oxidising agent which can be used to oxidise ethanol to ethanoic acid.

..... [2]

(ii) Draw the structure of ethanoic acid. Show all of the atoms and all of the bonds.

[1]

(f) Carboxylic acids can be converted into esters.

(i) The ester formed by reacting propanoic acid and methanol has the molecular formula $C_4H_8O_2$.

Name this ester and draw its structure. Show all of the atoms and all of the bonds.

name of the ester .....

structure of the ester

[2]

(ii) Name another ester with the molecular formula $C_4H_8O_2$.

..... [1]

(g) Polyesters are polymers.

(i) What type of polymerisation is used in the manufacture of polyesters?

..... [1]

(ii) Name a polyester.

..... [1]

[Total: 17]

Topic Chem 14 **Q# 269/** IGCSE Chemistry/2018/w/Paper 41/Q6

6 **(a)** Ethane, C_2H_6, is a member of the homologous series called alkanes.
Ethanol, C_2H_5OH, is a member of the homologous series called alcohols.

(i) Alkanes are hydrocarbons.

What is meant by the term *hydrocarbon*?

.....

..... [2]

(ii) All members of a homologous series can be represented by a general formula.

State the general formula of:

- alkanes .....
- alcohols .....

[2]

(iii) State **two** characteristics, other than having the same general formula, of members of a homologous series.

1 .....

.....

2 .....

.....

[2]

(b) Ethane can react with chlorine in a substitution reaction.

(i) State **one** essential reaction condition.

..... [1]

(ii) Draw the structure of the organic product formed by substitution of **one** of the hydrogen atoms in ethane with chlorine. Show all of the atoms and all of the bonds.

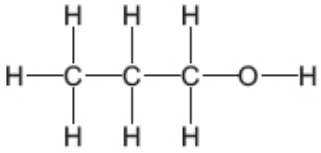
[1]

(iii) Name the product of the substitution reaction between ethane and chlorine that does **not** contain carbon.

..... [1]

(c) Propan-1-ol is an alcohol.

The structure of propan-1-ol is shown.

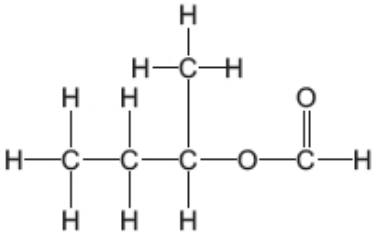


Propan-1-ol reacts with ethanoic acid to form an ester.

Give the name of the ester formed in this reaction.

..... [1]

(d) Ester **Y** has the structure shown.



ester **Y**

(i) Give the molecular formula of ester **Y**.

..... [1]

(ii) Draw the structures of the carboxylic acid and the alcohol used to make ester **Y**. Show all of the atoms and all of the bonds. Give the name of the carboxylic acid and the alcohol.

structure of the carboxylic acid

name of the carboxylic acid .....

structure of the alcohol

name of the alcohol .....

[4]

(e) Nylon is a polyamide.

Complete the diagram to show the structure of nylon. Show all of the atoms and all of the bonds present in the linkages.

[3]

Topic Chem 14 **Q# 270/** IGCSE Chemistry/2018/w/Paper 41/Q1

1 The following formulae represent different substances.

Al Ag $CaCO_3$ CH_4 Cl_2 Cu SO_2

Answer the following questions using only these substances.
Each substance may be used once, more than once or not at all.

State which substance is:

(c) the main constituent of natural gas ..... [1]

4 Ethanol is a member of the homologous series of alcohols.

(a) Give **two** characteristics of members of a homologous series.

1 .....

2 .....

[2]

(c) Ethanol can be produced by the catalytic addition of steam to ethene or by the fermentation of glucose.

(i) Write a chemical equation for the production of ethanol by the catalytic addition of steam to ethene.

..... [1]

(ii) Write a chemical equation for the production of ethanol by the fermentation of glucose, $C_6H_{12}O_6$.

..... [1]

(iii) State **one** advantage of producing ethanol by the catalytic addition of steam to ethene. Your answer must **not** refer to cost.

..... [1]

(iv) State **one** advantage of producing ethanol by the fermentation of glucose. Your answer must **not** refer to cost.

..... [1]

(d) Ethanol can be oxidised to ethanoic acid.

State the chemical reagent needed to oxidise ethanol to ethanoic acid.

..... [1]

(e) Ethanoic acid reacts with ethanol in the presence of an acid catalyst. The products are an organic compound and water.

(i) Draw the structure of the organic compound formed. Show all of the atoms and all of the bonds.

[2]

(ii) State the name of the organic compound formed.

..... [1]

(iii) Which homologous series does the organic compound formed belong to?

..... [1]

(c) Compounds **T** and **V** both have the molecular formula $C_3H_6O_2$.

- Compound **T** produces bubbles of carbon dioxide gas when it is added to aqueous sodium carbonate.
- Compound **V** is an ester.

(i) What is the name given to compounds with the same molecular formula but different structures?

..... [1]

(ii) Draw the structures of compounds **T** and **V**. Show all of the atoms and all of the bonds.

compound **T**

compound **V**

[2]

(iii) All compounds with the molecular formula $C_3H_6O_2$ can undergo complete combustion in an excess of oxygen.

Complete the chemical equation for this reaction.

$C_3H_6O_2$ + ... → ..... + ...

[2]

(d) Compound **W** has the molecular formula C_2H_6O. Compound **W** reacts when heated with ethanoic acid and a catalyst to produce a sweet-smelling liquid.

(i) Give the name of the homologous series to which compound **W** belongs.

..... [1]

(ii) Draw the structure of compound **W**. Show all of the atoms and all of the bonds.

[1]

(e) Alkanes and alkenes are hydrocarbons.

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

.....

..... [2]

(ii) State the general formula of:

alkanes .....

alkenes .....

[2]

(f) Ethanol can be produced from long-chain alkanes as shown.

long-chain alkane $\xrightarrow{\textbf{step 1}}$ ethene $\xrightarrow{\textbf{step 2}}$ ethanol

Describe the **two-stage** manufacture of ethanol from the long-chain alkane octane, C_8H_{18}.
Include:

- the names of the types of chemical reactions that occur
- reaction equations
- reaction conditions.

step 1 .....

.....

.....

.....

step 2 .....

.....

.....

..... [5]

Topic Chem 14 **Q# 273/** IGCSE Chemistry/2018/s/Paper 42/

1 Give the name of the process that is used:

(d) to separate the components of petroleum

..... [1]

6 The table shows the structures of four hydrocarbons.

P	Q	R	S
$CH_3–CH_3$	$CH_2=CH_2$	$CH_2=CH–CH_3$	$CH_2=CH–CH_2–CH_3$

(a) Why are compounds **P**, **Q**, **R** and **S** known as hydrocarbons?

.....

..... [2]

(b) Compound **P** is saturated.

What is meant by the term *saturated*?

.....

..... [1]

(c) Compound **P** undergoes a substitution reaction with chlorine.

(i) What is meant by the term *substitution reaction*?

.....

..... [1]

(ii) State a condition required for this reaction to occur.

..... [1]

(iii) Write a chemical equation for this reaction.

..... [2]

(d) Compound **R** undergoes an addition reaction with bromine.

(i) Why is this reaction an addition reaction?

..... [1]

(ii) A compound containing bromine is formed in this reaction.

Draw the structure of this compound. Show all of the atoms and all of the bonds.

[1]

(e) Draw the structure of an unbranched isomer of compound **S**. Show all of the atoms and all of the bonds. Name this unbranched isomer of compound **S**.

structure

name .....

[2]

(f) Compound **Q** undergoes polymerisation.

(i) Name the polymer formed.

..... [1]

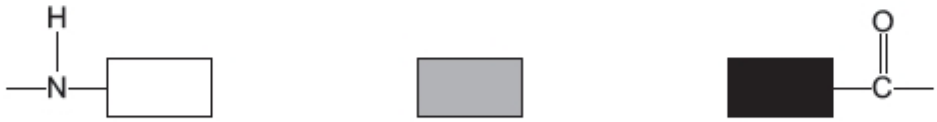
(ii) Complete the chemical equation to show the polymerisation of compound **Q**.

$n\ CH_2{=}CH_2 \rightarrow$

[2]

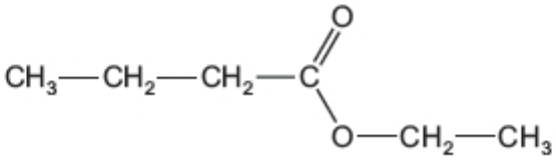
(g) Amino acids undergo polymerisation to form proteins. Part of a protein molecule with the linkages missing is shown.

Draw the linkages on the diagram. Show all of the atoms and all of the bonds.



[2]

(h) The structure shows an ester.



Write the word equation for a reaction which could be used to make this ester.

..... [3]

5 Alcohols are a 'family' of organic molecules which have the same general formula.

(a) What is the name given to any 'family' of organic molecules which have the same general formula and similar chemical properties?

..... [1]

(b) Give the general formula of alcohols.

..... [1]

(c) Propan-1-ol can be made from propene.

(i) Name the reagent and give the conditions needed to convert propene into propan-1-ol.

reagent .....

conditions .....

[2]

(ii) Write a chemical equation for the complete combustion of propan-1-ol.

..... [2]

(d) A simple sugar can be represented as shown.

Simple sugars can be polymerised to make more complex carbohydrates.

(i) Complete the diagram to show part of a carbohydrate **polymer** made from the simple sugar shown.

[2]

(ii) Name the chemical process which occurs when a carbohydrate polymer is broken down into simple sugars.

..... [1]

(iii) What conditions are needed for this process to occur?

..... [1]

Topic Chem 14 **Q# 276/** IGCSE Chemistry/2018/m/Paper 42/

1 This question is about gases.

(a) The following substances are gases at room temperature.

letter	A	B	C	D	E	F	G	H
substance	SO_2	Ar	CO	Cl_2	NH_3	CO_2	CH_4	C_3H_8

Identify, by letter:

(vi) **two** gases which are found in refinery gas. ..... [2]

Topic Chem 14 **Q# 277/** IGCSE Chemistry/2017/w/Paper 43/Q4e

(iii) Name the process by which ethanol can be manufactured from a renewable resource.

..... [1]

Topic Chem 14 **Q# 278/** IGCSE Chemistry/2017/w/Paper 43/

1 Substances can be classified as elements, compounds or mixtures.

State whether each of the following is an element, a compound or a mixture.

(c) butane ..... [1]

Topic Chem 14 **Q# 279/** IGCSE Chemistry/2017/w/Paper 43/

6 **(a)** Alkanes and alkenes are two homologous series of hydrocarbons.

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

..... [1]

(ii) What is the general formula of the homologous series of

alkanes, ...

alkenes? .....

[2]

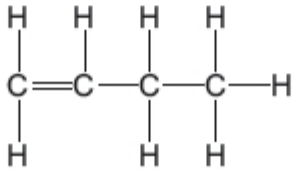
(iii) Other than having a general formula, state **two** characteristics of a homologous series.

1 .....

2 .....

[2]

(iv) The structure of an alkene molecule with the molecular formula C_4H_8 is shown.



Draw the structure of a different alkene molecule with the molecular formula C_4H_8. Show all of the atoms and all of the bonds.

[1]

(v) What term describes molecules with the same molecular formula but different structural formulae?

..... [1]

(b) 25 cm^3 of a gaseous hydrocarbon, C_xH_y, were burnt in 150 cm^3 of oxygen. This was an excess of oxygen.

After cooling, the volume of the gases remaining was 100 cm^3. This consisted of 75 cm^3 of carbon dioxide and 25 cm^3 of unreacted oxygen. The water that was produced in the reaction was liquid.

All volumes were measured at the same temperature and pressure.

(i) What is meant by an *excess* of oxygen?

..... [1]

(ii) What was the volume of oxygen that reacted with the hydrocarbon?

..... cm^3 [1]

(iii) Complete the table to show the smallest whole number ratio of volumes.

	volume of hydrocarbon reacted	:	volume of oxygen reacted	:	volume of carbon dioxide produced
smallest whole number ratio of volumes		:		:	

[1]

(iv) Use your answer to **(b)(iii)** to balance the chemical equation. Deduce the formula of the hydrocarbon.

$$C_xH_y(g) + ...O_2(g) \rightarrow .....CO_2(g) + ...H_2O(l)$$

formula of the hydrocarbon = ... [2]

Topic Chem 14 **Q# 280/** IGCSE Chemistry/2017/w/Paper 43/

(b) Starch is a natural polymer made from glucose.

(i) What type of polymerisation occurs when glucose is converted into starch?

..... [1]

(ii) What type of reaction occurs when starch is converted into glucose?

..... [1]

(iii) Starch can be represented as shown.

Complete the diagram below to represent the structure of the glucose monomer.

[1]

Topic Chem 14 **Q# 281/** IGCSE Chemistry/2017/w/Paper 42/Q3

(d) Dodecane is an alkane containing 12 carbon atoms. Ethanol can be manufactured from dodecane in a two-stage process.

In **stage 1**, each molecule of dodecane is converted into three molecules of ethene and one molecule of another hydrocarbon.

(i) Name the process which occurs in **stage 1**.

..... [1]

(ii) Write a chemical equation for the reaction which occurs in **stage 1**.

..... [2]

In **stage 2**, ethene reacts with steam to produce ethanol.

(iii) State **two** conditions needed for **stage 2**.

1 .....

2 .....

[2]

(iv) Name the type of reaction which occurs in **stage 2**.

..... [1]

(v) Suggest how to test the purity of the ethanol produced.

.....

..... [2]

(e) Ethanol can also be manufactured by the fermentation of glucose, $C_6H_{12}O_6$.

(i) State **two** conditions needed for the fermentation of glucose.

1 .....

2 .....

[2]

(ii) Complete the chemical equation for the fermentation of glucose.

$$C_6H_{12}O_6 \rightarrow \text{.....}C_2H_5OH + \text{.....}$$

[2]

(iii) One disadvantage of fermentation is that the maximum concentration of ethanol produced is about 15%.

Suggest why the concentration of ethanol produced by fermentation does **not** exceed 15%.

.....

..... [1]

(iv) Give **one** other disadvantage of manufacturing ethanol by fermentation.

..... [1]

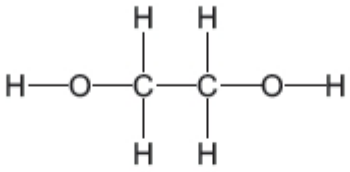
(v) Give **one** advantage, other than cost, of manufacturing ethanol by fermentation.

..... [1]

(vi) Suggest the name of a process to obtain ethanol from a mixture of ethanol and water.

..... [1]

(f) Ethane-1,2-diol has the following structure.



(i) Write the empirical formula of ethane-1,2-diol.

..... [1]

(ii) Ethane-1,2-diol can undergo condensation polymerisation but cannot undergo addition polymerisation.

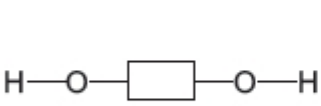
Explain why ethane-1,2-diol **cannot** undergo addition polymerisation.

.....

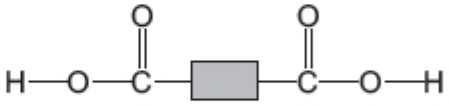
..... [1]

(iii) Ethane-1,2-diol undergoes condensation polymerisation with molecule **Y**.

The diagrams represent the structures of ethane-1,2-diol and molecule **Y**.



ethane-1,2-diol



molecule **Y**

Draw the condensation polymer formed between ethane-1,2-diol and molecule **Y**.
Show **one** repeat unit. Show all of the atoms and all of the bonds in the linkage.

[3]

(iv) Name the type of condensation polymer formed between ethane-1,2-diol and molecule **Y**.

..... [1]

4 **(a)** Ethanol, C_2H_5OH, can be made by fermentation.

(i) Complete the chemical equation for the formation of ethanol by fermentation.

$$C_6H_{12}O_6 \rightarrow \text{.....}C_2H_5OH + \text{.....}$$

[2]

(ii) State **two** conditions required for fermentation.

1 .....

2 .....

[2]

(b) Ethanol can also be made by the catalytic hydration of ethene. The equation for the reaction is shown.

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

(i) Name a suitable catalyst for this reaction.

..... [1]

(ii) Calculate the maximum mass of ethanol that can be made from 56 g of ethene.

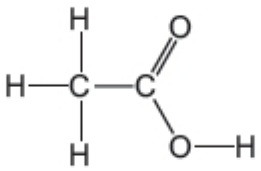
maximum mass of ethanol = ... g [2]

(c) Ethanol can be oxidised to form ethanoic acid.

(i) Name a suitable oxidising agent for this reaction.

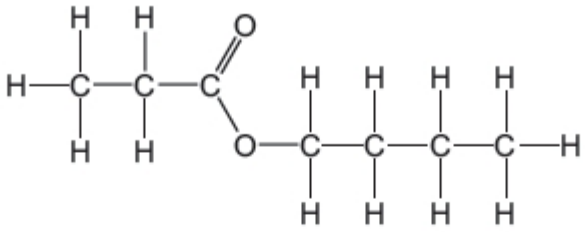
..... [1]

(ii) A molecule of ethanoic acid has the structure shown.



(e) Carboxylic acids react with alcohols to make esters.

The structure of an ester is shown.



Draw the structures of the carboxylic acid and alcohol from which this ester can be made.
Give the names of the carboxylic acid and alcohol.

structure of the carboxylic acid

name of the carboxylic acid .....

structure of the alcohol

name of the alcohol .....

[4]

Topic Chem 14 **Q# 283/** IGCSE Chemistry/2017/s/Paper 43/

4 Gasoline is used as a fuel for cars. It is a mixture of hydrocarbons.

(a) Name the raw material from which gasoline is obtained.

..... [1]

(b) One of the compounds in gasoline is heptane, C_7H_{16}. Heptane is a saturated hydrocarbon.

(i) What is meant by the term *saturated hydrocarbon*?

saturated .....

.....

hydrocarbon .....

.....

[3]

(ii) To which homologous series does heptane belong?

..... [1]

(iii) Give **two** characteristics of an homologous series.

1 .....

2 .....

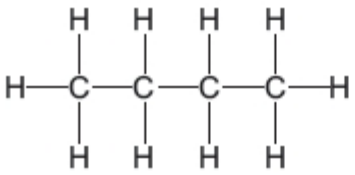
[2]

(iv) Complete the chemical equation for the complete combustion of heptane.

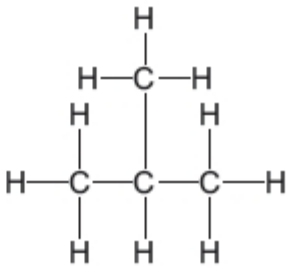
C_7H_{16} + ...O_2 → ..... + ...

[2]

(d) The formula C_4H_{10} represents two structural isomers, **A** and **B**.



A



B

(i) Name isomer **A**.

..... [1]

(ii) What is meant by the term *structural isomers*?

.....

.....

..... [2]

(iii) Isomer **B** reacts with chlorine in a substitution reaction.

Give the conditions required for the reaction to occur and draw the structures of **two** possible products, **one** of which is organic and **one** of which is **not** organic.

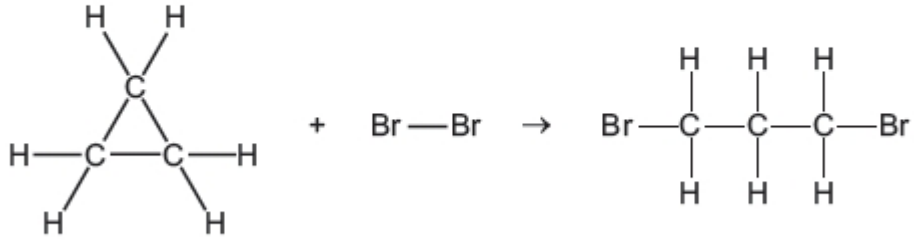
conditions .....

structures of products

[3]

Topic Chem 14 **Q# 284/** IGCSE Chemistry/2017/s/Paper 43/

2 Cyclopropane is a colourless gas.
Cyclopropane reacts with bromine at room temperature. The chemical equation for the reaction is shown.



cyclopropane bromine dibromopropane

(a) (i) What is the empirical formula of cyclopropane?

..... [1]

(ii) What colour change, if any, would you see when cyclopropane is bubbled into aqueous bromine?

initial colour .....

final colour .....

[2]

Topic Chem 14 **Q# 285/** IGCSE Chemistry/2017/s/Paper 42/

1 **(a)** State the name of the process that is used to

(iii) produce ethanol from simple sugars,

..... [1]

6 **(a)** An homologous series is a 'family' of organic compounds whose names have the same ending.

(i) Name the homologous series for which the names of the organic compounds end in *-ene* and *-oic acid*.

-ene ..... [1]

-oic acid ..... [1]

(ii) State **two** characteristics of an homologous series.

.....

..... [2]

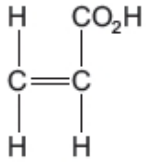
(b) Propan-1-ol is a member of the homologous series of alcohols. It reacts in the same way as ethanol with acidified potassium manganate(VII) and with carboxylic acids.

Name the **type** of compound that is formed when propan-1-ol is heated with

acidified potassium manganate(VII), ...

ethanoic acid and a suitable catalyst. .....
[2]

(c) The structure of prop-2-enoic (acrylic) acid is shown.



(i) What would you see if prop-2-enoic acid were added to

aqueous bromine, ...

a solution of sodium carbonate. .....
[2]

(ii) Prop-2-enoic acid can be polymerised to form poly(acrylic acid).

Suggest the type of polymerisation that occurs and draw **one** repeat unit of the polymer.

type of polymerisation .....

repeat unit

[3]

6 The alkenes and alkanes are both examples of homologous series which are hydrocarbons.

(a) What is meant by the term *hydrocarbon*?

.....

..... [2]

(b) Give **three** characteristics of an homologous series.

1 .....

2 .....

3 .....

[3]

(c) Name and draw the structure of the second member of the alkene homologous series.
Show all of the atoms and all of the bonds.

name .....

structure

[2]

(d) Alcohols can be made from alkenes.

Name the reagent and conditions needed to convert an alkene into an alcohol.

.....

..... [2]

(e) The alcohol butanol, $CH_3CH_2CH_2CH_2OH$, can be converted into a carboxylic acid with four carbon atoms.

(i) Name the carboxylic acid formed from butanol and draw its structure. Show all of the atoms and all of the bonds.

name .....

structure

[2]

(ii) Ethanoic acid can be formed from ethanol by fermentation. It can also be formed by the addition of a suitable chemical reagent.

Name the reagent needed to convert ethanol into ethanoic acid.

..... [2]

(iii) State the type of chemical change which occurs when ethanol is converted into ethanoic acid.

..... [1]

(f) Describe how a student could prepare the ester methyl ethanoate in a school laboratory.
In your description give

- the names of the **two** starting organic chemicals,
- the essential reaction conditions needed,
- a chemical equation for the reaction.

.....

.....

.....

.....

.....

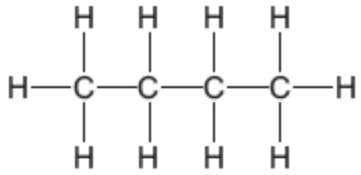
.....

.....

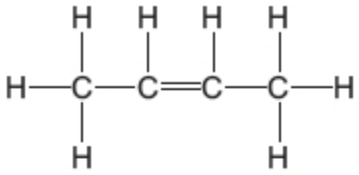
..... [5]

1 **(a)** Five organic compounds have the following structures.

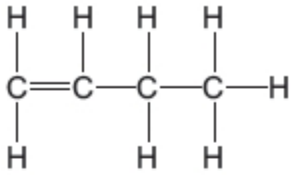
A



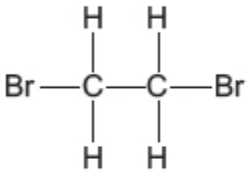
B



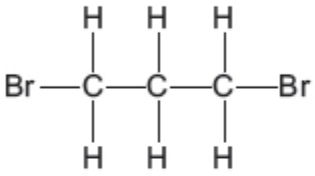
C



D



E



(i) Which compound is butane?

..... [1]

(ii) Which **two** compounds are structural isomers of each other?

..... [1]

(iii) Which compound can be made by reacting an alkene with bromine?

..... [1]

(iv) Which compound is a saturated hydrocarbon?

..... [1]

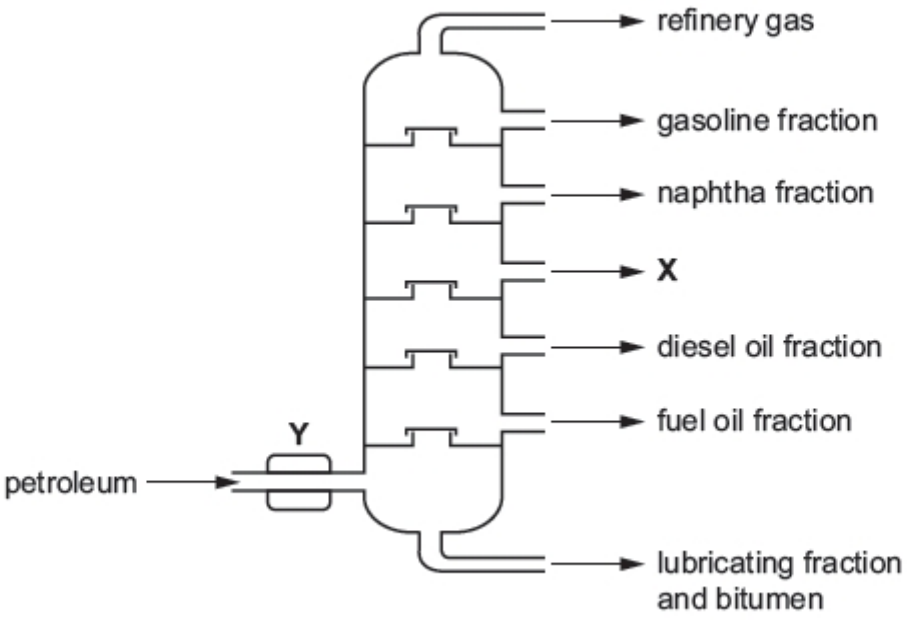
(v) Which compound has the empirical formula C_2H_5?

..... [1]

(vi) Name the **two** products made during the complete combustion of compound **C**.

..... [1]

(b) Petroleum can be separated into useful substances using the apparatus shown.



(i) Name the fraction which is the most viscous.

..... [1]

(ii) Name the fraction with the smallest molecules.

..... [1]

(iii) Name the fraction which has the weakest attractive forces between molecules.

..... [1]

(iv) Fraction **X** is used as jet fuel.

Name fraction **X**.

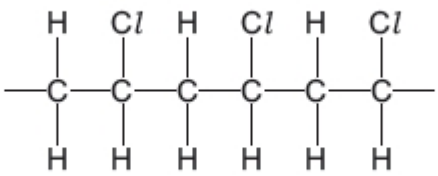
..... [1]

(v) What happens at point **Y** on the diagram?

..... [1]

Topic Chem 14 **Q# 289/** IGCSE Chemistry/2017/m/Paper 42/

7 **(a)** The diagram shows part of the structure of an addition polymer.



(i) Draw a circle around **one** repeat unit of the polymer. [1]

(ii) Draw the structure of the monomer from which this addition polymer is made.

[1]

(iii) Aqueous bromine is added to both the polymer and the monomer.

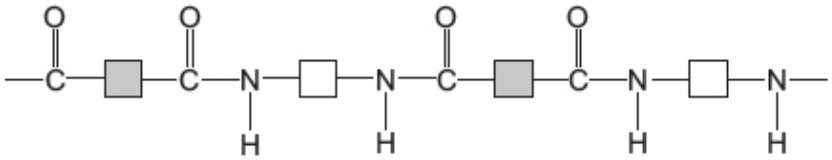
Describe what would be seen in each case.

with the polymer .....

with the monomer .....

[2]

(b) The diagram shows part of the structure of a condensation polymer.



(i) What type of condensation polymer is this?

..... [1]

(ii) On the diagram, draw a circle around **one** repeat unit of the polymer. [1]

(iii) Draw the structures of the **two** monomers from which the condensation polymer is made.

[2]

Topic Chem 14 **Q# 290/** IGCSE Chemistry/2016/w/Paper 43/

6 Synthetic polyamides are made by condensation polymerisation.

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

.....

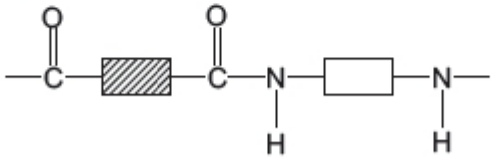
.....

..... [3]

(ii) Name another type of polymerisation.

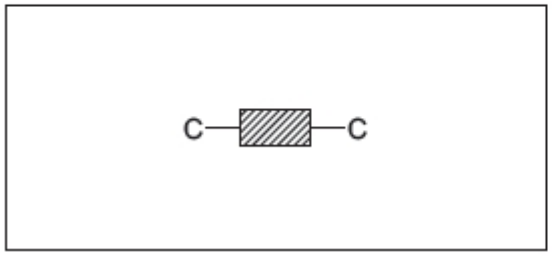
..... [1]

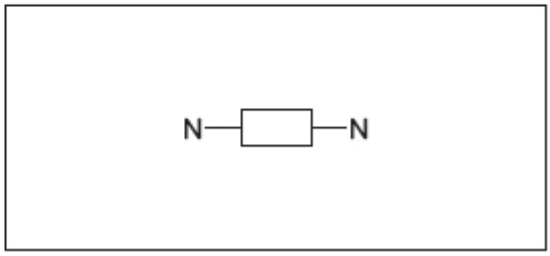
(b) One repeat unit of a synthetic polyamide is represented by the following structure.



(i) Draw a ring around the amide link. [1]

(ii) Complete the diagrams to show the structures of the monomers used to produce the synthetic polyamide. Show all the missing atoms and bonds.





[2]

(iii) Name an example of a synthetic polyamide.

..... [1]

(c) Proteins and synthetic polyamides have similarities and differences.

(i) Name the type of compounds that are the monomers used to make up proteins.

..... [1]

(ii) Starting with a sample of protein, describe how to produce, separate, detect and identify the monomers which make it up.

Your answer should include

- the name of the process used to break down the protein into its monomers,
- the name of the process used to separate the monomers,
- the method used to detect the monomers after they have been separated,
- the method used to identify the monomers after they have been separated.

.....

.....

.....

.....

..... [4]

(c) When one mole of bromine, Br_2, reacts with one mole of propene, one organic product is formed.

(i) Which part of the propene molecule reacts with bromine?

..... [1]

(ii) What is the name of the type of reaction which takes place between bromine and propene?

..... [1]

(d) When one mole of chlorine, Cl_2, reacts with one mole of propane, a mixture of two structural isomers is formed.

(i) What is the name of the type of reaction which takes place between chlorine and propane?

..... [1]

(ii) Explain what is meant by the term *structural isomers*.

.....

..... [2]

(iii) Draw the structure of **two** structural isomers formed when **one** mole of chlorine reacts with **one** mole of propane.

[2]

(e) Iodine forms an oxide which has the composition by mass: I, 76.0%; O, 24.0%.

(i) Use this information to determine the empirical formula of this oxide of iodine.

empirical formula ..... [3]

7 Proteins are a major constituent of food.

Proteins are polymers.

(a) What is a polymer?

.....

.....

..... [2]

(b) Proteins can be converted into amino acids.

(i) Name the type of chemical reaction which occurs when proteins are converted into amino acids.

..... [1]

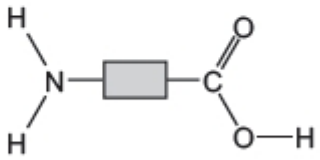
(ii) Suggest a condition needed to convert proteins into amino acids.

..... [1]

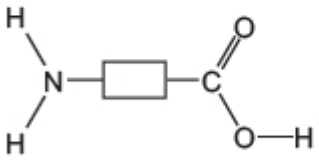
(d) When one molecule of an amino acid **A** combines with one molecule of another amino acid **B**, two different dipeptide molecules could be formed.

Draw the structures of the **two** different dipeptide molecules.
Show all of the atoms and all of the bonds in the linkages.

amino acid **A**

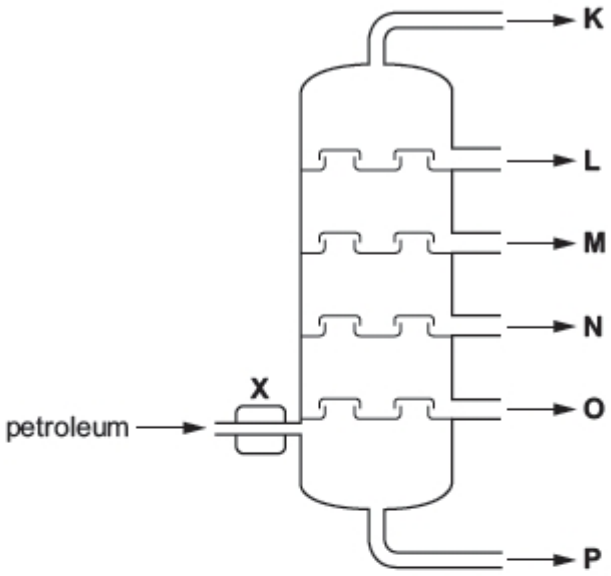


amino acid **B**



[3]

3 **(a)** Petroleum is a mixture of hydrocarbons. It is separated into useful fractions by fractional distillation. This can be done using the fractionating column shown.



(i) What happens to the petroleum at point **X**, before it enters the fractionating column?

.....

..... [1]

(ii) State **two** ways in which fraction **O** differs from fraction **L**.

.....

.....

..... [2]

(b) Most of the hydrocarbons obtained from petroleum are alkanes. The alkanes are an homologous series of saturated hydrocarbons with the general formula C_nH_{2n+2}.

Give **two** characteristics, other than having the same general formula, of members of an homologous series.

.....

.....

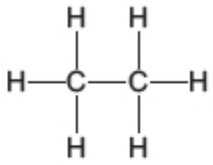
..... [2]

(c) The alkane with the molecular formula C_5H_{12} can exist as a number of structural isomers.

Draw the structures of **two** isomers with the formula C_5H_{12}.

[2]

(d) The alkane ethane has the structure shown.



When a mixture of ethane and chlorine is exposed to ultraviolet light a substitution reaction takes place.

Draw the structure of **one** organic product from this substitution reaction.

[1]

(e) Isoprene is a naturally occurring hydrocarbon.

(i) Explain how the name of isoprene suggests that it contains a C=C double bond.

..... [1]

(ii) A sample of isoprene had the following composition by mass: C, 88.24%; H, 11.76%.

Calculate the empirical formula of isoprene. Show all your working.

empirical formula = ... [3]

(iii) What additional information would be required to calculate the molecular formula of isoprene?

..... [1]

6 Nylon, *Terylene* and proteins are all polymers.

(a) What is a polymer?

.....

.....

..... [2]

(b) Proteins are natural polymers. Proteins are biodegradable.

(i) Name the type of linkage in proteins.

..... [1]

(ii) What is meant by the term *biodegradable*?

.....

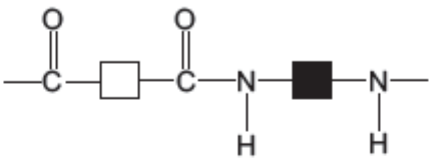
.....

..... [2]

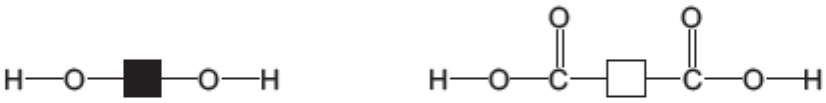
(iii) Name another natural polymer.

..... [1]

(c) Nylon and *Terylene* are synthetic polymers.
The repeat unit of nylon can be shown as



Terylene can be made from the monomers shown.



Draw a diagram to show the repeat unit of *Terylene*.

[3]

(d) Nylon and proteins are both polymers containing nitrogen.

(i) Name the linkages found in the polymers of nylon and protein.

..... [1]

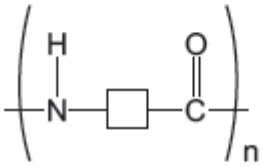
(ii) Describe **one** difference in the structures of nylon and protein.

..... [1]

(iii) What is the general name given to the products of hydrolysis of proteins?

..... [1]

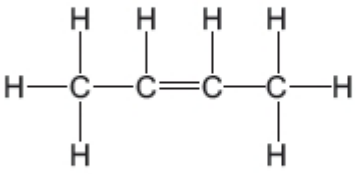
(e) Suggest the structure of the monomer used to make the polymer shown.



[1]

2 The structures of six organic compounds are shown.

A



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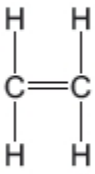
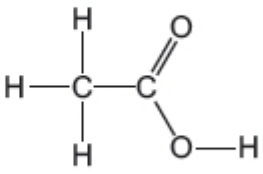
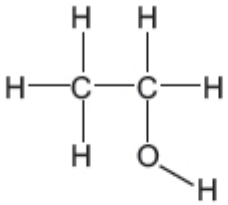


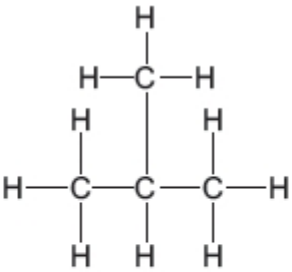
C



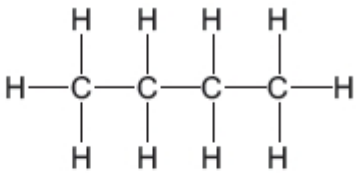
D



E



F



(a) Give the name of **F**.

..... [1]

(b) Identify **two** of the compounds that are members of the same homologous series.
Give the general formula of this homologous series.

compounds .....

general formula .....

[2]

(c) Which **two** compounds are isomers of each other?
Explain why they are isomers.

compounds .....

explanation .....

.....

[3]

(d) Explain why **B** is an unsaturated hydrocarbon.

.....

.....

..... [2]

(e) Describe how **D** is manufactured from **B**. Give a chemical equation for the reaction.

.....

.....

..... [3]

(f) Compound **A** forms an addition polymer.

Draw **two** repeat units of the addition polymer formed from **A**.

[2]

(b) Cracking is used to convert long chain alkanes into shorter chain alkanes and alkenes. Alkenes are unsaturated compounds.

Decane, $C_{10}H_{22}$, can be cracked to give propene and one other product.

(i) Complete the chemical equation.

$$C_{10}H_{22} \rightarrow C_3H_6 + \text{.....}$$

[1]

(ii) What is meant by the term *unsaturated*?

..... [1]

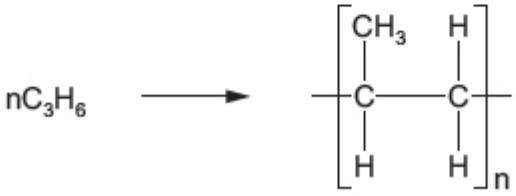
(iii) Describe a test to show that propene is an unsaturated compound.

test .....

result .....

[2]

(c) Propene can be polymerised. The only product is polypropene. The equation for the polymerisation is:



(i) Name the type of polymerisation that occurs.

..... [1]

(ii) Deduce the maximum mass of polypropene that could be produced from 1 kg of propene.

..... kg [1]

(iii) Give the empirical formula of

propene, ...

polypropene. .....

[2]

6 Petroleum is a source of many important chemicals.

(a) Name **two** industrial processes which must take place to produce alkenes from petroleum.

.....

..... [2]

(b) Ethene, $CH_2=CH_2$, and propene, $CH_2=CHCH_3$, can both be converted into polymers.

(i) What type of polymerisation takes place when ethene forms a polymer?

..... [1]

(ii) What is the empirical formula of the polymer formed from ethene?

..... [1]

(iii) Propene has the structural formula $CH_2=CHCH_3$.

Draw **two** repeat units of the polymer made from propene.

[2]

(c) Ethene will react with steam to form ethanol.

Propene will react with steam to form two isomers, both of which are alcohols.

Suggest the structures of these alcohols.

[2]

(d) Esters are organic chemicals noted for their characteristic smells. Ethanoic acid and methanol will react to form an ester.

(i) Name the catalyst needed to form an ester from ethanoic acid and methanol.

..... [1]

(ii) Name the ester formed when ethanoic acid reacts with methanol.

..... [1]

(iii) Draw the structure of the ester formed when ethanoic acid reacts with methanol. Show all bonds.

[2]

(iv) Give the name of a polyester.

..... [1]

Topic Chem 14 **Q# 299/** IGCSE Chemistry/2016/m/Paper 42/Q3

(d) (i) Name the type of chemical reaction in which carbon dioxide is produced from fossil fuels.

..... [1]

(ii) Name the chemical process in which green plants convert carbon dioxide into carbohydrates.

..... [1]

(iii) Name the chemical process in which living things produce carbon dioxide.

..... [1]

Topic Chem 14 **Q# 300/** IGCSE Chemistry/2016/m/Paper 42/

7 (a) Alkanes and alkenes are examples of hydrocarbons.

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

.....

..... [1]

(ii) Give the general formula of straight-chain

alkanes, ...

alkenes. .....

[2]

(c) An ester has the molecular formula $C_3H_6O_2$.

Name and give the structural formulae of **two** esters with the molecular formula $C_3H_6O_2$.

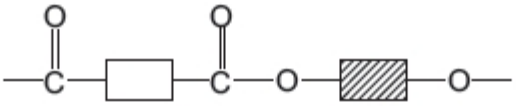
name of ester		
structural formula		

[4]

(d) Name the ester produced from the reaction of propanoic acid and methanol.

..... [1]

(e) A polyester is represented by the structure shown.



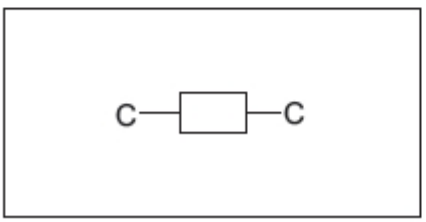
(i) What type of polymerisation is used for the production of polyesters?

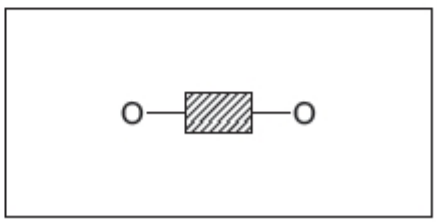
..... [1]

(ii) Which simple molecule is removed when the polyester is formed?

..... [1]

(iii) Complete the diagrams below to show the structures of the monomers used to produce the polyester. Show all atoms and bonds.





[2]

Mark Schemes

Mark Scheme for Topic Chem 1 **Q# 1/** IGCSE Chemistry/2018/w/Paper 42/

1(a)(i)	M1 Melting M2 Condensing M3 Freezing M4 Sublimation	4
1(a)(ii)	No new substances are made **or** The change can be reversed (by a physical process)	1
1(a)(iii)	Boiling happens at a specific temperature **or** Evaporation happens over a range of temperatures	1
1(b)	M1 Separation: Touching M2 Arrangement: Regular M3 Movement: Vibrate	3

Topic Chem 1 **Q# 2/** IGCSE Chemistry/2017/w/Paper 42/

1(a)(i)	Brownian (motion)	1
1(a)(ii)	molecules	1
	nitrogen / N_2 / N OR oxygen / O_2 / O	1
1(a)(iii)	nitrogen OR oxygen (particles) collide with / bombard / hit the dust (particles)	1
	(the bombarding particles) move **randomly**	1
1(b)(i)	diffusion	1
1(b)(ii)	Br_2 has an M_r of 160 **AND** Cl_2 has an M_r of 71 / bromine has an A_r of 80 **AND** chlorine has an A_r of 35.5	1
	(heavier) bromine (molecules / particles) diffuses more slowly	1
1(b)(iii)	particles have more energy / move faster	1

Topic Chem 1 **Q# 3/** IGCSE Chemistry/2017/w/Paper 41/

Question	Answer	Marks
1(a)(i)	B	1
1(a)(ii)	A	1
1(a)(iii)	C	1
1(a)(iv)	E	1
1(b)	O^{2-} **M1** O **M2** $^{2-}$	2

Question	Answer	Marks
2(a)(i)	**S**	1
2(a)(ii)	**S**	1
2(a)(iii)	**V**	1
2(b)	any value in the range 130–145 °C	1
2(c)	sublimation	1
2(d)(i)	Brownian motion	1
2(d)(ii)	nitrogen / oxygen / carbon dioxide / air molecules hit / bombard the smoke particles	1
	(the bombarding particles) move randomly	1

Topic Chem 1 **Q# 4/** IGCSE Chemistry/2017/m/Paper 42/

2(d)(i)	**M1** dichromate ions / particles are heavier (than silver ions)	1
	M2 so dichromate ions diffuse / move more slowly **ORA**	1
	M3 (where they meet they react and) silver dichromate is made	1
2(d)(ii)	**M1** red solid forms in less than five minutes **or** red solid forms faster / sooner	1
	M2 particles / ions move faster	1
2(e)(i)	**M1** breaking down	1
	M2 when heated	1

Topic Chem 1 **Q# 5/** IGCSE Chemistry/2016/w/Paper 42/

1(a)	fixed volume **AND** take the shape of the container	1
1(b)	<table><tr><td>solid</td><td>touching</td><td>regular</td><td>vibrate</td></tr><tr><td>liquid</td><td></td><td></td><td></td></tr><tr><td>gas</td><td>not touching</td><td>random</td><td>random</td></tr></table>	6
1(c)(i)	melting	1
1(c)(ii)	sublimation	1

Topic Chem 1 **Q# 6/** IGCSE Chemistry/2016/w/Paper 41/

2(a)(i)	melt(ing)	1
2(a)(ii)	sublimation / sublime	1
2(a)(iii)	condensing / condensation	1
2(b)	overcome / break the attractive forces	1
2(c)	E **AND** particles hit the walls (of the container) more often	1

Topic Chem 1 **Q# 7/** IGCSE Chemistry/2016/s/Paper 43/

6(a)(ii)	diffusion;	1
6(a)(iii)	solid forms at: A; explanation: ammonia molecules/ particles have a smaller mass; (and so) move/ diffuse faster;	3 1 2
6(a)(iv)	**M1** solid forms in less time/faster/ quicker; **M2** particles/molecules have more energy; **M3** (and so) move faster/diffuse faster;	3 1 1 1

Mark Scheme for Topic Chem 2 **Q# 8/** IGCSE Chemistry/2018/w/Paper 42/

3(c)(i)	Measuring cylinder	1
3(c)(iv)	M1 A solution that can hold no more solute M2 at the specified temperature	2

Topic Chem 2 **Q# 9/** IGCSE Chemistry/2018/s/Paper 42/

6(b)(iv)	boiling point sharp / melting point sharp / freezing point sharp / boiling point 100 (□)C / freezing point or melting point 0 (□)C	1

Topic Chem 2 **Q# 10/** IGCSE Chemistry/2018/s/Paper 42/

1(a)	distillation	1

1(c)	filtration	1
1(e)	chromatography	1

Topic Chem 2 **Q# 11/** IGCSE Chemistry/2018/s/Paper 41/

1(b)	dissolving	1
	filtration	1
	evaporation / crystallisation	1
	three correct stages in the correct order	1
1(c)(i)	condenser	1
	arrow pointing into lower aperture **only**	1
1(c)(ii)	stopper shown in diagram	1
	gases or vapours escape	1
1(c)(iii)	(mixture is) (in)flammable	1
1(c)(iv)	water bath cannot exceed 100 (°C)	1
	C AND D have a boiling point above 100 (°C)	1

Topic Chem 2 **Q# 12/** IGCSE Chemistry/2018/m/Paper 42/

5(e)(i)	locating ((re)agent)	1
5(e)(ii)	$\frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$	1
5(e)(iii)	compare to known data	1
5(e)(iv)	similar R_f values	1

Topic Chem 2 **Q# 13/** IGCSE Chemistry/2017/s/Paper 42/

1(a)(ii)	chromatography	1
1(a)(iii)	fermentation / ferment	1
1(a)(iv)	(simple) distillation / distil	1
1(a)(v)	filtration / decantation / centrifugation	1

Topic Chem 2 **Q# 14/** IGCSE Chemistry/2017/s/Paper 41/

3(a)(iii)	(a solution in which) no more solute will dissolve	1
	at that temperature	1
3(a)(iv)	the solubility deceases as the temperature decreases	1

Topic Chem 2 **Q# 15/** IGCSE Chemistry/2016/w/Paper 42/

7(c)(i)	$\frac{\text{distance moved by substance}}{\text{distance moved by solvent (front)}}$	1
7(c)(ii)	circle around top spot	1
7(c)(iii)	mixture of amino acids is placed as a spot onto a (pencil) baseline placed into a (suitable) solvent / water a locating agent is added to the (finished) chromatogram (to reveal spots)	

Topic Chem 2 **Q# 16/** IGCSE Chemistry/2016/w/Paper 41/

1(c)	filtration	1
1(d)	fractional distillation	1 1
1(e)	add / mix / stir / dissolve / shake / heat with water filter / decant heat (filtrate) or (leave filtrate to) evaporate	1 1 1

Mark Scheme for Topic Chem 3 **Q# 17/** IGCSE Chemistry/2018/w/Paper 43/

1(f)	sodium chloride	1

Topic Chem 3 **Q# 18/** IGCSE Chemistry/2018/w/Paper 42/

2(d)(i)	M1 Mg shown with new outer shell with 8 crosses; M2 Both *Cl* atoms with a new outer shell with 7 dots and 1 cross; M3 '2+' charge on Mg **and** '–' charge on each *Cl*;	3
2(d)(ii)	M1 *Physical constants mark* High melting point or high boiling point M2 *Solubility mark* Dissolve in water M3 *Electrical conductivity mark* Conduct (electricity) when molten **or** conduct (electricity) in aqueous solution	3

Topic Chem 3 **Q# 19/** IGCSE Chemistry/2018/w/Paper 41/

4(c)(ii)	**M1** one shared pair between each H and S	1
	M2 four unpaired electrons on S giving S a total of 8 outer shell electrons and no other unpaired electrons	1
4(c)(iii)	**M1** weak (attractive) forces **OR** (attractive) forces need little energy to overcome	1
	M2 forces between molecules / intermolecular	1

Topic Chem 3 **Q# 20/** IGCSE Chemistry/2018/w/Paper 41/

2(a)	**M1** 11 **M2** 18 **M3** 2.8.8 **M4** –1	4
2(b)	A **and** B	1

Topic Chem 3 **Q# 21/** IGCSE Chemistry/2018/s/Paper 43/

4(b)	all bonding pairs correct and no extra incorrect non-bonding electrons	1
	4 non-bonding electrons on O completing oxygen octet	1

Topic Chem 3 **Q# 22/** IGCSE Chemistry/2018/s/Paper 43/

2(a)(i)	similarities: number of protons **and** electrons	1
	differences: number of neutrons	1
2(a)(ii)	nucleons: 27	1
	neutrons: 14	1
	electrons: 10	1

Topic Chem 3 **Q# 23/** IGCSE Chemistry/2018/s/Paper 42/

2(a)	silicon / Si	1

Topic Chem 3 **Q# 24/** IGCSE Chemistry/2018/s/Paper 42/

4(a)	$2K(s) + Br_2(l) \rightarrow 2KBr(s)$ 1 mark for formulae all correct 1 mark for balancing 1 mark for state symbols	3
4(b)(i)	(ionic): made of, positive and negative ions / anions and cations / oppositely charged ions / unlike charged ions / different charged ions	1
	(lattice): regular / sequence / pattern / alternating / repeated / framework / ordered / organised / network / uniform	1
4(b)(ii)	(in solid) ions don't move	1
	(when molten) ions move / ions mobile	1

4(d)(i)	$I_2 + ICl_2 \rightarrow 2ICl$ 1 mark for formulae all correct 1 mark for correct balancing	2
4(d)(ii)	one bonding pair	1
	6 non-bonding electrons on each atom	1
4(e)	(potassium bromide): ionic bonds / attraction between ions	1
	(iodine monochloride): intermolecular forces / forces between molecules / named intermolecular forces, e.g. van der Waals / London forces / dispersion forces / dipole- dipole	1
	bonds in KBr are stronger / need more energy to break bonds / ORA	1

Topic Chem 3 **Q# 25/** IGCSE Chemistry/2018/s/Paper 42/

3	particles	number of protons	number of electrons	number of neutrons	number of nucleons	6
				12 (1)	
		17 (1)	18 (1)		37 (1)
	Fe (1) 2+ (1)				

Topic Chem 3 **Q# 26/** IGCSE Chemistry/2018/s/Paper 41/

1(a)	a substance made from two (or more) **elements**	1
	chemically combined	1

Topic Chem 3 **Q# 27/** IGCSE Chemistry/2018/s/Paper 41/

2(d)(i)	radioisotopes	1
2(d)(ii)	^{286}Fl 114p 172n 114e	1
	^{289}Fl 114p 175n 114e	1
2(e)(i)	any **two** from: high melting point / boiling point hard dense conduct electricity conduct heat ductile / malleable sonorous lustrous / shiny	2
2(e)(ii)	basic (oxide)	1

Topic Chem 3 **Q# 28/** IGCSE Chemistry/2018/m/Paper 42/

1(a)(ii)	M1 **C** M2 **D**	2

Topic Chem 3 **Q# 29/** IGCSE Chemistry/2018/m/Paper 42/

2(a)(i)	M1 correct orientation of '+' and '–' on front four ions M2 rest of structure	2
2(a)(ii)	18	1
2(a)(iii)	Ne or Neon	1

Topic Chem 3 **Q# 30/** IGCSE Chemistry/2018/m/Paper 42/

1(b)(i)	a shared **pair** of electrons (between two atoms) M1 shared electrons M2 pair of / two electrons	2
1(b)(ii)	M1 three correct bonding pairs from one N atom to each of three F atoms M2 (3 pairs of) non-bonding electrons on each of three F atoms to complete an octet M3 (1 pair of) non-bonding electrons on N atom to complete an octet	3

Topic Chem 3 **Q# 31/** IGCSE Chemistry/2017/w/Paper 43/

3(c)(i)	positive ions / cations	1
	sea of electrons / mobile electrons / delocalised electrons / moving electrons / flowing electrons	1
	attraction between positive ions and electrons	1
3(c)(ii)	layers / rows / sheets of ions	1
	slide / slip / shift (over each other or past each other)	1

Topic Chem 3 **Q# 32/** IGCSE Chemistry/2017/w/Paper 43/

2(a)(i)	(two or more) **atoms**	1
	combined / joined / sharing electrons (by a covalent bond) / bonded	1
2(a)(ii)	substance that cannot be split up / broken down / decomposed (into anything simpler) OR (substance) made of **atoms** with the same atomic number / number of protons / proton number	1
2(b)(i)	10	1
2(b)(ii)	22	1
2(b)(iii)	A **AND** B	1
2(b)(iv)	A **AND** B	1
2(b)(v)	C **AND** D	1
2(c)		3

	number of protons	number of electrons
Na	11	11
S^{2-}	16	18
Cl_2	34	34

Topic Chem 3 **Q# 33/** IGCSE Chemistry/2017/w/Paper 43/

1(b)	element	1
1(d)	mixture	1

Topic Chem 3 **Q# 34/** IGCSE Chemistry/2017/w/Paper 42/

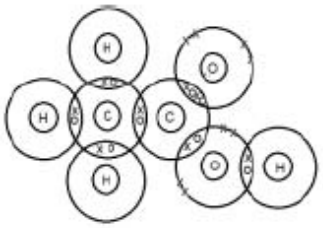
2(a)	*Si*: 2: 8 : 4	1
	Ca^{2+}: 2 : 8: 8	1
	N^{3-}: 2 : 8	1
2(b)	Ca_3N_2	1
2(c)	Li shown as having one shell with 2 electrons OR no electrons OR no outer shell	1
	Cl shown as having an outer shell of 7 electrons of one type, plus one different electron which matches Li electrons	1
	'+' charge on Li **AND** '–' charge on *Cl*	1
2(d)	two shared pairs of electrons	1
	both *Cl* with complete outer shells	1
	S with complete outer shell	1
2(e)	SCl_2 has intermolecular forces (of attraction)	1
	LiCl has (electrostatic) forces (of attraction) between ions	1
	intermolecular forces are weaker / less energy is needed to break intermolecular forces	1
2(f)	silicon(IV) oxide	1

Topic Chem 3 **Q# 35/** IGCSE Chemistry/2017/w/Paper 41/

6(b)(i)	oxide ion has an outer shell with six dots and two crosses	1
	oxide ion has a charge of 2^-	1

6(b)(ii)	(electrostatic) forces of attraction between ions	1
	(are) strong OR require lots of energy to overcome	1

Topic Chem 3 **Q# 36/** IGCSE Chemistry/2017/w/Paper 41/

4(c)(ii)	 **M1** all shared pairs of electrons correct for single bonds **M2** 2 shared pairs of electrons for the C=O bond **M3** total of 8 electrons on each O including 4 non-bonding electrons and no additional non-bonding electrons	3

Topic Chem 3 **Q# 37/** IGCSE Chemistry/2017/w/Paper 41/

Question	Answer	Marks
1(a)(i)	B	1
1(a)(ii)	A	1
1(a)(iii)	C	1
1(a)(iv)	E	1
1(b)	O^{2-} **M1** O **M2** $^{2-}$	2

Question	Answer	Marks
2(a)(i)	**S**	1
2(a)(ii)	**S**	1
2(a)(iii)	**V**	1
2(b)	any value in the range 130–145 °C	1
2(c)	sublimation	1
2(d)(i)	Brownian motion	1
2(d)(ii)	nitrogen / oxygen / carbon dioxide / air molecules hit / bombard the smoke particles	1
	(the bombarding particles) move randomly	1

Topic Chem 3 **Q# 38/** IGCSE Chemistry/2017/s/Paper 43/

2(c)	(attractive) forces between molecules	1
	(forces of attraction) are stronger in iodine	1

Topic Chem 3 **Q# 39/** IGCSE Chemistry/2017/s/Paper 43/

3(a)	regular arrangement / lattice of positive ions / magnesium ions / Mg^{2+} ions	1
	sea of electrons OR delocalised electrons	1
	attraction between (positive) ions and (delocalised / sea of) electrons	1
3(b)	electrons	1
	move / flow (throughout / through the structure)	1
3(c)	layers (of atoms or ions)	1
	layers / atoms / ions can slide / slip / glide (over each other) (without breaking the metallic bonds)	1
3(d)(i)	magnesium shown as (2, 8) using crosses	1
	sulfide shown as (2, 8, 8), with the two gained electrons in the outer shell of sulfur shown as crosses and all other electrons on sulfur shown as dots	1
	magnesium ion charge as 2^+ **AND** sulfide charge as 2^-	1
3(d)(ii)	melt / fused	1
	ions can move OR are mobile	1

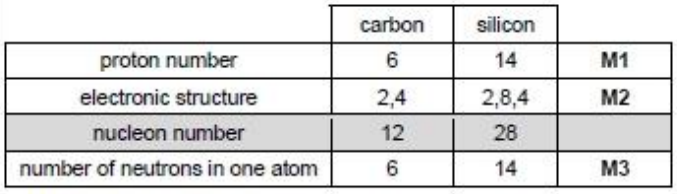
Topic Chem 3 **Q# 40/** IGCSE Chemistry/2017/s/Paper 43/

1(a)(i)	J	1
1(a)(ii)	E	1
1(a)(iii)	D	1
1(a)(iv)	J	1
1(a)(v)	L	1
1(a)(vi)	D	1
1(b)(i)	(atoms with) same **number** of protons / atomic number / of same element	1
	different **number** of neutrons / different mass number / different nucleon number	1
1(b)(ii)	E AND G	1
1(b)(iii)	they have the same number of electrons in their outer shell	1

Topic Chem 3 **Q# 41/** IGCSE Chemistry/2017/s/Paper 42/

1(b)(i)	(substance that) cannot be split up / broken down into (two or more) simpler substances by chemical means OR (substance) made of **atoms** with the same atomic number / number of protons / proton number	1
1(b)(ii)	(two or more) **elements** joined or combined or bonded (together)	1
1(b)(iii)	(particle) containing different numbers of protons and electrons OR atom or group of atoms that has gained or lost an electron / electrons	1

Topic Chem 3 **Q# 42/** IGCSE Chemistry/2017/s/Paper 42/

Question	Answer	Marks
2(a)	atoms of the same element / atoms with the same proton number / atoms with the same atomic number	1
	different neutron **number** / different nucleon **number** / different mass number	1
2(b)		3
2(c)(i)	covalent	1
2(c)(ii)	award 1 mark for each correct property and one mark for each correct matching reason.	4
	property: high melting point / high boiling point reason: bonds between atoms are strong OR covalent bonds are strong / **bonds** need large amount of energy to break	
	property: non-conductor / poor conductor(of electricity) / insulator reason: no moving charged particles / no moving ions / no moving electrons / all (outer shell) electrons used in bonding	
	property: hard reason: bonds between atoms are strong OR covalent bonds are strong	
	property: brittle reason: bonds between atoms are strong OR covalent bonds are strong / bonds are directional	
	property: insoluble reason: does not form hydrogen bonds with water / no ions that can be hydrated	
2(d)(i)	incomplete combustion / incomplete burning / combustion in insufficient air / oxygen	1
	of **fossil** fuels / named fossil fuel / named petroleum fraction / name or formula of a type of substance containing carbon	1
2(d)(ii)	toxic / poisonous / combines with or binds to haemoglobin	1

2(e)(i)	carbon dioxide: (simple) molecular / simple covalent	1
	silicon(IV) dioxide: macromolecular / giant molecular / giant covalent / giant atomic	1
2(e)(ii)	carbon dioxide: **weak (force of) attraction between** molecules / **weak** intermolecular forces / **weak** van der Waals' forces / **weak** dispersion forces / **weak** London forces	1
	silicon(IV) dioxide: covalent bonds are **strong** / force of attraction between atoms is **strong** / no weak bonds (are present) / **all** bonds are **strong**	1
	(weak) forces of attraction in carbon dioxide need small amounts of **energy** or heat to break / **less energy** or heat needed to break **forces of attraction** in carbon dioxide **OR** **(strong) bonds** in silicon(IV) dioxide need large amounts of **energy** or heat to break / **more energy** or heat needed to break **bonds** in silicon(IV) dioxide	1

Topic Chem 3 **Q# 43/** IGCSE Chemistry/2017/s/Paper 41/

1(a)	*proton number*: the number of protons	1
	nucleon number: the total number of protons and neutrons	1
	nucleon number: in the nucleus / nuclei (of an atom)	1
1(b)	(hydrogen is the only atom to have) no neutrons	1
1(c)		

	number of protons	number of neutrons	number of electrons
^{19}F	9	10	9
^{26}Mg	12	14	12
$^{31}P^{3-}$	15	16	18
$^{87}Sr^{2+}$	38	49	36

	fluorine protons **AND** neutrons correct	1
	magnesium neutrons **AND** electrons correct	1
	phosphorus protons **AND** neutrons correct	1
	phosphorus electrons correct	1
	strontium protons **AND** neutrons correct	1
	strontium electrons correct	1
1(d)(i)	MgF_2	1
1(d)(ii)	Sr_3P_2	1

Topic Chem 3 **Q# 44/** IGCSE Chemistry/2017/m/Paper 42/

3(e)(ii)	**M1** weak forces (of attraction)	1
	M2 between molecules / intermolecular	1

Topic Chem 3 **Q# 45/** IGCSE Chemistry/2016/w/Paper 43/

Question	Answer	Marks
2(a)	2,2 / 2.2	1
2(b)	BeO	1
2(c)(i)	positive ions / cations labelled or named in text electrons labelled or named in text attraction between positive ions and negative electrons	1 1 1
2(c)(ii)	(conduction due to) moving electrons / mobile electrons	1

Topic Chem 3 **Q# 46/** IGCSE Chemistry/2016/w/Paper 43/

Question	Answer	Marks
1(a)	proton +1 1 neutron 0 1 electron –1 $^1/_{1840}$	2
1(b)(i)	(same) number of protons and electrons / 6 protons and six electrons (different) neutron (number) / 6,7 and 8 neutrons	2 1
1(b)(ii)	same number of electrons / electron configuration	1
1(c)	diamond *and* graphite	1
1(d)	two double bonds with no extra electrons on the carbon atoms both oxygen atoms with four non-bonding electrons	1 1

Topic Chem 3 **Q# 47/** IGCSE Chemistry/2016/w/Paper 43/

4(a)	*silicon(IV) oxide*: covalent *sodium chloride*: ionic / electrovalent	1 1
4(b)	giant molecular / macromolecular / giant covalent / giant atomic	1
4(c)(i)	**M1** (covalent) bonds are strong **M2** a lot of heat or energy is needed to break / weaken / overcome bonds OR there are no weak bonds OR there are no intermolecular forces OR covalent bonds are the only bonds OR strong bonds are the only bonds	2
4(c)(ii)	(it has) no moving ions / no moving electrons / all electrons are used in bonding / no moving charged particles	1
4(d)	(sodium chloride contains) ions / is ionic in the solid ions are not moving / they are in fixed positions ions can move when molten	1 1 1

Topic Chem 3 **Q# 48/** IGCSE Chemistry/2016/w/Paper 42/

2(a)	(total) number of protons and neutrons in a nucleus (of an atom)	2
2(b)	Na 2 : 8 : 1 P^{3-} 2 : 8 : 8	2
2(c)	radiotherapy OR treatment of cancer	1
2(d)	average mass of (naturally occurring) atom(s) (of an element) (compared to an atom of) ^{12}C	2
2(e)	chlorine must have more than one isotope the masses of these isotopes / (any given) mass numbers are averaged	2
2(f)	lattice of labelled Al^{3+} ions electrons seen on the diagram between the ions attraction between (positive) ions and (sea of / delocalised) electrons	3

Topic Chem 3 **Q# 49/** IGCSE Chemistry/2016/w/Paper 41/

1(a)	H	1
1(b)	G	1
1(f)	electrons (electrons) move / flow (throughout structure)	1 1

Topic Chem 3 **Q# 50/** IGCSE Chemistry/2016/s/Paper 43/

6(c)(i)	covalent;	1
6(c)(ii)	**M1** one shared pair of electrons between each N and H; **M2** one shared pair of electrons between the N atoms; **M3** one lone pair on each N and no additional electrons anywhere;	3 1 1 1
6(d)(i)	amide;	1

Topic Chem 3 **Q# 51/** IGCSE Chemistry/2016/s/Paper 43/

Question	Answer	Marks
4(a)(i)	**M1** movement of electron(s) from potassium to iodine; **M2** one electron transferred;	2 1 1
4(a)(ii)	**M1** regular arrangement/(giant) lattice of alternating; **M2** positive potassium ions/ K^+ **and** negative iodide ions/ I^-;	2 1 1
4(a)(iii)	**M1** strong (forces of) attraction (between oppositely charged ions) / ionic bonds are strong; **M2** which require lots of energy to overcome/ break;	2 1 1

Topic Chem 3 **Q# 52/** IGCSE Chemistry/2016/s/Paper 42/

1(a)(i)	nitrogen/ oxygen / fluorine / neon;	1
1(a)(v)	neon;	1
1(a)(vi)	carbon;	1
1(b)(i)	B_2O_3;	1
1(b)(ii)	Li_3N;	1

Topic Chem 3 **Q# 53/** IGCSE Chemistry/2016/s/Paper 42/

3(a)(i)	**M1** positive ions/cations (labelled or named in text); **M2** electrons (labelled or named in text); **M3** attraction between positive and negative;	3 1 1 1
3(a)(ii)	(conduction due to) movement of electrons / mobile electrons;	1
3(b)	$GaCl_3$; $Ga_2(SO_4)_3$;	2 1 1

Topic Chem 3 **Q# 54/** IGCSE Chemistry/2016/s/Paper 42/

2(a)(i)	number of protons in one atom of an element;	1
2(a)(ii)	**M1** number of protons and neutrons in one atom of an element; **M2** in one atom of an element;	2 1 1
2(b)		6

A	6	6	6	$^{12}_{6}C$
B	12	12	12	$^{24}_{12}Mg$;
C	8	10;	8;	$^{16}_{8}O^{2-}$
D	11	10	13	$^{24}_{11}Na^{+}$ 11, 24; Na;+;

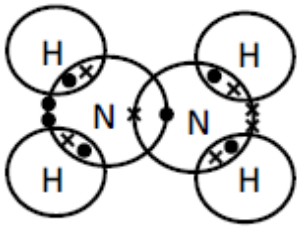
Topic Chem 3 **Q# 55/** IGCSE Chemistry/2016/s/Paper 41/

2(d)(i)	covalent;	1
2(d)(ii)	any 2 from: high melting point/high boiling point; poor conductor (of electricity); hard; insoluble;	2
2(e)(i)	**M1** (electrostatic) attraction; **M2** between oppositely charged ions;	2 1 1
2(e)(ii)	$Ca_3(PO_4)_2$;	1

Topic Chem 3 **Q# 56/** IGCSE Chemistry/2016/s/Paper 41/

Question	Answer	Marks
1(a)	<table><tr><th>particle</th><th>relative mass</th><th>relative charge</th></tr><tr><td>proton</td><td>1</td><td>+1</td></tr><tr><td>neutron</td><td>1</td><td>nil</td></tr><tr><td>electron</td><td>1/1840</td><td>–1</td></tr></table>	3
1(b)(i)	**M1** atom(s) of the same element; **M2** with different number of neutrons;	2 1 1
1(b)(ii)	**M1** (both have) the same number of electrons; **M2** in the outer shell;	2 1 1
1(c)	<table><tr><th>particle</th><th>number of protons</th><th>number of neutrons</th><th>number of electrons</th></tr><tr><td>$^{7}_{3}Li$</td><td>3</td><td>4</td><td>3</td></tr><tr><td>$^{34}_{16}S^{2-}$</td><td>16</td><td>18</td><td>18</td></tr><tr><td>$^{41}_{19}K^{+}$</td><td>19</td><td>22</td><td>18</td></tr></table>	5

Topic Chem 3 **Q# 57/** IGCSE Chemistry/2016/m/Paper 42/

5(b)	 **M1** all shared electrons correct (5 bonds); **M2** exactly two non-bonding electrons on each N and no additional non-bonding electrons;	2

Topic Chem 3 **Q# 58/** IGCSE Chemistry/2016/m/Paper 42/

6(a)	S_2^{2-}; **or** S^{-};	1
6(b)	test conductivity; gold conducts/ora; **or** malleability/hit with a hammer; gold malleable/only gold produces ringing sound/ora; **or** density; gold denser/ora; **or** add acid/any named/formula of acid; gold does not react (ignore products with pyrites)/ora; **or** heat (both strongly) in air/oxygen; iron pyrite reacts (ignore products); **or** melting point; gold lower/ora; **or** heat with a more reactive metal than iron; gold does not react/ora;	2

Topic Chem 3 **Q# 59/** IGCSE Chemistry/2016/m/Paper 42/

1(a)	B = 17; C = 18; D = 2,8; 2^- / $^-2$;	**4**
1(b)	Substance that cannot be broken down into anything simpler / substance that cannot be broken down (by chemical means) / substance containing **atoms** with the same atomic number or proton number;	**1**
1(c)	<table><tr><th>number of protons</th><th>number of neutrons</th><th>number of electrons</th></tr><tr><td>31</td><td>38</td><td>31</td></tr><tr><td>31</td><td>40</td><td>31</td></tr></table> **M1** column one; **M2** column two; **M3** column three;	**3**

Topic Chem 3 **Q# 60/** IGCSE Chemistry/2016/m/Paper 42/

3(a)	<table><tr><td>CO_2;</td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td>solid;</td></tr><tr><td></td><td>poor conductor / non-conductor;</td></tr><tr><td>simple molecular / simple (covalent);</td><td></td></tr></table>	**4**
3(b)(i)	covalent;	**1**
3(b)(ii)	all bonds are (very) strong or bonds; **or** bonds need a lot of energy or heat to break; **or** (there are) no weak bonds / no (weak) intermolecular forces;	**1**
3(b)(iii)	weak forces between molecules; **or** weak intermolecular forces or weak van der Waals' forces; **or** low amount of energy needed to break intermolecular / van der Waals' forces;	**1**
3(b)(iv)	no (moving) ions / no mobile or moving electrons / all electrons used in bonding / made of uncharged molecules;	**1**

Mark Scheme for Topic Chem 4 **Q# 61/** IGCSE Chemistry/2018/w/Paper 43/

4(a)	**M1** (Mol KOH =) 0.00125 / 1.25 □ 10^{-3} **M2** (Mol H_2SO_4 =) 0.000625 / 6.25 □ 10^{-4} **M3** (Conc H_2SO_4 =) 0.03125 / 3.125 □ 10^{-2} (mol / dm^3)	**3**

Topic Chem 4 **Q# 62/** IGCSE Chemistry/2018/w/Paper 43/

3(a)	[(64 □ 2) + 56 + 119 + (32 □ 4) =] **431**	**1**
3(b)	[(119 / 151) □ 100 =] **78.8 (%)**	**1**
3(c)	SnO_2 because the percentage of tin is **larger** in SnO_2 **or** answer to **(b)** □ 27.6 %	**1**

Topic Chem 4 **Q# 63/** IGCSE Chemistry/2018/w/Paper 42/

3(d)(ii)	M1 0.2 □ 25 / 1000 = 5(.00) □ 10^{-3} or 0.005(00) (mol) M2 5(.00) □ 10^{-3} / 2 = 2.5(.0) □ 10^{-3} or 0.0025(0) (mol) M3 2.5(.0) □ 10^{-3} □ 1000 / 20 = 0.125 (mol / dm^3) M4 0.125 □ 98 = 12.25 (g / dm^3)	**4**
3(e)	M1 Mol $FeSO_4$ = 15.2 / 152 = 0.1(00) M2 Expected mol of Fe_2O_3 = 0.1 / 2 = 0.05(00)) **or** Actual mol of Fe_2O_3 = 4.80 / 160= 0.03(00) M3 Percentage yield = 100 □ 0.03(00) / 0.05(00) = 60%	**3**

Topic Chem 4 **Q# 64/** IGCSE Chemistry/2018/w/Paper 42/

1(c)	$4X + O_2 \rightarrow 2X_2O$ M1 Species M2 Balance	2

Topic Chem 4 **Q# 65/** IGCSE Chemistry/2018/w/Paper 41/

4(d)(i)	0.003	1
4(d)(ii)	0.006	1
4(d)(iii)	30	1

Topic Chem 4 **Q# 66/** IGCSE Chemistry/2018/w/Paper 41/

3(c)(i)	**M1** 188 **M2** (18.8 / 188) = 0.1(00)	2
3(c)(ii)	0.05	1
3(c)(iii)	1200	1

Topic Chem 4 **Q# 67/** IGCSE Chemistry/2018/s/Paper 43/

3(f)	3+	1

Topic Chem 4 **Q# 68/** IGCSE Chemistry/2018/s/Paper 43/

6(a)(i)	74	1
	0.12	1
6(a)(ii)	0.3	1
6(a)(iii)	0.02	1
6(a)(iv)	207	1
	4.14	1
6(a)(v)	75%	1

Topic Chem 4 **Q# 69/** IGCSE Chemistry/2018/s/Paper 42/

4(a)	$2K(s) + Br_2(l) \rightarrow 2KBr(s)$ 1 mark for formulae all correct 1 mark for balancing 1 mark for state symbols	3

Topic Chem 4 **Q# 70/** IGCSE Chemistry/2018/s/Paper 42/

7(a)	60 / 12 :13.33 / 1 : 26.67 / 16 or evaluation 5 : 13.33 : 1.67 or 3:8:1	1
	C_3H_8O	1
7(b)	$(C_2H_4O =)$ 44	1
	$C_4H_8O_2$	1

Topic Chem 4 **Q# 71/** IGCSE Chemistry/2018/s/Paper 41/

4(a)	relative atomic mass	1
4(b)	C_4H_{10} is covalent	1
	KF is ionic	1
4(c)	mol of Y = 0.060 / 24.0 = 2.5 □ 10^{-3} or 0.0025	1
	M_r = 0.095 / 2.5 □ 10^{-3} = 38(.0)	1
	fluorine	1
4(d)	mass of O = 3.87 g – 1.68 g = 2.19 (g)	1
	mol of P 1.68 / 31 OR 0.054.. and mol of O 2.19 / 16 **OR** 0.13...	1
	ratio of P to O P = 0.054... / 0.054 = 1 = 2.5 O = 0.13... / 0.054...	1
	whole number ratio and P_2O_5 = 2 = 5	1

4(e)	the formula is P_4O_6 or (one mole of) P_2O_3 = 110 (g)	1
	mass = 220 (g)	1

Topic Chem 4 **Q# 72/** IGCSE Chemistry/2018/m/Paper 42/

4(b)(i)	M1 (moles of NH_3 = 0.68 / 17 =) 0.04(00) M2 (M1 × 3 / 2 =) 0.06(00) M3 (volume of Cl_2 = 0.06(00) × 24000 =) 1440 (cm^3)	3

Topic Chem 4 **Q# 73/** IGCSE Chemistry/2018/m/Paper 42/

3(c)		Mg	Si	O	2
	M1 OR	2.73 / 24 0.11375	1.58 / 28 0.0564	3.60 / 16 0.23(0)	
	M2	0.0.11375 / .0564	0.0564 / .0564	0.230 / .0564	leading to Mg_2SiO_4

Topic Chem 4 **Q# 74/** IGCSE Chemistry/2018/m/Paper 42/

2(c)(iv)	M1 (moles of NaCl = 0.20 × 20 ÷ 1000 =) 4(.00) × 10^{-3} or 0.004(00) M2 (M_r of $NaNO_3$ =) 85 M3 (85 × 4(.00) × 10^{-3} =) 0.34 (g) M4 (0.34 × 90 / 100 =) 0.306 (g) OR 0.31 (g)	4

Topic Chem 4 **Q# 75/** IGCSE Chemistry/2017/w/Paper 42/

5(b)(i)	210 cm^3 **M1** expected volume of hydrogen = 300 cm^3 **M2** 70% of **M1**	2

Topic Chem 4 **Q# 76/** IGCSE Chemistry/2017/w/Paper 41/

7(b)(i)	0.075 If full credit is not awarded, allow 1 mark for M_r of CuO = 80	2
7(b)(ii)	0.05	1
7(b)(iii)	4 (g) **M1** moles copper(II) oxide that reacted = (0.05 / 2) = 0.025 mol **M2** mass copper(II) oxide = ((0.075 – 0.025) □ 80) = 4 g	2
7(c)	CuH_4O_2 **M1** 41.52 / 35.5; 37.43 / 64; 2.34 / 1; 18.71 / 16 OR 1.17 : 0.58 : 2.34 : 1.17 **M2** appropriate scaling to give whole number ratios	2

Topic Chem 4 **Q# 77/** IGCSE Chemistry/2017/s/Paper 43/

6(c)(i)	M_r = 197	1
	(9.85 / 197 =) 0.05 (mol)	1
6(c)(ii)	0.05 (mol)	1
6(c)(iii)	(0.05 × 24) = 1.2 (dm_3)	1
6(c)(iv)	moles of HCl at the start = (250 / 1000 × 1.00) = 0.25	1
	moles HCl in excess = 0.25 – (2 × 0.05) = 0.15 (mol)	1

Topic Chem 4 **Q# 78/** IGCSE Chemistry/2017/s/Paper 42/

5(b)(ii)	0.02 (mol)	1
5(b)(iii)	0.02 (mol)	1
5(b)(iv)	1:2	1
	VCl_2	1

Topic Chem 4 **Q# 79/** IGCSE Chemistry/2017/s/Paper 41/

3(b)(i)	moles of water = 2.52 / 18 = 0.14 (mol)	1
3(b)(ii)	moles of anhydrous magnesium sulfate = 0.02 (mol)	1
3(b)(iii)	ratio = 0.02 / 0.02 : 0.14 / 0.02 = 1 : 7	1

3(b)(iv)	$MgSO_4.7H_2O$ **M1** $MgSO_4$ **M2** rest of the formula correct	2

Topic Chem 4 **Q# 80/** IGCSE Chemistry/2017/s/Paper 41/

5(c)	**M1** moles of carbon dioxide = 180 / 24 000 = 0.0075	1
	M2 molar mass of barium carbonate = 197	1
	M3 mass of barium carbonate = **M1** × **M2** = 1.48 (g)	1
5(f)	360 (cm^3)	1

Topic Chem 4 **Q# 81/** IGCSE Chemistry/2017/m/Paper 42/

7(c)(i)	**M1** 34.61/12 : 61.54/16 : 3.85/1 **OR** 2.885 : 3.846 : 3.85	1
	M2 2.885/2.885 : 3.846/2.885 : 3.85/2.885 **OR** 1 : 1.3(33) : 1.3(33) **OR** 3:4:4	1
	M3 $C_3O_4H_4$	1
7(c)(ii)	relative formula mass / relative molecular mass	1

Topic Chem 4 **Q# 82/** IGCSE Chemistry/2017/m/Paper 42/

2(b)(i)	2^-	1
2(b)(ii)	$2Ag^+ + Cr_2O_7^{2-} \rightarrow Ag_2Cr_2O_7$	1

Topic Chem 4 **Q# 83/** IGCSE Chemistry/2017/m/Paper 42/

6(a)(i)	**M1** (relative formula mass $BaCO_3$ =) 197	1
	M2 (10.0/197 =) 0.0508 (0.0508 alone scores [2])	1
6(a)(ii)	1.22	1
6(b)	2.24	1
6(c)(i)	0.00219	1
6(c)(ii)	**M1** moles HCl = 2 × 0.00219 **OR** correct evaluation of this (= 0.00438)	1
	M2 (0.00438/0.01875) = 0.234 (0.234 alone scores [2])	1

Topic Chem 4 **Q# 84/** IGCSE Chemistry/2016/w/Paper 43/

3(a)	331	1
3(b)(i)	**M1** mol = 6.62 / 331OR 0.02 **M2** 0.02 × 223 = 4.46 (g)	1 1
3(b)(ii)	**M1** mol O_2 = 0.02 ÷ 2 OR 0.01 **M2** vol = 0.01 × 24 = 0.24 (dm^3)	1 1
3(c)	*test:* glowing splint *result:* relights / rekindles	1 1
3(d)(i)	more than enough to react (with all the acid) OR some lead oxide remains after the reaction OR (nitric) acid is limiting	1
3(d)(ii)	solid stops dissolving	1

Topic Chem 4 **Q# 85/** IGCSE Chemistry/2016/w/Paper 42/

5(a)	20 cm^3 **M1** M_r of MnO_2: 87 **M2** moles of MnO_2 used: 3.48 / 87 = 0.04 **M3** moles of HC*l* needed: 0.04 × 4 = 0.16 **M4** volume of HC*l* needed: (0.16 / 8.0) × 1000 **AND** 20 cm^3	4
5(b)(ii)	$Cl_2(g) + 2Br^-(aq) \rightarrow Br_2(aq) + 2Cl^-(aq)$ **M1** (aq) as state symbols for the two products given **M2** correct products **M3** balancing	3
5(e)(i)	I_2O_5 **M1** 76.0 / 127 **AND** 24.0 / 16.0 **M2** 0.59 **AND** 1.5 **OR** 1 **AND** 2.5 **M3** I_2O_5	3

Topic Chem 4 **Q# 86/** IGCSE Chemistry/2016/w/Paper 41/

7(a)	0.025 **M1** 50 / 1000 (=0.05) **M2** (0.05 × 0.5) = 0.025	 1 1
7(b)	0.0125	1
7(c)	0.55 **M1** 44 **M2** 0.55	 1 1
7(d)	0.3	1

Topic Chem 4 **Q# 87/** IGCSE Chemistry/2016/s/Paper 43/

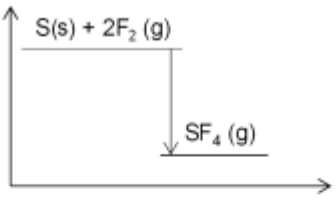
5(a)	carbon dioxide / a gas is made;	1
5(b)(i)	red;	1
5(b)(ii)	0.001;	1
5(b)(iii)	0.0005;	1
5(b)(iv)	0.031 (2 marks) **M1 (iii)** / 0.0162;	2
5(c)	0.48 (dm^3) **M1** moles carbon dioxide = 0.02; **M2** volume carbon dioxide = 0.02 × 24; **M3** = 0.48 (dm^3);	3 1 1 1

Topic Chem 4 **Q# 88/** IGCSE Chemistry/2016/s/Paper 42/

Question	Answer	Marks
5(a)(i)	more than enough to react (with all the hydrocarbon); **OR** (some) oxygen remaining;	1
5(a)(ii)	75 cm^3;	1
5(a)(iii)	2 : 15 : 10;	1
5(a)(iv)	 2 : 15 : 10 : 10; C_5H_{10};	2 1 1

Topic Chem 4 **Q# 89/** IGCSE Chemistry/2016/s/Paper 41/

2(a)	 number of moles of $NaNO_3$ used: 3.40/85 = 0.04(00) (mol) **OR** 4.(00) × 10^{-2} (mol); number of moles of O_2 formed: 0.04/2 = 0.02(00) (mol) **OR** 2.(00) × 10^{-2} (mol); volume of O_2 formed: 0.02 × 24 = 0.48 (dm^3);	3

Question	Answer	Marks
2(f)(i)	 **M1** *exothermic mark*: horizontal product energy line at lower energy than that of reactant energy line; **M2** *label of product mark*: SF_4; **M3** *correct direction of vertical heat of reaction arrow*: arrow must start level with reactant energy and finish level with product energy **and** must have only **one** (correct) arrow-head;	**3** 1 1 1
2(f)(ii)	**M1** *bond energy of $2F_2$*: 2 × F–F = 2 × 160 = 320 (kJ/mol); **M2** *bond energy of all bonds in SF_4*: 780 + 320 = 1100 (kJ/mol); **M3** *calculated bond energy of SF_4 divided by 4*: 1100/4 = 275 (kJ/mol);	**3** 1 1 1
2(g)(i)	kills bacteria;	**1**
2(g)(ii)	name of compound: cobalt(II) chloride; from: blue; to: pink;	**3** 1 1 1
2(h)(i)	it has a complete outer shell/a full outer shell/8 electrons in the outer shell;	**1**
2(h)(ii)	(in) lamps;	**1**

Topic Chem 4 **Q# 90/** IGCSE Chemistry/2016/m/Paper 42/

7(b)(i)	mol C = 54.54 / 12 or 4.5(45) **and** mol H = 9.09 / 1 or 9.09 **and** mol O = 36.37 / 16 or 2.27; C_2H_4O;	**2**
7(b)(ii)	M_r of C_2H_4O = 44; 88 / 44 = 2 therefore $C_4H_8O_2$;	**2**

Topic Chem 4 **Q# 91/** IGCSE Chemistry/2016/m/Paper 42/

4(c)(i)	0.002 (mol);	**1**
4(c)(ii)	0.001 (mol);	**1**
4(c)(iii)	0.024 (dm^3);	**1**
4(c)(iv)	no change / no effect;	**1**
4(c)(v)	0.048 (dm^3);	**1**

Mark Scheme for Topic Chem 5 **Q# 92/** IGCSE Chemistry/2018/w/Paper 43/

2(a)(i)	**M1** breakdown of an ionic **compound** when molten or in aqueous solution **M2** (using) electricity / electric current	**2**
2(a)(ii)	**M1** electron(s) **M2** ion(s)	**2**
2(b)(i)	**M1** inert / unreactive **M2** conducts **electricity**	**2**
2(b)(ii)	<table><tr><td>observation at anode(+)</td><td>name of product at anode(+)</td><td>observation at cathode(–)</td><td>name of product at cathode(–)</td></tr><tr><td>**M1** green / yellow bubbles</td><td>**M2** chlorine</td><td></td><td>**M3** hydrogen</td></tr><tr><td></td><td>**M4** oxygen</td><td>**M5** pink / brown solid</td><td>**M6** copper</td></tr></table>	**6**

Topic Chem 5 **Q# 93/** IGCSE Chemistry/2018/s/Paper 43/

1(c)	Cu / copper	**1**

Topic Chem 5 **Q# 94/** IGCSE Chemistry/2018/s/Paper 43/

5(a)	14.01/59 : 60.33/127 : 2.85/1 : 22.81/16 **OR** 0.237 : 0.475 : 2.85 : 1.43	**1**
	$NiI_2H_{12}O_6$	**1**
5(b)(i)	electrons	**1**
5(b)(ii)	(positive and negative) ions	**1**
5(b)(iii)	nickel	**1**
	iodine	**1**
	$Ni^{2+} + 2e^- \rightarrow Ni$ **OR** $2I^- \rightarrow I_2 + 2e^-$	**1**
5(c)(i)	copper formed/copper deposited	**1**
5(c)(ii)	oxygen	**1**
5(c)(iii)	copper removed or copper lost **or** copper forms ions	**1**
5(c)(iv)	any **three** from: (apparatus **A**): solution becomes paler/fades in **A** (apparatus **B**): solution stays the same colour in **B** (explanation): copper ions removed (but not added) copper ions not replaced in **A** **OR** copper ions both removed and added (at the same rate) copper ions are being replaced (continually)	**3**

Topic Chem 5 **Q# 95/** IGCSE Chemistry/2018/s/Paper 42/

4(c)(i)	substance that conducts electricity / (undergoes) electrolysis	**1**
	decomposed / chemically changed **OR** molten or liquid or solution or aqueous **AND** containing ions/or ionic	**1**
4(c)(ii)	$2H^+ + 2e(^-) \rightarrow H_2$ 1 mark for $H^+ + e(^-)$ as the only species on the left 1 mark for equation fully correct 1 mark for bromine at the anode 1 mark for potassium hydroxide	**4**
4(c)(iii)	potassium	**1**

Topic Chem 5 **Q# 96/** IGCSE Chemistry/2018/s/Paper 42/

2(b)	aluminium / *Al*	**1**

Topic Chem 5 **Q# 97/** IGCSE Chemistry/2018/s/Paper 41/

5(e)(i)	$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ 1 mark for any equation which has Cu as the product or Cu^{2+} ions on left 1 mark for correct species 1 mark for correct state symbols	**3**
5(e)(ii)	(a pink / brown) solid / deposit forms	**1**
5(e)(iii)	bubbles / fizzing (at the anode)	**1**
	solution becomes paler / less blue / colourless	**1**
5(e)(iv)	a green gas would be seen (on the anode)	**1**

Topic Chem 5 **Q# 98/** IGCSE Chemistry/2018/m/Paper 42/

2(b)(i)	M1 breakdown of an ionic compound when molten or in aqueous solution M2 (by the passage of) electricity / electric current / electrical energy	2
2(b)(ii)	hydrogen chlorine sodium hydroxide	3
2(b)(iii)	$2H^+(aq) + 2e^- \rightarrow H_2(g)$ M1 H^+ on left hand side with e^- added M2 fully correct equation	2

Topic Chem 5 **Q# 99/** IGCSE Chemistry/2017/w/Paper 43/

4(b)(i)	oxidation	1
4(c)	$2H_2 + O_2 \rightarrow 2H_2O$	1
4(f)	electrolysis	1

Topic Chem 5 **Q# 100/** IGCSE Chemistry/2017/w/Paper 42/

4(a)	the breakdown (into elements)	1
	of an (ionic) compound by (the passage of) electricity	1
4(b)(i)	oxygen	1
4(b)(ii)	**glowing** splint	1
	relights	1
4(b)(iii)	$2H^+ + 2e^- \rightarrow H_2$ **M1** gain of electrons by H^+ **M2** rest of equation	2
4(c)	*the wires:* electrons	1
	the electrolyte: ions	1
4(d)	any 2 from: □ green gas at positive electrode □ bulb is brighter □ rate of bubbles increases	2

Topic Chem 5 **Q# 101/** IGCSE Chemistry/2017/s/Paper 43/

Question	Answer	Marks
5(a)(i)	loss (of electrons)	1
5(a)(ii)	$Ni \rightarrow Ni^{2+} + 2e^-$	1
5(a)(iii)	goes down / gets less / decreases / lower / smaller	1

Topic Chem 5 **Q# 102/** IGCSE Chemistry/2016/w/Paper 43/

4(e)(i)	*product at the positive electrode:* chlorine *product at the negative electrode:* hydrogen	1 1
4(e)(ii)	$2H^+ + 2e(^-) \rightarrow H_2$ OR $2H_3O^+ + 2e(^-) \rightarrow H_2 + 2H_2O$	1
4(f)	oxygen	1
4(g)(i)	sodium	1
4(g)(ii)	$Na^+ + e(^-) \rightarrow Na$	1

Topic Chem 5 **Q# 103/** IGCSE Chemistry/2016/w/Paper 41/

5(a)	(gas) oxygen (test) glowing splint (result of test) relights	1 1 1
5(b)	reference to ions / ionic ions cannot move in solid OR are in fixed positions in solid ions can move when in solution	1 1 1
5(c)(i)	copper ions / Cu^{2+} gain of electrons / oxidation number decreases	1 1
5(c)(ii)	any 3 from: anode decreases (in mass) copper removed (from anode) / solid (copper from anode) becomes aqueous cathode increases (in mass) copper deposited / added / Cu^{2+} deposited as Cu (on cathode)	3
5(c)(iii)	copper is both added and removed (at same rate) OR the concentration (of copper ions) does not change	1

Topic Chem 5 **Q# 104/** IGCSE Chemistry/2016/s/Paper 42/

4(e)(i)	**M1** breakdown of an ionic compound when molten or in aqueous solution; **M2** (using) electricity / electric current / electrical energy;	2 1 1
4(e)(ii)	carbon / graphite / platinum;	1
4(e)(iii)	$2H^+ + 2e(^-) \rightarrow H_2$; **OR** $2H_3O^+ + 2e(^-) \rightarrow H_2 + 2H_2O$;	1
4(e)(iv)	cathode / negative electrode;	1
4(f)	$2NaCl + 2H_2O \rightarrow 2NaOH + H_2 + Cl_2$ all formulae correct; balancing;	2
4(g)	**M1** *chlorine*: treating (drinking) water / treating water in swimming pools / kill bacteria in water / chlorination of water / (manufacture of) paper products / plastics / PVC / dyes / textiles / medicines / antiseptics / insecticides / herbicides / fungicides / solvents / paints / disinfectant / bleach / hydrochloric acid; **M2** *sodium hydroxide*: drain cleaner / oven cleaner / extraction of aluminium / purification of bauxite / (manufacture of) biodiesel / paper / soap / detergents / washing powder / textiles / dyes; **M3** *hydrogen*: fuel / rocket fuel / fuel cells / in welding / (manufacture of) ammonia / NH_3 / margarine / methanol / hydrochloric acid / refrigerants;	3 1 1 1

Topic Chem 5 **Q# 105/** IGCSE Chemistry/2016/s/Paper 41/

4(a)(ii)	formation of Cu^{2+} / copper ions at the anode happens at the same rate as; removal of Cu^{2+} / copper ions at the cathode ora;	2 1 1
4(b)	replace (anode of) copper with nickel; replace electrolyte with nickel(II) sulfate / $NiSO_4$;	2 1 1

Mark Scheme for Topic Chem 6 **Q# 106/** IGCSE Chemistry/2018/s/Paper 42/

1(b)	electrolysis	1

Topic Chem 6 **Q# 107/** IGCSE Chemistry/2018/s/Paper 41/

5(a)(i)	(a substance which) increases the rate of a reaction	1
	without being used up (at the end) / remains unchanged or unaffected or without changing mass	1
5(c)(i)	$ZnSO_4$	1
	H_2 written on product line	1
	states (aq) **AND** (g)	1
5(c)(ii)	(labelled) arrow pointing upwards starting level with reactants and finishing level with top of the hump.	1
5(c)(iii)	exothermic **AND** products are at lower energy (than reactants)	1
5(d)	lower hump starting from reactants line	1

Topic Chem 6 **Q# 108/** IGCSE Chemistry/2018/m/Paper 42/

4(b)(ii)	M1 (reactants 2 × 3 × 390 (= 2340) + 3 × 240 (= 720) =) 3060 M2 (products 945 + 6 × 430 (= 2580) =) 3525 M3 M1 – M2	3
4(b)(iii)	**((b)(ii)** is exothermic then) exothermic **and** more energy released than used OR **((b)(ii)** is endothermic then) endothermic **and** less energy released than used	1

Topic Chem 6 **Q# 109/** IGCSE Chemistry/2017/w/Paper 42/

3(a)	*exothermic mark*: horizontal line representing the energy of the products below the energy of the reactants	1
	label of products mark: product line labelled with $2CO_2$ + $3H_2O$	1
	correct direction of vertical heat of reaction arrow: arrow starts level with reactant energy and finishes level with product energy **AND** has (only) **one** arrow head	1
3(b)	activation energy / E_a	1
3(c)	–650 kJ / mol **M1** bonds broken 2 □ ((3 □ 410) + 360 + 460) + (3 □ 500) 2 □ (1230 + 360 + 460) + 1500 2 □ 2050 + 1500 4100 + 1500 = 5600 **M2** bonds formed (2 □ (2 □ 805)) + (4 □ (2 □ 460)) 2 □ 1610 + 4 □ 920 3220 + 3680 = 6900 **M3 = M1 – M2** energy change of reaction = 5600 – 6900 = –1300 **M4 = M3** / 2	4

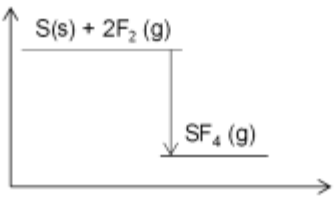
Topic Chem 6 **Q# 110/** IGCSE Chemistry/2017/s/Paper 43/

2(b)(i)	approximately horizontal line draw to right of and below the reagent line	1
	energy change shown starting level with the reactant energy **AND** finishing level with the product energy **AND** having only one (correct) arrow head **AND** labelled ΔH / energy change	1
2(b)(ii)	(energy required to break bonds =) 3624	1
	(energy given out when bonds made =) 3738	1
	–114 (kJ / mol)	1

Topic Chem 6 **Q# 111/** IGCSE Chemistry/2017/m/Paper 42/

Question	Answer	Marks
4(a)(i)	arrow labelled **A** on or near wire going in an anti-clockwise direction	1
4(a)(ii)	arrow labelled **B** in electrolyte pointing towards the cathode	1
4(c)	**M1** anode mass decreases	1
	M2 copper lost as ions **OR** copper (atoms) becomes ions **OR** $Cu \rightarrow Cu^{2+} + 2e^-$	1
	M3 cathode mass increases	1
	M4 copper deposited / layer of copper forms / copper collected at cathode **OR** $Cu^{2+} + 2e^- \rightarrow Cu$	1

Topic Chem 6 **Q# 112/** IGCSE Chemistry/2016/s/Paper 41/

2(f)(i)	 **M1** *exothermic mark*: horizontal product energy line at lower energy than that of reactant energy line; **M2** *label of product mark*: SF_4; **M3** *correct direction of vertical heat of reaction arrow*: arrow must start level with reactant energy and finish level with product energy **and** must have only **one** (correct) arrow-head;	**3** 1 1 1
2(f)(ii)	**M1** *bond energy of $2F_2$*: 2 × F–F = 2 × 160 = 320 (kJ/mol); **M2** *bond energy of all bonds in SF_4*: 780 + 320 = 1100 (kJ/mol); **M3** *calculated bond energy of SF_4 divided by 4*: 1100/4 = 275 (kJ/mol);	**3** 1 1 1

Mark Scheme for Topic Chem 7 **Q# 113/** IGCSE Chemistry/2018/w/Paper 43/

5(a)	**M1** volume of gas **M2** time	**2**
5(b)	**M1** rate decreases / reaction gets slower **M2** concentration of acid decreases **M3** fewer collisions per unit time	**3**
5(c)	**M1** particles have **more** kinetic energy **M2** particles move faster **M3 more** collisions **per unit time** **M4 more** of the particles have energy greater than or equal to activation energy / **more** of the collisions have energy greater than or equal to activation energy **OR** **more** of the particles have sufficient energy to react / **more** of the collisions have sufficient energy to react **OR** A greater percentage or greater proportion or greater fraction of collisions are successful	**4**
5(d)	**ANY TWO FROM:** □ increase concentration of hydrochloric acid □ decrease particle size of calcium carbonate / increase surface area of calcium carbonate □ (add)catalyst	**2**

Topic Chem 7 **Q# 114/** IGCSE Chemistry/2018/w/Paper 43/

1(g)	carbon dioxide	**1**
1(h)	oxygen	**1**

Topic Chem 7 **Q# 115/** IGCSE Chemistry/2018/w/Paper 42/

4(a)(i)	Gradient gets less	**1**
4(a)(ii)	Concentration of HCl is decreasing	**1**
4(a)(iii)	120 seconds	**1**
4(b)	M1 New line steeper than printed line and starts at origin M2 New line reaches same final volume as printed line	**2**

4(c)	M1 **Time** taken is less M2 (particles) have more energy M3 (particles) move faster M4 More collisions (of particles) occur per second / per unit time M5 More (of the) particles / collisions have energy greater than activation energy **or** More (of the) particles / collisions have sufficient energy to react **or** A greater percentage / proportion / fraction of collisions (of particles) are successful	**5**

Topic Chem 7 **Q# 116/** IGCSE Chemistry/2018/w/Paper 41/

5(a)	**M1** forward and back reactions occur at equal rates	**1**
	M2 concentration (of substances) remains constant	**1**
5(b)(i)	equal / same number of moles on each side **or** amount / molecules (of gas) on each side is the same	**1**
5(b)(ii)	**M1** (forward) reaction exothermic **or** reverse reaction endothermic **M2** yield lower at higher temperature **or** (position of) equilibrium moves left at higher temperature ORA	**2**
5(c)(i)	at the start / beginning	**1**
5(c)(ii)	**M1** new line is steeper than printed line and starts at origin	**1**
	M2 new line reaches same final volume as printed line	**1**
5(d)(i)	**M1** Faster **and** More particles per unit volume / dm^3 / cm^3 **M2** More collisions per second / unit time or greater collision rate	**2**
5(d)(ii)	Reaction faster **and** (particles) have more energy **or** (particles) move faster	**1**
	more collisions per second **or** greater collision rate	**1**
	more (of the) particles / collisions have energy greater than the activation energy **or** more particles / collisions have sufficient energy to react **or** a greater percentage / proportion / fraction of collisions are successful	**1**

Topic Chem 7 **Q# 117/** IGCSE Chemistry/2018/w/Paper 41/

4(c)(i)	(oxidation is) loss of electrons	**1**

Topic Chem 7 **Q# 118/** IGCSE Chemistry/2018/s/Paper 43/

3(d)(ii)	any **one** from: increase surface area (of cobalt) powder the metal add a catalyst	**1**
3(d)(iii)	(particles) have more energy / (particles) move faster	**1**
	more collisions per second / greater collision rate	**1**
	more of the colliding molecules have sufficient energy (activation energy) to react	**1**
3(e)(i)	becomes pink / becomes purple	**1**
	equilibrium moves right	**1**
3(e)(ii)	(forward reaction is) exothermic	**1**

Topic Chem 7 **Q# 119/** IGCSE Chemistry/2018/s/Paper 42/

4(f)(i)	$Cl_2 + 2e^- \rightarrow 2Cl^-$	**1**
4(f)(ii)	(bromide ions) lose electrons / donate electrons / are oxidised	**1**

Topic Chem 7 **Q# 120/** IGCSE Chemistry/2018/s/Paper 42/

5(a)	the rate of forward reaction equals (the rate of the) reverse reaction	1
	concentrations of reactants and products are constant	1
5(b)(i)	same number of gas moles on both sides of the equilibrium / same number of gas molecules on both sides of the equilibrium	1
5(b)(ii)	(increased pressure) particles or molecules (forced) closer together / same number of particles or molecules in a smaller volume	1
5(c)(i)	to left / towards reactants / in reverse direction	1
5(c)(ii)	increase / faster	1
	increase / faster	1

Topic Chem 7 **Q# 121/** IGCSE Chemistry/2018/m/Paper 42/

4(c)(i)	ammonia / it is oxidised / oxygen is reduced	1

Topic Chem 7 **Q# 122/** IGCSE Chemistry/2017/w/Paper 43/

5(b)(i)	reversible reaction in which the rate of the forward reaction **equals** the rate of the backward reaction	1
	concentration of all reactants and products becomes constant / does not change	1
5(b)(ii)	forward reaction is endothermic	1
	(increased temperature) causes equilibrium to shift to the right / to shift in the endothermic direction / to form more nitrogen dioxide / to form more product(s)	1
5(b)(iii)	less brown / lighter / paler / colour fades	1
	more molecules / moles / volume on the right ORA OR equilibrium shifts in the direction of fewer molecules / moles / lower volume	1

Topic Chem 7 **Q# 123/** IGCSE Chemistry/2017/w/Paper 42/

5(a)	both colours referred to correctly as observations in both parts of the answer	1
	(if sulfuric acid is added to solution Y,) equilibrium moves to the right-hand side	1
	because the concentration of acid has increased	1
	(if sodium hydroxide is added to solution Y,) equilibrium moves to the left-hand side	1
	because sodium hydroxide reacts with / neutralises sulfuric acid	1
5(b)(ii)	fewer moles / molecules / particles (of gas) on the left-hand side	1
5(b)(iii)	endothermic	1
5(b)(iv)	increases rate (of reaction)	1

Topic Chem 7 **Q# 124/** IGCSE Chemistry/2017/w/Paper 41/Q5

5(c)(i)	becomes paler	1
	equilibrium moves right	1
	(because) fewer moles (of gas) on right	1
5(c)(ii)	equilibrium moved right / more N_2O_4 / less NO_2	1
	(forward) reaction exothermic	1

Topic Chem 7 **Q# 125/** IGCSE Chemistry/2017/w/Paper 41/

3(a)(i)	brown / orange solid (forms / is made) OR solution becomes paler / colourless	1
3(a)(ii)	magnesium is oxidised **AND** copper ions are reduced OR magnesium loses electrons **AND** copper ions gain electrons OR magnesium increases in oxidation number **AND** copper decreases in oxidation number	1
3(a)(iii)	Cu^{2+} OR copper(II) ions OR copper ions	1
	gains electrons	1

Topic Chem 7 **Q# 126/** IGCSE Chemistry/2017/w/Paper 41/

7(a)(i)	more particles (of acid) in a given volume / dm^3 / cm^3	1
	more collisions per second / unit time OR greater collision rate	1
7(a)(ii)	particles have more energy / particles move faster / more collisions per second / more collisions per unit time / greater collision rate	1
	more (of the) particles / collisions have energy greater than the activation energy / more particles have sufficient energy to react / more collisions have sufficient energy to react / a greater percentage of collisions are successful	1

Topic Chem 7 **Q# 127/** IGCSE Chemistry/2017/s/Paper 41/

5(a)	(stop-) watch **AND** syringe	1
5(b)	graph starts at **X** and is a curve with a decreasing gradient	1
	graph hits zero rate at 114±6 seconds	1
5(c)	**M1** moles of carbon dioxide = 180 / 24 000 = 0.0075	1
	M2 molar mass of barium carbonate = 197	1
	M3 mass of barium carbonate = **M1** × **M2** = 1.48 (g)	1
5(d)	curve starts from (0,0) and has a lower gradient than the original curve	1
	because lumps have a lower surface area	1

5(d)	curve starts from (0,0) and has a lower gradient than the original curve	1
	because lumps have a lower surface area	1

Topic Chem 7 **Q# 128/** IGCSE Chemistry/2017/m/Paper 42/

4(b)(i)	electrons are lost	1
4(b)(ii)	**M1** Cu^{2+} ions on left	1
	M2 rest of equation correct and correctly balanced ($Cu^{2+} + 2e^- \rightarrow Cu$ scores [2])	1

Topic Chem 7 **Q# 129/** IGCSE Chemistry/2017/m/Paper 42/

3(a)	any 2 from: • forward and backward reactions occur at equal rates • amounts / moles / concentrations (of substances) remain constant • closed system	2
3(b)	**M1** (particles) have more energy **OR** (particles) move faster	1
	M2 more collisions per second **OR** greater collision rate	1
	M3 more (of the) particles / collisions have energy greater than the activation energy **OR** more particles / collisions have sufficient energy to react **OR** a greater percentage / proportion / fraction of collisions are successful	1
3(c)	**M1** equilibrium moves left / yield decreases	1
	M2 because the forward reaction is exothermic **OR** because the reverse reaction is endothermic	1
3(d)	**M1** no change	1
	M2 numbers of moles of gas on each side is the same	1

Topic Chem 7 **Q# 130/** IGCSE Chemistry/2016/w/Paper 41/

5(c)(i)	copper ions / Cu^{2+} gain of electrons / oxidation number decreases	1 1

Topic Chem 7 **Q# 131/** IGCSE Chemistry/2016/w/Paper 41/

8(a)(i)	any 4 from: slowed down acid became less concentrated OR fewer particles per unit volume fewer collisions per second OR lower collision rate (then the reaction) stopped all the hydrochloric acid reacted	4
8(a)(ii)	any 4 from: faster (reaction) (powder has) larger surface area more collisions per second OR higher collision rate same volume of gas amount/moles hydrochloric acid is not changed	4
8(b)	any 5 from: temperature increased particles have more energy (particles) move faster more collisions per second OR higher collision rate more particles have sufficient energy to react/activation energy more of the collisions are successful	5

Topic Chem 7 **Q# 132/** IGCSE Chemistry/2016/s/Paper 43/

4(c)(ii)	**M1** iodide / I^-; **M2** it is oxidised **OR** it loses electrons / it increases oxidation number / it reduces the chlorine;	2 1 1

Topic Chem 7 **Q# 133/** IGCSE Chemistry/2016/s/Paper 42/

1(a)(ii)	carbon;	1
1(a)(iii)	oxygen;	1

Topic Chem 7 **Q# 134/** IGCSE Chemistry/2016/s/Paper 42/

6(d)(ii)	oxidising agent/oxidant;	1
6(d)(iii)	reducing agent/reductant;	1

Topic Chem 7 **Q# 135/** IGCSE Chemistry/2016/s/Paper 42/

4(a)	**M1** substance that speeds up a reaction/increases rate; **M2** unchanged (chemically) at the end/not used up/lowers activation energy/provides alternative pathway;	2 1 1
4(b)	**M1** too slow/slower; **M2** lower yield/less product(s)/equilibrium shifts to left/equilibrium shifts in direction of reactants/backward reaction favoured/reverse reaction favoured;	2 1 1
4(c)	faster/increase rate;	1
4(d)	lower yield/less product(s)/equilibrium shifts to left/equilibrium shifts in direction of reactants/backward reaction favoured/reverse reaction favoured; **OR** higher cost/expensive; **OR** safety risks;	1

Topic Chem 7 **Q# 136/** IGCSE Chemistry/2016/s/Paper 41/

4(a)(i)	reduction **and** (the Cu^{2+} ion/copper ions) is gaining electrons/is decreasing in oxidation number;	1

Topic Chem 7 **Q# 137/** IGCSE Chemistry/2016/s/Paper 41/

Question	Answer	Marks
3(a)	1 $Na_2S_2O_3$ 2 H_2O 3 HCl **OR** 1 HCl 2 H_2O 3 $Na_2S_2O_3$ **OR** 1 H_2O 2 $Na_2S_2O_3$ 3 HCl **OR** 1 H_2O 2 HCl 3 $Na_2S_2O_3$;	1
3(b)(i)	**M1** volumes 40 : 10 : 10; **M2** time = 14;	2 1 1
3(b)(ii)	**M1** more particles per unit volume/particles are closer together; **M2** increases the rate of collisions/there are more collisions per unit time;	2 1 1
3(c)	**M1** particles gain more energy **and** move faster; **M2** increasing rate of collisions/more collisions per unit time; **M3** higher proportion of particles have sufficient energy to react/collisions have sufficient energy to react/are above the activation energy;	3 1 1 1

Topic Chem 7 **Q# 138/** IGCSE Chemistry/2016/m/Paper 42/

4(a)	**M1** (substance that) speeds up a reaction / increases the rate of a reaction; **M2** any one from: unchanged (chemically at the end) / not used up; lowers activation energy;	2
4(b)(i)	at the start/initially / t = 0;	1
4(b)(ii)	catalyst should be powdered / increase surface area (of catalyst) / decrease particle size (of catalyst); **or** increase temperature / heat / warm;	1
4(d)	same mass / amount of / moles / 1.0 g of catalyst; same temperature; same volume **and** concentration of hydrogen peroxide / 20 cm^3 of 0.1 mol / dm^3 of hydrogen peroxide or reactant;	3

Mark Scheme for Topic Chem 8 **Q# 139/** IGCSE Chemistry/2018/w/Paper 43/

4(b)	**SUMMARY** **M1** repeat **M2** heat (liquid or solution should be implied) **M3** when to stop heating **M4** what to do after heating **M5** method of drying crystals (crystals or solid should be implied) **M1** repeat without indicator using same volumes **M2** evaporate / heat / warm / boil / leave in sun **M3** until most of the water is gone / some water left / saturation(point) / crystallisation point / evaporate **some** of the water **M4** leave / (allow to) cool / allow to crystallise **M5** details of drying	5
4(c)(i)	**M1** bubbles / effervescence / fizzing **M2** solid or magnesium dissolves / solid or magnesium disappears	2
4(c)(ii)	lilac flame	1
4(c)(iii)	white precipitate	1
4(d)(i)	$Mg(OH)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O$ **M1** formula of **both** $Mg(OH)_2$ and $MgSO_4$ **M2** equation fully correct	2
4(d)(ii)	$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ **M1** formula of $ZnSO_4$ **M2** equation fully correct	2
4(d)(iii)	$Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$ **M1** formulae of **both** Na_2CO_3 and Na_2SO_4 **M2** equation fully correct	2

Topic Chem 8 **Q# 140/** IGCSE Chemistry/2018/w/Paper 43/

3(f)(i)	**M1** glowing splint **M2** relights / rekindles	2

Topic Chem 8 **Q# 141/** IGCSE Chemistry/2018/w/Paper 43/

1(a)	oxygen	1

Topic Chem 8 **Q# 142/** IGCSE Chemistry/2018/w/Paper 42/

3(c)(ii)	M1 No more fizzing; M2 ($ZnCO_3$) stops dissolving or a (white) solid remains / is visible	2
3(c)(iii)	To use up all the acid / H^+ ions	1

3(c)(v)	(aq)	1
3(c)(vi)	Zinc oxide **or** zinc hydroxide	1
3(c)(vii)	Barium sulfate is insoluble	1

3(d)(i)	yellow	1

Topic Chem 8 **Q# 143/** IGCSE Chemistry/2018/w/Paper 42/

2(c)(i)	Hydrogen	1
2(c)(ii)	Hydroxide OR OH^-	1
2(c)(iii)	7< pH ⩽12	1
2(c)(iv)	$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$ M1 $Ca(OH)_2$ M2 Rest of equation	2
2(e)	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$ M1 Species M2 States	2

Topic Chem 8 **Q# 144/** IGCSE Chemistry/2018/w/Paper 41/

1(e)	Cl_2 / chlorine	1

Topic Chem 8 **Q# 145/** IGCSE Chemistry/2018/w/Paper 41/

1(e)	Cl_2 / chlorine	1

Topic Chem 8 **Q# 146/** IGCSE Chemistry/2018/s/Paper 43/

6(c)(i)	red	1
6(c)(ii)	proton donor	1
6(c)(iii)	$\rightarrow ClO_3^- + H_3O^+$	1

Topic Chem 8 **Q# 147/** IGCSE Chemistry/2018/s/Paper 43/

4(f)(i)	partially dissociated / partially ionised	1
4(f)(ii)	add excess copper(II) carbonate to ethanoic acid	1
	filter	1
	heat to point of crystallisation **AND** leave (to cool)	1
4(f)(iii)	ethanoic acid + copper carbonate → copper ethanoate + carbon dioxide + water	1

Topic Chem 8 **Q# 148/** IGCSE Chemistry/2018/s/Paper 43/

3(d)(i)	test: lighted splint / flame result: (squeaky) pop	2

Topic Chem 8 **Q# 149/** IGCSE Chemistry/2018/s/Paper 42/

6(b)(iii)	blue	1
	pink	1

Topic Chem 8 **Q# 150/** IGCSE Chemistry/2018/s/Paper 42/

6(a)	(mix) sodium carbonate **AND** barium nitrate / barium chloride	1
	in solution / aqueous / dissolved (in water)	1
	filter / centrifuge (barium carbonate)	1
	wash (residue) **AND** dry / description of washing and drying	1
	$Ba(NO_3)_2 + Na_2CO_3 \rightarrow BaCO_3 + 2NaNO_3$ / $Ba^{2+} + CO_3^{2-} \rightarrow BaCO_3$ **OR** $BaCl_2 + Na_2CO_3 \rightarrow BaCO_3 + 2NaCl$	1

Topic Chem 8 **Q# 151/** IGCSE Chemistry/2018/m/Paper 42/

1(a)(iii)	**D**	1

Topic Chem 8 **Q# 152/** IGCSE Chemistry/2018/m/Paper 42/

4(a)(i)	proton acceptor	1
4(a)(ii)	ammonia + named acid → correct ammon**ium** salt M1 ammon**ium** product (from ammonia / ammonium hydroxide + acid) M2 fully correct equation	2

Topic Chem 8 **Q# 153/** IGCSE Chemistry/2018/m/Paper 42/

2(c)(i)	white precipitate	1
2(c)(ii)	to ensure all sodium nitrate / $NaNO_3$ was collected	1
2(c)(iii)	M1 evaporation M2 crystallisation	2

Topic Chem 8 **Q# 154/** IGCSE Chemistry/2018/m/Paper 42/

3(a)(vi)	M1 CO_2 is acidic M2 $Ca(OH)_2$ is a base / alkali	2
3(b)	$MgCO_3 + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O + CO_2$ M1 $Mg(NO_3)_2$ M2 rest of equation	2

Topic Chem 8 **Q# 155/** IGCSE Chemistry/2017/w/Paper 43/

3(d)(i)	$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$	1
3(d)(ii)	$Fe_2O_3 + 3H_2SO_4 \rightarrow Fe_2(SO_4)_3 + 3H_2O$ **M1** formula of $Fe_2(SO_4)_3$ **M2** all formulae correct (no additional species) **M3** balanced	3
3(e)		4

	observation with aqueous iron(II) sulfate	observation with aqueous iron(III) sulfate
aqueous sodium hydroxide		M3 brown precipitate
aqueous potassium iodide	M1 no change	M4 brown solution / black solid
aqueous acidified potassium manganate(VII)	M2 (pink / purple to) colourless / decolourised	

Topic Chem 8 **Q# 156/** IGCSE Chemistry/2017/w/Paper 43/

4(b)(ii)	acid(ic)	1

Topic Chem 8 **Q# 157/** IGCSE Chemistry/2017/w/Paper 41/Q5

5(b)(i)	*(copper(II) ions)* add sodium hydroxide (solution)	1
	(copper(II) ions) blue ppt.	1
	(nitrate ions) add aluminium **AND** aqueous sodium hydroxide **AND** warm	1
	ammonia given off / gas turns damp (red) litmus blue	1

Topic Chem 8 **Q# 158/** IGCSE Chemistry/2017/w/Paper 41/

4(d)(ii)	**M1** (acids) have same concentration	1
	M2: measure pH OR describe how to measure pH (such as use Universal Indicator) **M3**: lower pH corresponds to the stronger acid / hydrochloric acid OR **M2**: add calcium / magnesium / zinc / iron **M3**: faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid OR **M2**: rate of reaction with (metal) carbonate **M3**: faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid OR **M2**: rate of reaction with (named) metal oxide **M3**: dissolves faster means that reaction is with the stronger acid / hydrochloric acid OR **M2**: electrical conductivity **M3**: greater conductivity corresponds to the stronger acid / hydrochloric acid OR **M2**: add sodium hydroxide (or other named alkali) **M3**: greater temperature change corresponds to the stronger acid / hydrochloric acid	2

Topic Chem 8 **Q# 159/** IGCSE Chemistry/2017/s/Paper 43/

6(a)(i)	$BaCO_3 \rightarrow BaO + CO_2$	1
6(a)(ii)	anything pH in the range pH 10 to pH 14	1
6(a)(iii)	nitrogen dioxide	1
	oxygen	1
6(b)(i)	$Na_2CO_3 + Ba(NO_3)_2 \rightarrow BaCO_3 + 2NaNO_3$ **M1** formula of $NaNO_3$ **M2** equation fully correct	2
6(b)(ii)	filter	1
	wash (the residue) using water	1
	dry the residue between filter papers / in a warm place	1

Topic Chem 8 **Q# 160/** IGCSE Chemistry/2017/s/Paper 42/

4(b)	add sodium hydroxide (solution) / NaOH / potassium hydroxide (solution) / KOH	1
	zinc oxide dissolves / reacts OR copper(II) oxide does not dissolve / react	1
	filter / decant / centrifuge (copper(II) oxide)	1

Topic Chem 8 **Q# 161/** IGCSE Chemistry/2017/s/Paper 42/

3(c)	$4NO + 3O_2 + 2H_2O \rightarrow 4HNO_3$ **M1** all formulae correct **M2** balancing	2
3(d)	add copper(II) carbonate (to acid) until it stops dissolving or no more effervescence / bubbling / fizzing	1
	filter (to remove copper(II) carbonate)	1
	evaporate / heat / warm / boil / leave in sun **AND** until most of the water has gone / some water is left / evaporate some of the water / until it is concentrated / saturation (point) / crystallisation point / crystals form on glass rod or microscope slide / crystals start to form	1
	(for any solution) leave / allow to cool / allow to crystallise OR (for any crystals) filter / wash / dry with filter paper / dry in warm place / dry in a (low) oven / leave to dry	1
	formula of $Cu(NO_3)_2$	1
	equation: $CuCO_3 + 2HNO_3 \rightarrow Cu(NO_3)_2 + CO_2 + H_2O$	1

Topic Chem 8 **Q# 162/** IGCSE Chemistry/2017/s/Paper 42/

2(f)	$2NaOH + SiO_2 \rightarrow Na_2SiO_3 + H_2O$ **IF** full credit is not awarded, allow 1 mark for Na_2SiO_3 **OR** $2OH^- + SiO_2 \rightarrow SiO_3^{2-} + H_2O$ **M1** species correct **M2** balancing	2

Topic Chem 8 **Q# 163/** IGCSE Chemistry/2017/s/Paper 41/

PUBLISHED

Question	Answer	Marks
2(a)(i)	SO_2	1
2(a)(ii)	Na_2O	1
2(a)(iii)	Cr_2O_3	1
2(a)(iv)	SiO_2	1
2(a)(v)	Al_2O_3 / Cr_2O_3	1
2(a)(vi)	CO	1
2(b)(i)	an amphoteric oxide will react with acids **AND** with bases	1
2(b)(ii)	a neutral oxide will **not** react with acids or with bases	1

Topic Chem 8 **Q# 164/** IGCSE Chemistry/2017/s/Paper 41/

3(a)(i)	no (more) effervescence	1
3(a)(ii)	magnesium carbonate	1
3(a)(iii)	(a solution in which) no more solute will dissolve	1
	at that temperature	1
3(a)(iv)	the solubility deceases as the temperature decreases	1
3(b)(i)	moles of water = 2.52 / 18 = 0.14 (mol)	1
3(b)(ii)	moles of anhydrous magnesium sulfate = 0.02 (mol)	1
3(b)(iii)	ratio = 0.02 / 0.02 : 0.14 / 0.02 = 1 : 7	1
3(c)	mix and stir the two solutions	1
	filter (to obtain residue)	1
	wash (the residue) using water	1
	dry the residue between filter papers / in a warm place	1
3(d)	$Pb^{2+}(aq) + SO_4^{2-}(aq) \rightarrow PbSO_4(s)$ **M1** correct species **M2** correct state symbols	2

Topic Chem 8 **Q# 165/** IGCSE Chemistry/2017/m/Paper 42/

2(a)	**M1** filter	1
	M2 wash (the residue) using water	1
	M3 dry the residue between filter papers / in a warm place	1
2(c)	**M1** Universal Indicator turns blue	1
	M2 ammonia / NH_3 (is made)	1

Topic Chem 8 **Q# 166/** IGCSE Chemistry/2016/w/Paper 43/

5(f)(i)	exists completely as ions (in solution) / completely dissociates (in solution) / completely ionises (in solution)	1
5(f)(ii)	Universal Indicator / pH paper / pH indicator / pH meter Universal Indicator or pH paper or pH indicator turns red / pH 0–1	1 1
5(f)(iii)	$Na_2CO_3 + 2C_6H_5SO_3H \rightarrow 2C_6H_5SO_3Na + CO_2 + H_2O$ formula of $C_6H_5SO_3Na$ all formulae correct and balancing correct	2

Topic Chem 8 **Q# 167/** IGCSE Chemistry/2016/w/Paper 43/

4(g)(iii)	*test:* (damp blue) litmus *result:* bleached / removes colour / (turns) white	1 1

Topic Chem 8 **Q# 168/** IGCSE Chemistry/2016/w/Paper 43/

3(c)	*test:* glowing splint *result:* relights / rekindles	1 1
3(d)(iii)	$PbO + 2HNO_3 \rightarrow Pb(NO_3)_2 + H_2O$ OR $PbO + 2H^+ \rightarrow Pb^{2+} + H_2O$	1

Topic Chem 8 **Q# 169/** IGCSE Chemistry/2016/w/Paper 43/

2(d)(i)	Be^{2+}	1
2(d)(ii)	$Be(OH)_2 + 2HCl \rightarrow BeCl_2 + 2H_2O$ formula of $BeCl_2$ all formulae correct and balancing correct	2
2(d)(iii)	$2NaOH + Be(OH)_2 \rightarrow Na_2BeO_2 + 2H_2O$ formula of Na_2BeO_2 all formulae correct and balancing correct	2

Topic Chem 8 **Q# 170/** IGCSE Chemistry/2016/w/Paper 42/

Question	Answer	Mark
5(c)(i)	the (C=C) double bond	1
5(c)(ii)	addition OR bromination	1
5(d)(i)	substitution	1
5(d)(ii)	(compounds with the) same molecular formula different structural formulae or structures	2
5(d)(iii)	structure of 1–chloropropane structure of 2–chloropropane	2
5(e)(i)	I_2O_5 **M1** 76.0 / 127 **AND** 24.0 / 16.0 **M2** 0.59 **AND** 1.5 **OR** 1 **AND** 2.5 **M3** I_2O_5	3
5(e)(ii)	(turns) red / pink / orange / yellow iodine is a non-metal	2

Question	Answer	Mark
6(a)	bauxite/Alumina is dissolved in molten cryolite cryolite lowers the melting temperature molten aluminium forms *anode reaction*: $2O^{2-} \rightarrow O_2 + 4e^-$ *cathode reaction*: $Al^{3+} + 3e^- \rightarrow Al$	5

Topic Chem 8 **Q# 171/** IGCSE Chemistry/2016/w/Paper 42/

Question	Answer	Mark
4(a)	*copper(II) carbonate* fizzes / bubbles / effervescence dissolves / disappears *copper(II) oxide* dissolves / disappears blue (solution formed)	2 2
4(b)(i)	$Cu(NO_3)_2$ 3Cu **AND** 3$Cu(NO_3)_2$	2
4(b)(ii)	hydrogen (gas) is not produced (when copper reacts with nitric acid)	1

Topic Chem 8 **Q# 172/** IGCSE Chemistry/2016/w/Paper 41/

	(test) glowing splint (result of test) relights	1 1

Topic Chem 8 **Q# 173/** IGCSE Chemistry/2016/s/Paper 43/

5(b)(i)	red;	1

Topic Chem 8 **Q# 174/** IGCSE Chemistry/2016/s/Paper 43/

4(b)(i)	**M1** dissolve solids (in water) and mix/combine/add; **M2** filter; **M3** wash the residue (with water); **M4** leave to dry/place in oven/dry between filter papers;	4 1 1 1 1
4(b)(ii)	$Pb^{2+} + 2I^- \rightarrow PbI_2$ formulae of ions correct; rest correct;	2

Topic Chem 8 **Q# 175/** IGCSE Chemistry/2016/s/Paper 43/

Question	Answer	Marks
6(a)(i)	$NH_3 + HCl \rightarrow NH_4Cl$;	1
6(a)(ii)	diffusion;	1
6(a)(iii)	solid forms at: A; explanation: ammonia molecules/particles have a smaller mass; (and so) move/diffuse faster;	3 1 2
6(a)(iv)	**M1** solid forms in less time/faster/quicker; **M2** particles/molecules have more energy; **M3** (and so) move faster/diffuse faster;	3 1 1 1
6(b)(i)	test: add sodium hydroxide (solution and warm); result: test gas/ammonia with (red) litmus/Universal Indicator/pH paper; indicator turns blue/ammonia produced;	3 1 2
6(b)(ii)	test: add silver nitrate (solution); result: add (dilute) nitric acid; white precipitate;	3 1 2

Topic Chem 8 **Q# 176/** IGCSE Chemistry/2016/s/Paper 42/

4(e)(v)	**M1** damp blue litmus paper; **M2** bleaches/loses colour/turns white/turns colourless;	2 1 1

Topic Chem 8 **Q# 177/** IGCSE Chemistry/2016/s/Paper 42/

3(c)(i)	$Ga_2O_3 + 6HNO_3 \rightarrow 2Ga(NO_3)_3 + 3H_2O$ formula of $Ga(NO_3)_3$; all formulae and balancing correct;	2
3(c)(ii)	$Ga_2O_3 + 2NaOH \rightarrow Na_2Ga_2O_4 + H_2O$; formula of $Na_2Ga_2O_4$; all formulae and balancing correct;	2

Topic Chem 8 **Q# 178/** IGCSE Chemistry/2016/s/Paper 42/

6(d)(i)	green precipitate; red-brown/brown/orange precipitate;	2 1 1
6(d)(ii)	oxidising agent/oxidant;	1
6(d)(iii)	reducing agent/reductant;	1
6(d)(iv)	iron(III)/Fe^{3+};	1
6(d)(v)	iron(II)/Fe^{2+};	1

Topic Chem 8 **Q# 179/** IGCSE Chemistry/2016/s/Paper 41/

5(d)(i)	3 correct (2 marks) 2 correct (1 mark) bubbles/effervescence/fizzing; dissolves/disappears/*forms* a solution; blue (solution);	2
5(d)(ii)	carbon dioxide and water and copper(II) sulfate;	1

Topic Chem 8 **Q# 180/** IGCSE Chemistry/2016/s/Paper 41/

2(b)(i)	(a substance which is) a proton/H^+/hydrogen ion acceptor;	1
2(c)	**M1** add a *named* acid, e.g. HCl **and** a named alkali, e.g. NaOH; **M2** Al_2O_3 will react with/neutralises both reagents; **M3** and so it will dissolve into the reagent/form a solution;	3 1 1 1
2(g)(ii)	name of compound: cobalt(II) chloride; from: blue; to: pink;	3 1 1 1

Topic Chem 8 **Q# 181/** IGCSE Chemistry/2016/m/Paper 42/

3(b)(iv)	no (moving) ions / no mobile or moving electrons / all electrons used in bonding / made of uncharged molecules;	1

Topic Chem 8 **Q# 182/** IGCSE Chemistry/2016/m/Paper 42/

2(d)(ii)	yellow;	1

Topic Chem 8 **Q# 183/** IGCSE Chemistry/2016/m/Paper 42/

5(c)(i)	proton / H^+ acceptor;	1
5(c)(ii)	$(N_2H_4 + H_2O) \rightarrow N_2H_5^+ + OH^-$; **or** $(N_2H_4) + 2H_2O \rightarrow N_2H_6^{2+} + 2OH^-$;	1

Mark Scheme for Topic Chem 9 **Q# 184/** IGCSE Chemistry/2018/w/Paper 42/

2(a)	2 : 8 : 8 : 2	1
2(b)(i)	M1 Same number of (**or** 2) outer electrons	2
2(b)(ii)	M2 (Sr has) outer electrons are in the 5th shell	

Topic Chem 9 **Q# 185/** IGCSE Chemistry/2018/w/Paper 41/

3(a)(ii)	nitrogen dioxide is acidic **OR** nitrogen dioxide reacts with sodium hydroxide	1

3(b)	**M1** nitrogen and oxygen (from the air) **M2** (react) at high temperatures (in engine) **or** (electrical) spark (in engine)	2
3(c)(i)	**M1** 188 **M2** (18.8 / 188) = 0.1(00)	2
3(c)(ii)	0.05	1
3(c)(iii)	1200	1
3(d)(i)	$Cu(OH)_2$	1
3(d)(ii)	Any three from: **1** zinc more reactive than copper **2** displacement / redox reaction **OR** zinc displaces copper **OR** zinc reacts with copper **ions** **3** copper is solid / copper is brown **4** zinc nitrate is colourless (solution) **OR** blue colour disappears because Cu^{2+} ions removed (from solution)	**max 3**
3(d)(iii)	**M1** sodium hydroxide / NaOH **M2** aluminium / Al	2
3(e)(i)	$CuCO_3 + 2HNO_3 \rightarrow Cu(NO_3)_2 + CO_2 + H_2O$ **M1** carbon dioxide and water as products **M2** rest correct	2

3(b)	**M1** nitrogen and oxygen (from the air) **M2** (react) at high temperatures (in engine) **or** (electrical) spark (in engine)	2
3(c)(i)	**M1** 188 **M2** (18.8 / 188) = 0.1(00)	2
3(c)(ii)	0.05	1
3(c)(iii)	1200	1
3(d)(i)	$Cu(OH)_2$	1
3(d)(ii)	Any three from: **1** zinc more reactive than copper **2** displacement / redox reaction **OR** zinc displaces copper **OR** zinc reacts with copper **ions** **3** copper is solid / copper is brown **4** zinc nitrate is colourless (solution) **OR** blue colour disappears because Cu^{2+} ions removed (from solution)	**max 3**
3(d)(iii)	**M1** sodium hydroxide / NaOH **M2** aluminium / Al	2
3(e)(i)	$CuCO_3 + 2HNO_3 \rightarrow Cu(NO_3)_2 + CO_2 + H_2O$ **M1** carbon dioxide and water as products **M2** rest correct	2

Topic Chem 9 **Q# 186/** IGCSE Chemistry/2018/w/Paper 41/

2(c)	Li / Lithium	1
2(d)	it has a complete **or** full **or** 8 electrons in the outer shell	1

Topic Chem 9 **Q# 187/** IGCSE Chemistry/2018/s/Paper 43/

1(d)	Ar / argon	1

Topic Chem 9 **Q# 188/** IGCSE Chemistry/2018/s/Paper 43/

3(a)	any **one** from: conduct electricity conduct heat malleable ductile shiny	1
3(b)(i)	any **one** from: melting point hardness strength density	1
3(b)(ii)	(cobalt) high(er) / (cobalt) strong(er)	1
3(c)	any **two** from: potassium melts / potassium forms a ball fizzes / bubbles potassium moves (lilac) flame	2

Topic Chem 9 **Q# 189/** IGCSE Chemistry/2018/s/Paper 42/

2(c)	sodium / Na	1
2(d)	chlorine / Cl_2 / Cl	1
2(e)	argon / Ar	1

Topic Chem 9 **Q# 190/** IGCSE Chemistry/2018/s/Paper 41/

2(a)	calcium / Ca	1
2(b)	7	1
2(c)	4	1

Topic Chem 9 **Q# 191/** IGCSE Chemistry/2018/s/Paper 41/

5(a)(ii)	variable oxidation states	1
5(b)	any **two** from: high(er) melting point / boiling point (very) hard(er) (very) strong(er) dense(r)	2

Topic Chem 9 **Q# 192/** IGCSE Chemistry/2018/m/Paper 42/

4(c)(ii)	M1 platinum M2 transition metal / element	2

Topic Chem 9 **Q# 193/** IGCSE Chemistry/2018/m/Paper 42/

1(a)(iv)	**B**	1

Topic Chem 9 **Q# 194/** IGCSE Chemistry/2017/s/Paper 43/

1(a)(v)	**L**	1
1(a)(vi)	**D**	1

Topic Chem 9 **Q# 195/** IGCSE Chemistry/2017/s/Paper 42/

4(a)	any 3 from: • catalyst • more than one / variable oxidation state / oxidation number / valency • form coloured **compounds** / coloured **ions** • forms complex ions / complexes	3

Topic Chem 9 **Q# 196/** IGCSE Chemistry/2017/s/Paper 42/

5(a)(i)	<table><tr><th></th><th>aqueous potassium chloride</th><th>aqueous potassium bromide</th><th>aqueous potassium iodide</th></tr><tr><td>chlorine</td><td></td><td></td><td>✓</td></tr><tr><td>bromine</td><td>✗</td><td></td><td>✓</td></tr><tr><td>iodine</td><td>✗</td><td>✗</td><td></td></tr></table> 5 cells completed correctly = [3] 3 or 4 cells completed correctly = [2] 2 cells completed correctly = [1]	3
5(c)(i)	solid	1
5(c)(ii)	$2Na + At_2 \rightarrow 2NaAt$ **M1** formula of NaAt **M2** equation fully correct	2

Topic Chem 9 **Q# 197/** IGCSE Chemistry/2017/s/Paper 41/

2(a)(iii)	Cr_2O_3	1

Topic Chem 9 **Q# 198/** IGCSE Chemistry/2016/w/Paper 42/

5(b)(i)	from colourless to yellow / orange / brown	2

Topic Chem 9 **Q# 199/** IGCSE Chemistry/2016/s/Paper 43/

4(c)(i)	start colour: colourless; 1 end colour: brown; 1	2

Topic Chem 9 **Q# 200/** IGCSE Chemistry/2016/s/Paper 42/

1(a)(vii)	lithium / fluorine;	1
1(a)(viii)	lithium;	1

Topic Chem 9 **Q# 201/** IGCSE Chemistry/2016/s/Paper 41/

4(c)	(good) catalysts; 1 variable oxidation numbers; 1 form coloured compounds / coloured ions; 1	3

Topic Chem 9 **Q# 202/** IGCSE Chemistry/2016/s/Paper 41/

2(h)(i)	it has a complete outer shell / a full outer shell / 8 electrons in the outer shell;	1
2(h)(ii)	(in) lamps;	1

Topic Chem 9 **Q# 203/** IGCSE Chemistry/2016/m/Paper 42/

2(a)	1;	1
2(b)	conducts electricity or heat / malleable / ductile / sonorous / shiny;	1
2(c)	any two from: • (low) melting point / (low) boiling point; • hardness / softness / rubidium can be cut easily; • strength; • (low) density;	2

2(d)(i)	any two from: • bubbles / effervescence / fizzing; • flame / sparks / ignites; • movement; • dissolves / forms a solution / disappears / gets smaller; • floats; • rubidium melts / rubidium forms a ball; • explosion;	2
2(d)(ii)	yellow;	1
2(d)(iii)	$2Rb + 2H_2O \rightarrow 2RbOH + H_2$ formula of RbOH; whole equation completely correct;	2
2(d)(iv)	caesium → rubidium → potassium → sodium → lithium / Cs → Rb → K → Na → Li;	1
2(d)(v)	goggles / glasses / gloves / safety screen / stand at safe distance / tongs / open space;	1
2(e)	Rb_3PO_4;	1

Mark Scheme for Topic Chem 10 **Q# 204/** IGCSE Chemistry/2018/w/Paper 43/

3(a)	[(64 □ 2) + 56 + 119 + (32 □ 4) =] **431**	1
3(b)	[(119 / 151) □ 100 =] **78.8 (%)**	1
3(c)	SnO_2 because the percentage of tin is **larger** in SnO_2 **or** answer to **(b)** □ 27.6 %	1
3(d)	$SnO_2 + 2C \rightarrow Sn + 2CO$ **M1 all** formulae correct **M2** equation fully correct	2
3(e)	**M1** (→) $Fe^{2+} + Sn$ **OR** $2Fe + 3Sn^{2+} \rightarrow 2Fe^{3+} + 3Sn$ **M2** (→) $Sn^{2+} + Cu$ **OR** $Sn + 2Cu^{2+} \rightarrow Sn^{4+} + 2Cu$	2
3(f)(i)	**M1** glowing splint **M2** relights / rekindles	2
3(f)(ii)	**M1** nitrogen dioxide / nitrogen(IV) oxide **M2** brown (gas)	2
3(f)(iii)	$2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$	1
3(g)(i)	zinc acts as a barrier which prevents contact between iron and water and air / oxygen	1
3(g)(ii)	**SUMMARY** **M1** comparison of reactivity **M2** zinc loses **electrons** **M3** where **electrons** move to **OR** iron does not lose electrons **M1** zinc is **more** reactive than iron / steel **ORA** **M2** zinc loses electrons / zinc is oxidised **M3** electrons are transferred to iron / iron is not oxidised / iron does not lose electrons	3

Topic Chem 10 **Q# 205/** IGCSE Chemistry/2018/w/Paper 43/

1(b)	hematite	1

Topic Chem 10 **Q# 206/** IGCSE Chemistry/2018/w/Paper 41/

3(a)(i)	$4NO_2$ $2CuO$ **M1** CuO as a product (1) **M2** rest fully correct (1)	2

Topic Chem 10 **Q# 207/** IGCSE Chemistry/2018/w/Paper 41/

1(a)	*Al* / aluminium	1
1(b)	$CaCO_3$ / calcium carbonate	1

Topic Chem 10 **Q# 208/** IGCSE Chemistry/2018/s/Paper 43/

6(b)(i)	heat it	1
6(b)(ii)	$Ca(ClO_3)_2 \rightarrow CaCl_2 + 3O_2$ 1 mark for O_2 as product 1 mark for the rest correct and balanced	2

Topic Chem 10 **Q# 209/** IGCSE Chemistry/2018/s/Paper 43/

2(b)(i)	bauxite	1
2(b)(ii)	aluminium is more reactive than carbon	1
2(b)(iii)	to lower the operating temperature / the mixture has a lower melting point than aluminium oxide	1
	to increase the conductivity	1
2(b)(iv)	oxidation (because) (the O^{2-} ion OR 'oxide ions') electrons are lost **OR** (the O^{2-} ion OR 'oxide ions') oxidation number increases	1
2(b)(v)	electrodes/anodes are made from carbon/graphite	1
	oxygen (made) reacts with carbon/anode	1
2(c)(i)	zinc is more reactive than copper	1
2(c)(ii)	displacement / redox	1
2(c)(iii)	(aluminium) has (inert) coating of aluminium oxide	1

Topic Chem 10 **Q# 210/** IGCSE Chemistry/2018/s/Paper 42/

6(b)(i)	$2NaNO_3 \rightarrow 2NaNO_2 + O_2$ 1 mark for either $NaNO_2$ or O_2 on the right-hand side 1 mark for fully correct equation	2
6(b)(ii)	$2Cu(NO_3)_2.3H_2O(s) \rightarrow \mathbf{2}CuO(s) + \mathbf{4}NO_2(s) + O_2(g) + \mathbf{6}H_2O(g)$ all 3 numbers = 2 marks any 2 numbers = 1 mark	2

Topic Chem 10 **Q# 211/** IGCSE Chemistry/2018/s/Paper 41/

3(a)	(hot) air	1
3(b)	coke is burned (to form carbon dioxide) **OR** $C + O_2 \rightarrow CO_2$	1
	carbon dioxide is reduced by (more) coke to form **carbon monoxide** or **CO** **OR** $C + CO_2 \rightarrow 2CO$	1
	$3CO + Fe_2O_3 \rightarrow 2Fe + 3CO_2$	1
	limestone (decomposes to) form lime / CaO / calcium oxide (and carbon dioxide) **OR** $CaCO_3 \rightarrow CaO + CO_2$	1
	$CaO + SiO_2 \rightarrow CaSiO_3$	1
3(c)	the impurity is C	1
	blow **into** or pass oxygen **through** (molten) **iron**	1
	carbon dioxide escapes or carbon dioxide is a gas	1

Topic Chem 10 **Q# 212/** IGCSE Chemistry/2018/m/Paper 42/

2(c)(v)	$2NaNO_3 \rightarrow 2NaNO_2 + O_2$ M1 = $NaNO_2$ M2 = rest of equation	2

Topic Chem 10 **Q# 213/** IGCSE Chemistry/2017/w/Paper 43/

3(c)(iii)	particles have different sizes/radii	1
	layers cannot slide/slip/shift	1

Topic Chem 10 **Q# 214/** IGCSE Chemistry/2017/w/Paper 43/

1(a)	mixture	1

Topic Chem 10 **Q# 215/** IGCSE Chemistry/2017/w/Paper 43/

5(a)(i)	oxygen / O_2	1
	sodium nitrite / sodium nitrate(III) / $NaNO_2$	1
5(a)(ii)	$2Cu(NO_3)_2 \rightarrow 2CuO + O_2 + 4NO_2$ **M1** CuO **M2** rest of equation fully correct	2

Topic Chem 10 **Q# 216/** IGCSE Chemistry/2017/w/Paper 43/

3(a)	hematite	1
3(b)	(coke reacts with oxygen / air) to produce heat / increase temperature / exothermically	1
	coke is reducing agent / produces reducing agent / produces carbon monoxide OR coke reduces Fe_2O_3 / (iron) ore / hematite (producing iron)	1
	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ OR $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$ OR $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$ **M1** species correct **M2** balanced	2
	limestone (decomposes to calcium oxide which) reacts with / removes acidic impurities / SiO_2 / sand / silica / silicon(IV) oxide / silicon dioxide	1
	limestone / calcium oxide / lime is involved in the production of slag / calcium silicate	1

Topic Chem 10 **Q# 217/** IGCSE Chemistry/2017/w/Paper 42/

4(e)(i)	*anode made of:* impure copper	1
	cathode made of: (pure) copper	1
	electrolyte of: (aqueous) copper sulfate	1
4(e)(ii)	silver (impurities) fall to the bottom of the cell	1
	zinc (impurities) (dissolve) into solution (as ions)	1
	because zinc is more reactive than copper **AND** silver is less reactive than copper	1

Topic Chem 10 **Q# 218/** IGCSE Chemistry/2017/w/Paper 41/

6(a)	aluminium is more reactive than carbon	1
6(c)(i)	*the wires:* electrons	1
	the electrolyte: ions	1
6(c)(ii)	any 2 from: □ increases conductivity □ as a solvent □ lowers the operating temperature	2
6(c)(iii)	$Al^{3+} + 3e^- \rightarrow Al$	1
6(c)(iv)	oxygen is made at the anode	1
	the anodes are made of carbon	1
	oxygen (made) reacts with carbon	1
6(d)	aluminium coated with layer of (unreactive) aluminium oxide	1

Topic Chem 10 **Q# 219/** IGCSE Chemistry/2017/w/Paper 41/

3(a)(iv)	$3Mg + Fe_2O_3 \rightarrow 3MgO + 2Fe$ **M1** Fe_2O_3 AND MgO **M2** fully correct	2

Topic Chem 10 **Q# 220/** IGCSE Chemistry/2017/w/Paper 41/

5(a)(i)	*start colour:* green *end colour:* black	1
5(a)(ii)	$CuCO_3 \rightarrow CuO + CO_2$	1
5(b)(ii)	2 / 2 / 4 / 1	1

Topic Chem 10 **Q# 221/** IGCSE Chemistry/2017/s/Paper 43/

6(a)(i)	$BaCO_3 \rightarrow BaO + CO_2$	1
6(a)(ii)	anything pH in the range pH 10 to pH 14	1
6(a)(iii)	nitrogen dioxide	1
	oxygen	1
6(b)(i)	$Na_2CO_3 + Ba(NO_3)_2 \rightarrow BaCO_3 + 2NaNO_3$ **M1** formula of $NaNO_3$ **M2** equation fully correct	2
6(b)(ii)	filter	1
	wash (the residue) using water	1
	dry the residue between filter papers / in a warm place	1

Topic Chem 10 **Q# 222/** IGCSE Chemistry/2017/s/Paper 43/

5(a)(i)	loss (of electrons)	1
5(a)(ii)	$Ni \rightarrow Ni^{2+} + 2e^-$	1
5(a)(iii)	goes down / gets less / decreases / lower / smaller	1
5(b)(i)	beryllium	1
	most negative voltage with any (named) metal OR biggest voltage with cobalt / nickel	1
5(b)(ii)	cobalt **AND** nickel	1
5(b)(iii)	– sign	1
	2.7	1
5(c)	(set up cell) using magnesium and beryllium (electrodes)	1
	voltage positive if magnesium is metal 2	1
	OR	
	(set up cells) using both magnesium and beryllium with the same metal as the other electrode	1
	larger (magnitude) voltages with magnesium	1
	OR	
	use magnesium with a different metal and compare to a reference value in a table	1
	value is more negative than with beryllium, if magnesium is metal 1	1

Topic Chem 10 **Q# 223/** IGCSE Chemistry/2017/s/Paper 42/

4(c)(i)	$Zn \rightarrow Zn^{2+} + 2e / 2e^-$ **M1** formula of Zn^{2+} on the right-hand side **M2** equation fully correct	2
4(c)(ii)	zinc / Zn nickel / Ni copper / Cu	1
4(c)(iii)	copper (+) and nickel (–)	1
	0.59 V	1

Topic Chem 10 **Q# 224/** IGCSE Chemistry/2017/s/Paper 41/

2(a)(iv)	SiO_2	1

Topic Chem 10 **Q# 225/** IGCSE Chemistry/2017/s/Paper 41/

4(a)(i)	roast in air	1
4(a)(ii)	$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$ **M1** correct species **M2** correct balancing	2
4(b)(i)	coke	1
4(b)(ii)	zinc is vaporised / boiled	1
	and is condensed	1
4(c)(i)	$Zn \rightarrow Zn^{2+} + 2e^-$ **M1** correct species **M2** correct balancing	2
4(c)(ii)	$2H^+ + 2e^- \rightarrow H_2$ **M1** correct species **M2** correct balancing	2
4(c)(iii)	change: (the intensity would) decrease	1
	reason: the difference in reactivity between zinc and iron is less than the difference in reactivity between zinc and copper	1

Topic Chem 10 **Q# 226/** IGCSE Chemistry/2017/m/Paper 42/

2(e)(ii)	**M1** formula of chromium(III) oxide	1
	M2 rest of equation correct to give a fully correct equation ($(NH_4)_2Cr_2O_7 \rightarrow N_2 + Cr_2O_3 + 4H_2O$ scores [2])	1

Topic Chem 10 **Q# 227/** IGCSE Chemistry/2017/m/Paper 42/

5(a)	carbon dioxide reacts with carbon / coke **OR** $CO_2 + C \rightarrow 2CO$	1
5(b)	**M1** $CaO + SiO_2 \rightarrow CaSiO_3$	1
	M2 CaO is a base	1
	M3 SiO_2 is an acid	1
5(c)(i)	(the carbon makes the iron too) brittle	1
5(c)(ii)	reacted with oxygen / oxygen blown in	1
5(d)(i)	zinc blende	1
5(d)(ii)	$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$	1
5(d)(iv)	**M1** zinc boils	1
	M2 (both) impurities do not boil because their boiling point is above 1000 °C	1

Topic Chem 10 **Q# 228/** IGCSE Chemistry/2016/w/Paper 42/

6(a)	bauxite/Alumina is dissolved in molten cryolite cryolite lowers the melting temperature molten aluminium forms *anode reaction:* $2O^{2-} \rightarrow O_2 + 4e^-$ *cathode reaction:* $Al^{3+} + 3e^- \rightarrow Al$	5

6(b)	carbon or graphite electrode reacts with oxygen / burns (in oxygen) / combusts	2
6(c)	*use 1*: manufacture of aircraft *reason 1*: low density *use 2*: food containers OR cooking foil *reason 2*: Al resistant to corrosion	4

Topic Chem 10 **Q# 229/** IGCSE Chemistry/2016/s/Paper 43/

1(a)(i)	A;	1
1(a)(ii)	B;	1
1(a)(iii)	D;	1
1(a)(iv)	C;	1
1(a)(v)	C;	1
1(b)(i)	(hot) air;	1
1(b)(ii)	(molten) iron;	1
1(b)(iii)	any 2 from: carbon dioxide; carbon monoxide; nitrogen;	2
1(c)(i)	as the percentage of carbon increases, so the malleability decreases;	1
1(c)(ii)	**M1** oxygen (gas) blown in; **M2** carbon dioxide formed / $C + O_2 \rightarrow CO_2$;	2 1 1

Topic Chem 10 **Q# 230/** IGCSE Chemistry/2016/s/Paper 42/

3(d)	any 2 from: • (do not) corrode; • strong; • hard; • (improved) appearance;	2

Topic Chem 10 **Q# 231/** IGCSE Chemistry/2016/s/Paper 42/

Question	Answer	Marks
6(a)(i)	roast/heat **and** in air/oxygen;	1
6(a)(ii)	$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$; SO_2 on right of equation; all formulae and balancing correct;	2
6(b)(i)	**M1** heat produced by carbon / coke (burning in) oxygen / air; **OR** $C + O_2 \rightarrow CO_2$ produces heat / exothermic; **OR** $2C + O_2 \rightarrow 2CO$ produces heat / exothermic (scores **M1** and **M2**); **M2** $C + CO_2 \rightarrow 2CO$; **OR** $2C + O_2 \rightarrow 2CO$; **M3** $ZnO + CO \rightarrow Zn + CO_2$; **OR** $ZnO + C \rightarrow Zn + CO$; **OR** $2ZnO + C \rightarrow 2Zn + CO_2$;	3 1 1 1
6(b)(ii)	temperature (inside the furnace) is above 907 °C / temperature (inside the furnace) is above the boiling point (of zinc) / 1000 °C is above the boiling point (of zinc);	1
6(b)(iii)	condensation / condensing / condense;	1

Topic Chem 10 **Q# 232/** IGCSE Chemistry/2016/s/Paper 41/

2(b)(ii)	$Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(aq) + H_2(g)$ $Mg(OH)_2$; rest of equation;	2

3(g)(i)	zinc acts as a barrier which prevents contact between iron and water and air / oxygen	1
3(g)(ii)	**SUMMARY** **M1** comparison of reactivity **M2** zinc loses **electrons** **M3** where **electrons** move to **OR** iron does not lose electrons **M1** zinc is **more** reactive than iron / steel **ORA** **M2** zinc loses electrons / zinc is oxidised **M3** electrons are transferred to iron / iron is not oxidised / iron does not lose electrons	3

Topic Chem 11 **Q# 234/** IGCSE Chemistry/2018/w/Paper 43/

1(d)	ammonia	1

Topic Chem 11 **Q# 235/** IGCSE Chemistry/2018/w/Paper 43/

1(e)	carbon monoxide	1

Topic Chem 11 **Q# 236/** IGCSE Chemistry/2018/w/Paper 41/

3(b)	**M1** nitrogen and oxygen (from the air) **M2** (react) at high temperatures (in engine) **or** (electrical) spark (in engine)	2
3(e)(ii)	respiration	1
3(e)(iii)	photosynthesis	1

Topic Chem 11 **Q# 237/** IGCSE Chemistry/2018/s/Paper 43/

1(a)	Cl_2 / chlorine	1

Topic Chem 11 **Q# 238/** IGCSE Chemistry/2018/s/Paper 42/

2(g)	phosphorus / P	1

Topic Chem 11 **Q# 239/** IGCSE Chemistry/2018/m/Paper 42/

1(a)(i)	**A**	1
1(a)(v)	M1 **F** M2 **B**	2

Topic Chem 11 **Q# 240/** IGCSE Chemistry/2018/m/Paper 42/

1(c)(i)	two (or more) substances not chemically combined	1
1(c)(ii)	21(%)	1
1(c)(iii)	fractional distillation of liquid air M1 air is made into a liquid M2 (allow air to) boil or evaporate M3 condense the vapours / collect the vapours in order (of evaporation) fractional distillation gets M2 and M3	3
1(c)(iv)	boiling points	1

Topic Chem 11 **Q# 241/** IGCSE Chemistry/2017/w/Paper 43/

4(a)	fractional distillation	1
4(d)(i)	no carbon dioxide produced / more efficient	1
4(d)(ii)	storage of hydrogen is difficult / takes more space to store (hydrogen) / high likelihood of (hydrogen) leaks / lack of availability of hydrogen	1
4(e)(i)	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ **M1** species correct **M2** balanced	2
4(e)(ii)	climate change / greenhouse effect / consequence of climate change	1

Topic Chem 11 **Q# 242/** IGCSE Chemistry/2017/w/Paper 43/

7(a)(i)	diffusion	1
7(a)(ii)	silicon(IV) oxide is a solid, whereas carbon dioxide is a gas	1
7(a)(iii)	photosynthesis	1
	chlorophyll / chloroplasts	1
	M2 sunlight / UV (light)	1
	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ **M1** species correct **M2** balanced	2

Topic Chem 11 **Q# 243/** IGCSE Chemistry/2017/w/Paper 41/

3(b)(i)	prevents air / oxygen **AND** water from reaching the steel	1
3(b)(ii)	magnesium is more reactive than iron / steel	1
	the magnesium corrodes (before the iron / steel) OR the magnesium corrodes preferentially	1
3(b)(iii)	copper is less reactive than iron / steel	1

Topic Chem 11 **Q# 244/** IGCSE Chemistry/2017/s/Paper 43/

4(c)(i)	acid rain	1

4(c)(ii)	*carbon monoxide*: from incomplete combustion (of fuel)	1
	oxides of nitrogen: nitrogen (from the air) reacts with oxygen (from the air)	1
	oxides of nitrogen: at high temperatures (in engine) OR (electrical) spark (in the engine)	1
4(c)(iii)	poisonous / toxic / death	1
4(c)(iv)	any 3 from: • oxides of nitrogen are reduced / lose oxygen (to form nitrogen) • oxides of nitrogen form nitrogen • (oxides of nitrogen) react with carbon monoxide • gases (adsorb / stick) on the catalyst's surface	3

Topic Chem 11 **Q# 245/** IGCSE Chemistry/2017/s/Paper 42/

2(d)(i)	incomplete combustion / incomplete burning / combustion in insufficient air / oxygen	1
	of fossil fuels / named fossil fuel / named petroleum fraction / name or formula of a type of substance containing carbon	1
2(d)(ii)	toxic / poisonous / combines with or binds to haemoglobin	1

Topic Chem 11 **Q# 246/** IGCSE Chemistry/2017/s/Paper 42/

1(a)(i)	fractional distillation	1

Topic Chem 11 **Q# 247/** IGCSE Chemistry/2017/s/Paper 42/

Question	Answer	Marks
3(a)(i)	450 °C	1
	200 atmospheres	1
3(a)(ii)	iron	1
3(b)(i)	4(NO)	1
	5(O_2) **AND** 6(H_2O)	1
3(b)(ii)	lower yield of NO / lower yield of nitric acid / lower yield of product / equilibrium shifts to left (at higher temperatures) / backward reaction favoured(at higher temperatures) ORA	1
3(b)(iii)	too slow / rate decreases ORA	1

Topic Chem 11 **Q# 248/** IGCSE Chemistry/2017/m/Paper 42/

5(d)(iii)	any 2 from: • forms acid rain • kills trees / plants • kills fish • damages (limestone / marble) buildings / statues • causes breathing difficulties	**2**

Topic Chem 11 **Q# 249/** IGCSE Chemistry/2016/w/Paper 42/

3(a)	nitrogen (78%) **AND** oxygen (21%) noble gases **OR** argon (1%)	2
3(b)	nitrogen **AND** oxygen (from the air) react (in the) high temperatures of a car engine NO_x / oxides of nitrogen react with or dissolve in water (to form an acid)	3
3(c)	any 2 from: (named) ruminant animal / cattle / (anaerobic) digestion / flatulence (in animals) / animal waste / (animal) dung decomposing vegetation / animals / organisms / decaying (organic) matter / (fractional distillation / cracking of) petroleum / crude oil / hydrocarbons / natural gas / coal /	2
3(d)	photosynthesis	1

Topic Chem 11 **Q# 250/** IGCSE Chemistry/2016/w/Paper 41/

Question	Answer	Marks
4(a)(i)	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ **M1** formulae **M2** balancing	2
4(a)(ii)	(nitrogen) air / atmosphere (hydrogen) steam / water / hydrocarbons / natural gas	1 1
4(a)(iii)	(temperature) answer in range 370–470 °C (pressure) answer in range 150–300 atm	1 1
4(b)(i)	**M1** forward and reverse reactions (occur) **M2** amounts / moles / concentrations (of reagents and products) constant OR **M2** rate of forward and reverse reactions equal	1 1
4(b)(ii)	endothermic **AND** yield increases as temperature increases	1
4(b)(iii)	**M1** yield decreases (as pressure increases) **M2** because more moles / molecules (of gas) on the right **M3** so position of equilibrium moves left	1 1 1

Topic Chem 11 **Q# 251/** IGCSE Chemistry/2016/s/Paper 43/

3(a)	any 2 from: carbon dioxide; nitrogen; any named noble gas;	**2**
3(b)	any 6 from: carbon monoxide; from incomplete combustion (of carbon-containing fuel); sulfur dioxide; from burning fossil fuels / roasting ores which contain sulphur / volcanoes; oxides of nitrogen; nitrogen reacting with oxygen in car engines / lightning; methane; from anaerobic decomposition / anaerobic decay;	**6**

Topic Chem 11 **Q# 252/** IGCSE Chemistry/2016/s/Paper 42/

6(c)	**M1** zinc is more reactive than iron / zinc is higher in the reactivity series than iron ora; **M2** zinc loses electrons; **M3** iron / steel / oxygen / air / water gains electrons **OR** electrons move to iron / steel / oxygen / air / water; **M4** (therefore) iron does not lose electrons / get oxidised / form iron(II) / form iron(III);	**4** 1 1 1 1

Topic Chem 11 **Q# 253/** IGCSE Chemistry/2016/s/Paper 41/

2(g)(i)	kills bacteria;	1

Topic Chem 11 **Q# 254/** IGCSE Chemistry/2016/m/Paper 42/

5(a)(i)	pressure in range 150–300 atmospheres/atm; temperature in range 370–470 °C; iron (catalyst); balanced equation: $N_2 + 3H_2 \rightarrow 2NH_3$; equilibrium/reversible;	5
5(a)(ii)	manufacture of fertilisers/nylon/nitric acid/cleaning agent(allow oven cleaner)/hair dye/urea/refrigeration/explosives;	1
5(d)(i)	acid rain/effect of acid rain/(photochemical) smog/(producing) low level ozone;	1
5(d)(ii)	**M1** nitrogen and oxygen (from the air) react/combine or word equation; **M2** at high temperature/spark/very hot;	2

Mark Scheme for Topic Chem 12 **Q# 255/** IGCSE Chemistry/2018/w/Paper 43/

1(c)	sulfur dioxide	1

Topic Chem 12 **Q# 256/** IGCSE Chemistry/2018/w/Paper 42/

3(a)	M1 Sulfur dioxide / SO_2 is formed M2 SO_2 reacts with (atmospheric) water (vapour) / rain	2
3(b)(i)	$2SO_2 + O_2 \rightleftharpoons 2SO_3$ M1 Balanced equation M2 reversible arrow	2
3(b)(ii)	M1 450 °C (units required) M2 1–5 atmospheres (units required) M3 Vanadium (V) oxide **or** vanadium pentoxide **or** V_2O_5	3
3(b)(iii)	M1 SO_3 added to (concentrated) H_2SO_4 M2 (Oleum) diluted with / added to water	2

Topic Chem 12 **Q# 257/** IGCSE Chemistry/2018/w/Paper 41/

4(a)(i)	from petroleum or (crude) oil or fossil fuels	1
4(a)(ii)	Contact (process)	1
4(a)(iii)	**M1** vanadium pentoxide **or** vanadium(V) oxide **or** V_2O_5 (catalyst);	1
	M2 1–5 atmospheres; (Units required)	1
	M3 450°C; units required	1
	M4 $2SO_2 + O_2 \rightarrow 2SO_3$;	1
	M5 equilibrium / reversible reaction in equation or text	1
4(b)(i)	water / H_2O	1
4(b)(ii)	carbon / C	1

Topic Chem 12 **Q# 258/** IGCSE Chemistry/2018/w/Paper 41/

1(d)	SO_2/ sulfur dioxide	1

Topic Chem 12 **Q# 259/** IGCSE Chemistry/2018/s/Paper 43/

1(b)	SO_2 / sulfur dioxide	1

Topic Chem 12 **Q# 260/** IGCSE Chemistry/2018/s/Paper 43/

1(f)	V_2O_5 / vanadium(V) oxide	1

Topic Chem 12 **Q# 261/** IGCSE Chemistry/2018/s/Paper 42/

2(f)	sulfur / S	1

Topic Chem 12 **Q# 262/** IGCSE Chemistry/2016/w/Paper 43/

5(a)(i)	burned / heated in air	1
5(a)(ii)	$S + O_2 \rightarrow SO_2$	1
5(b)(i)	equilibrium / reversible	1
5(b)(ii)	vanadium(V) oxide / vanadium pentoxide	1
5(b)(iii)	increase rate (of reaction) / allow lower temperature to be used / allow lower pressure to be used	1
5(b)(iv)	less SO_3 forward reaction is exothermic / it is exothermic / reverse reaction is endothermic	1 1
5(b)(v)	rate too low / reaction too slow / slower	1
5(b)(vi)	more SO_3 fewer moles or molecules (of gas) on right-hand side / more moles or molecules(of gas) on left-hand side	1 1
5(c)(i)	concentrated sulfuric acid / concentrated H_2SO_4	1
5(c)(ii)	$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$	1
5(d)(i)	water	1
5(d)(ii)	$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$	1
5(e)	detergents / car batteries / dyes / paints / synthetic resins / printing inks / metal extraction / cleaning metals /	1

Topic Chem 12 **Q# 263/** IGCSE Chemistry/2016/s/Paper 41/

5(a)	(sulfur-containing) fossil fuels;	1
5(b)	**M1** vanadium pentoxide / vanadium(V) oxide / V_2O_5 (catalyst); **M2** 1–5 atmospheres (units required); **M3** 450 °C (units required); **M4** $2SO_2 + O_2 \rightarrow 2SO_3$; **M5** equilibrium / reversible reaction;	5 1 1 1 1 1
5(c)	$H_2S_2O_7$;	1
5(e)(i)	carbon;	1
5(e)(ii)	dehydration;	1

Topic Chem 12 **Q# 264/** IGCSE Chemistry/2016/m/Paper 42/

6(c)(i)	$4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$ all formulae; balancing;	2
6(c)(ii)	bleaching (in the manufacture of) wood pulp (for paper or straw or wool or cotton) / (food) preservative or killing bacteria in food or wine / fumigant / refrigerant / tanning(leather);	1

Mark Scheme for Topic Chem 13 **Q# 265/** IGCSE Chemistry/2018/s/Paper 43/

1(e)	$Ca(OH)_2$ / calcium hydroxide	1

Topic Chem 13 **Q# 266/** IGCSE Chemistry/2018/m/Paper 42/

3(a)(i)	M1 calcium oxide M2 CaO	2
3(a)(ii)	(step) **3**	1
3(a)(iii)	thermal decomposition	1
3(a)(iv)	heating	1
3(a)(v)	$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$	1

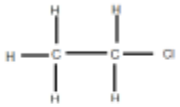
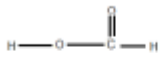
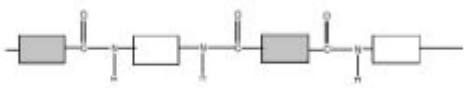
6(a)(i)	**SUMMARY** **M1 and M4** reactants **M2 and M5** conditions **M3 and M6** equation **FERMENTATION:** **M1** glucose / sucrose / starch / other named carbohydrate can score in equation as correct formula **M2** Zymase / Yeast / 37□□C **M3** $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ **HYDRATION:** **M4** Ethene and steam or water can score in equation as correct formulae **M5** H_3PO_4 (catalyst) / 300□□C / 60 atm **M6** $C_2H_4 + H_2O \rightarrow C_2H_5OH$	6
6(a)(ii)	**ANY TWO FROM:-** □ carbohydrates are renewable □ fossil fuels are non-renewable □ lower temperature means fossil fuels conserved **ORA** □ lower temperature means lower energy costs **ORA** □ hydration reaches an equilibrium meaning lower yield **ORA**	2
6(a)(iii)	**M1** solvent **M2** fuel	2
6(b)(i)	**E**	1
6(b)(ii)	**D**	1
6(b)(iii)	**B**	1
6(b)(iv)	**C**	1
6(b)(v)	**A**	1

Topic Chem 14 **Q# 268/** IGCSE Chemistry/2018/w/Paper 42/

5(a)	C_4H_6 Propyne	2
5(b)	M1 one shared pair between each H and C M2 three shared pairs of electrons between the C atoms and no other unpaired electrons	2
5(c)(i)	Any two from: same or similar chemical properties (contain) the same functional group (show) a trend or gradual change in physical properties (consecutive) members differ by CH_2 common methods of preparation	2

5(c)(ii)	C_nH_{2n-2}	1
5(d)	M1 Bromine water **or** aqueous bromine M2 Changes to colourless **or** decolourises	2
5(e)(i)	M1 Acidified; M2 (Potassium) manganate (VII)	2
5(e)(ii)	Diagram of ethanoic acid	1
5(f)(i)	M1 Methyl propanoate M2 Diagram of methyl propanoate	2
5(f)(ii)	Any four carbon ester not named in **5(f)(i)**	
5(g)(i)	Condensation	1
5(g)(ii)	Terylene	1

Topic Chem 14 **Q# 269/** IGCSE Chemistry/2018/w/Paper 41/

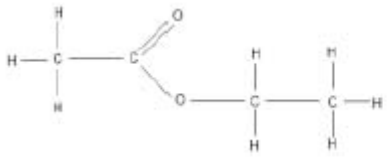
6(a)(i)	**M1** (compound that) contains carbon and hydrogen	1
	M2 and no other elements / only	1
6(a)(ii)	Alkanes: C_nH_{2n+2}	1
	Alcohols $C_nH_{2n+1}OH$ **OR** $C_nH_{2n+2}O$	1
6(a)(iii)	any **two** from: Similar / same chemical properties Same functional group Trend **or** gradual change in physical properties (Neighbouring) members differ by CH_2	**max 2**
6(b)(i)	ultraviolet light / sunlight	1
6(b)(ii)		1
6(b)(iii)	hydrogen chloride	1
6(c)	propyl ethanoate	1
6(d)(i)	$C_5H_{10}O_2$	1
6(d)(ii)	**M1** 	1
	M2 methanoic acid	1
	M3 	1
	M4 butan-2-ol	1
6(e)	 **M1** correct amide link between at least one pair of boxes **M2** all three amide linkages between boxes are correct **M3** continuation bonds shown	3

Topic Chem 14 **Q# 270/** IGCSE Chemistry/2018/w/Paper 41/

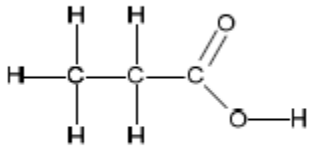
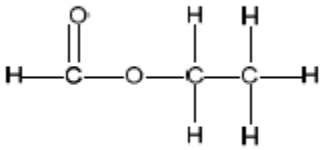
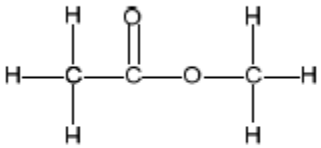
1(c)	CH_4 / methane	1

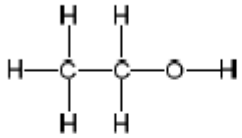
Topic Chem 14 **Q# 271/** IGCSE Chemistry/2018/s/Paper 43/

4(a)	any **two** from: trend in physical properties same/similar chemical properties (same) general formula successive members differ by CH_2 same functional group	**2**
4(c)(i)	$C_2H_4 + H_2O \rightarrow C_2H_5OH$	**1**
4(c)(ii)	$C_6H_{12}O_6 \rightarrow 2CO_2 + 2C_2H_5OH$	**1**
4(c)(iii)	any **one** from: pure(r) product fast(er) reaction continuous process	**1**
4(c)(iv)	any **one** from: renewable feedstock lower temperature lower pressure	**1**
4(d)	(acidified) potassium manganate(VII)	**1**

4(e)(i)	ester linkage correct	**1**
	fully correct molecule 	**1**
4(e)(ii)	ethyl ethanoate	**1**
4(e)(iii)	ester	**1**

Topic Chem 14 **Q# 272/** IGCSE Chemistry/2018/s/Paper 42/

7(c)(i)	structural isomers	**1**
7(c)(ii)	**T**  **V**  **OR** 	**2**
7(c)(iii)	$C_3H_6O_2 + 3½\ O_2 \rightarrow 3CO_2 + 3H_2O$ 1 mark for all formulae correct 1 mark for correct balancing	**2**

7(d)(i)	alcohol / alkanol	1
7(d)(ii)		1
7(e)(i)	(they contain) carbon and hydrogen (atoms)	1
	only	1
7(e)(ii)	alkane: C_nH_{2n+2}	1
	alkene: C_nH_{2n}	1
7(f)	(step 1) crack / cracking (of octane)	1
	(step 1) equation with only C_8H_{18} on left hand side and C_2H_4 + other correct product(s) on right hand side e.g. $C_8H_{18} \rightarrow C_2H_4 + C_6H_{14}$	1
	(step 2) hydration / addition	1
	(step 2) one correct condition for **either** process required (cracking): 450 (❑) C to 800 (❑) C / zeolites / aluminosilicates / silica / SiO_2 / aluminium oxide / Al_2O_3 / alumina / china / broken pot / chromium oxide / Cr_2O_3 / up to 70 atmospheres (hydration): phosphoric acid / H_3PO_4 / 300 (❑)C / 60 atmospheres	1
	$C_2H_4 + H_2O \rightarrow C_2H_5OH$ / CH_3CH_2OH	1

Topic Chem 14 **Q# 273/** IGCSE Chemistry/2018/s/Paper 42/

1(d)	fractional distillation / fractionation	1

Topic Chem 14 **Q# 274/** IGCSE Chemistry/2018/s/Paper 41/

6(a)	(they contain) carbon and hydrogen (atoms)	1
	only	1
6(b)	(all) the (C–C) bonds are single	1
6(c)(i)	(one) atom or group is replaced by another (atom or group)	1
6(c)(ii)	ultra-violet light **OR** sunlight	1
6(c)(iii)	$C_2H_6 + Cl_2 \rightarrow C_2H_5Cl + HCl$ 1 mark for C_2H_5Cl 1 mark for the rest of the equation	2
6(d)(i)	only one product (compound) forms	1
6(d)(ii)	fully displayed formula of 1,2-dibromopropane	1
6(e)	fully displayed formula of but-2-ene	1
	but-2-ene	1
6(f)(i)	poly(ethene)	1
6(f)(ii)	single bond between two C atoms	1
	fully correct answer	1
6(g)	any one correct amide link showing all bonds	1
	both amide links shown in the correct orientation for three amino acids	1
6(h)	ethanol + butanoic acid → ethyl butanoate + water 1 mark for the names of the reactants 1 mark for the name of the ester 1 mark for water as a product	3

Topic Chem 14 **Q# 275/** IGCSE Chemistry/2018/m/Paper 42/

5(a)	homologous series	1
5(b)	$C_nH_{2n+2}O$ OR $C_nH_{2n+1}OH$	1
5(c)(i)	M1 steam M2 catalyst	2
5(c)(ii)	$2C_3H_7OH + 9O_2 \rightarrow 6CO_2 + 8H_2O$ M1 species M2 fully correct equation	2
5(d)(i)	M1 at least one –O– link between two blocks M2 correct structure including continuation bonds	2
5(d)(ii)	hydrolysis	1
5(d)(iii)	enzyme OR heat + acid	1

Topic Chem 14 **Q# 276/** IGCSE Chemistry/2018/m/Paper 42/

1(a)(vi)	M1 **G** M2 **H**	2

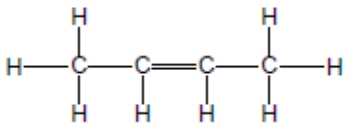
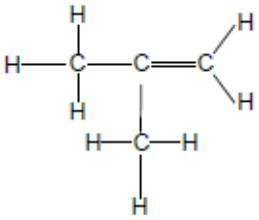
Topic Chem 14 **Q# 277/** IGCSE Chemistry/2017/w/Paper 43/

4(e)(iii)	fermentation	1

Topic Chem 14 **Q# 278/** IGCSE Chemistry/2017/w/Paper 43/

1(c)	compound	1

Topic Chem 14 **Q# 279/** IGCSE Chemistry/2017/w/Paper 43/

6(a)(i)	compounds containing carbon and hydrogen **only**	1
6(a)(ii)	*alkanes:* C_nH_{2n+2}	1
	alkenes: C_nH_{2n}	1
6(a)(iii)	any 2 from: • same or similar chemical properties • (consecutive members) differ by CH_2 • same functional group • common (allow similar) methods of preparation • physical properties vary in predictable manner / show trends / gradually change OR example of a physical property variation	2
6(a)(iv)	 **OR** 	1
6(a)(v)	structural isomers	1

6(b)(i)	**more than** enough oxygen to react with **all** of the hydrocarbon	1
6(b)(ii)	125 (cm^3)	1
6(b)(iii)	1:5:3	1
6(b)(iv)	C_3H_8 If full credit is not awarded, allow 1 mark for $C_xH_y(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$	2

Topic Chem 14 **Q# 280/** IGCSE Chemistry/2017/w/Paper 43/

7(b)(i)	condensation	1
7(b)(ii)	hydrolysis	1
7(b)(ii)	HO–□–OH OR H–O–□–O–H	1

Topic Chem 14 **Q# 281/** IGCSE Chemistry/2017/w/Paper 42/

3(d)(i)	cracking	1
3(d)(ii)	$C_{12}H_{26} \rightarrow 3C_2H_4 + C_6H_{14}$ **M1** $C_{12}H_{26}$ **M2** rest of equation	2
3(d)(iii)	phosphoric acid	1
	heat	1
3(d)(iv)	addition / hydration	1
3(d)(v)	measure its boiling temperature	1
	compare to (known) data	1
3(e)(i)	any 2 from: □ 37 °C □ anaerobic □ glucose is aqueous □ yeast	2
3(e)(ii)	$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ **M1** CO_2 as a product **M2** Rest of equation	2
3(e)(iii)	yeast is killed by the ethanol	1
3(e)(v)	slow rate of reaction	1
3(e)(v)	uses renewable resources / does not use a finite resource	1
3(e)(vi)	fractional distillation	1
3(f)(i)	CH_3O	1
3(f)(ii)	no (C=C) double bonds	1
3(f)(iii)	at least two alternating rectangles with attempted linking	1
	one displayed ester link (all atoms and all bonds)	1
	fully correct structure with at least one repeat unit including continuation bonds from correct atom or rectangle	1
3(f)(iv)	polyester	1

Topic Chem 14 **Q# 282/** IGCSE Chemistry/2017/w/Paper 41/

4(a)(i)	$\rightarrow 2(C_2H_5OH) + 2CO_2$ **M1** carbon dioxide made as product **M2** balanced	2
4(a)(ii)	any 2 from: □ 37 °C □ anaerobic □ glucose is aqueous □ yeast	2
4(b)(i)	(concentrated) phosphoric acid	1
4(b)(ii)	92 If full credit is not awarded, allow 1 mark for M_r of ethene = 28	2
4(c)(i)	(acidified) potassium manganate(VII) OR potassium (di)chromate(VI)	1

4(d)(ii)	**M1** (acids) have same concentration	1
	M2: measure pH OR describe how to measure pH (such as use Universal Indicator) **M3**: lower pH corresponds to the stronger acid / hydrochloric acid OR **M2**: add calcium / magnesium / zinc / iron **M3**: faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid OR **M2**: rate of reaction with (metal) carbonate **M3**: faster rate of forming bubbles corresponds to the stronger acid / hydrochloric acid OR **M2**: rate of reaction with (named) metal oxide **M3**: dissolves faster means that reaction is with the stronger acid / hydrochloric acid OR **M2**: electrical conductivity **M3**: greater conductivity corresponds to the stronger acid / hydrochloric acid OR **M2**: add sodium hydroxide (or other named alkali) **M3**: greater temperature change corresponds to the stronger acid / hydrochloric acid	2
4(e)	structure of propanoic acid	1
	propanoic acid	1
	structure of butan-1-ol	1
	butan-1-ol	1

Topic Chem 14 **Q# 283/** IGCSE Chemistry/2017/s/Paper 43/

4(a)	petroleum	1
4(b)(i)	*saturated:* only single bonds OR no double / multiple bonds (between carbon atoms)	1
	hydrocarbon: (compound that) contains carbon and hydrogen	1
	hydrocarbon: and no other elements / only	1
4(b)(ii)	alkane(s)	1
4(b)(iii)	any 2 from: • same / similar chemical properties • (same) general formula • (consecutive members) differ by CH_2 • same functional group • common (allow similar) methods of preparation • physical properties vary in predictable manner / show trends / gradually change / example of a physical property variation	2
4(b)(iv)	CO_2 and H_2O on right-hand side and no other products / reagents	1
	11 (O_2), 7 (CO_2), 8 (H_2O)	1
4(d)(i)	butane	1
4(d)(ii)	(molecules with) the same molecular formula	1
	different structural formula / different displayed formula	1
4(d)(iii)	**UV** light / **sun**light	1
	H–C*l*	1
	any mono to deca chloro-substituted derivative of methyl propane	1

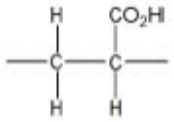
Topic Chem 14 **Q# 284/** IGCSE Chemistry/2017/s/Paper 43/

Question	Answer	Marks
2(a)(i)	CH_2	1
2(a)(ii)	initial colour: orange	1
	final colour: colourless / none	1

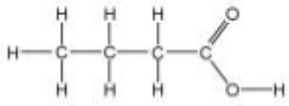
Topic Chem 14 **Q# 285/** IGCSE Chemistry/2017/s/Paper 42/

1(a)(iii)	fermentation / ferment	1

Topic Chem 14 **Q# 286/** IGCSE Chemistry/2017/s/Paper 42/

6(a)(i)	alkene	1
	carboxylic acid	1
6(a)(ii)	any 2 from: • same / similar chemical properties • (same) general formula • (consecutive members) differ by CH_2 • same functional group • common (allow similar) methods of preparation • physical properties vary in predictable manner / show trends / gradually change / example of a physical property variation	2
6(b)	carboxylic acid / aldehyde	1
	ester	1
6(c)(i)	colourless / decolourised	1
	bubbles / fizzing / effervescence	1
6(c)(ii)	addition	1
	 repeat unit	1
	continuation bonds at both ends	1

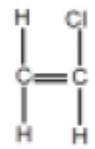
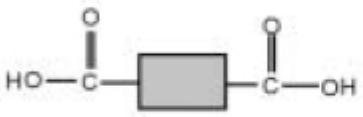
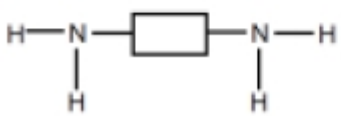
Topic Chem 14 **Q# 287/** IGCSE Chemistry/2017/s/Paper 41/

6(a)	(compound that) contains carbon and hydrogen	1
	and no other elements / only	1
6(b)	any 3 from: • same / similar chemical properties • (same) general formula • (consecutive members) differ by CH_2 • same functional group • common (allow similar) methods of preparation • physical properties vary in predictable manner / show trends / gradually change / example of a physical property variation	3
6(c)	propene	1
	structure correctly shown	1
6(d)	steam	1
	catalyst	1
6(e)(i)	butanoic acid	1
		1
6(e)(ii)	acidified	1
	(potassium) manganate(VII)	1
6(e)(iii)	oxidation	1
6(f)	methanol	1
	ethanoic acid	1
	catalyst	1
	heat	1
	$CH_3COOH + CH_3OH \rightarrow CH_3COOCH_3 + H_2O$	1

Topic Chem 14 **Q# 288/** IGCSE Chemistry/2017/m/Paper 42/

1(a)(i)	**A**	**1**
1(a)(ii)	**B and C**	**1**
1(a)(iii)	**D**	**1**
1(a)(iv)	**A**	**1**
1(a)(v)	**A**	**1**
1(a)(vi)	carbon dioxide **and** water	**1**
1(b)(i)	bitumen	**1**
1(b)(ii)	refinery gas	**1**
1(b)(iii)	refinery gas	**1**
1(b)(iv)	kerosene	**1**
1(b)(v)	heated / boiled / evaporated / vaporised	**1**

Topic Chem 14 **Q# 289/** IGCSE Chemistry/2017/m/Paper 42/

7(a)(i)	circle drawn round two consecutive carbons which includes 3 H atoms and 1 C*l* atom	**1**
7(a)(ii)		**1**
7(a)(iii)	**M1** stays yellow / orange / brown or no change	**1**
	M2 becomes colourless	**1**
7(b)(i)	polyamide	**1**
7(b)(ii)	circle must include exactly two C=O, two N–H, one shaded square and one unshaded square	**1**
7(b)(iii)	**M1** 	**1**
	M2 	**1**

Topic Chem 14 **Q# 290/** IGCSE Chemistry/2016/w/Paper 43/

6(a)(i)	*condensation:* **M1** (two) molecules / monomers joining **M2** with the removal of a (small) molecule *polymerisation:* **M3** (to form) a large molecule / a long chain	3
6(a)(ii)	addition	1
6(b)(i)	circled amide link	1
6(b)(ii)	all missing atoms and bonds shown on the diacid all missing atoms and bonds shown on the diamine	1 1
6(b)(iii)	nylon / Kevlar / Nomex	1
6(c)(i)	amino acids	1
6(c)(ii)	hydrolysis chromatography (spray with) locating agent / UV determine R_f values / compare with standards	1 1 1 1

Topic Chem 14 **Q# 291/** IGCSE Chemistry/2016/w/Paper 42/

5(c)(i)	the (C=C) double bond	1
5(c)(ii)	addition OR bromination	1
5(d)(i)	substitution	1
5(d)(ii)	(compounds with the) same molecular formula different structural formulae or structures	2
5(d)(iii)	structure of 1–chloropropane structure of 2–chloropropane	2

Topic Chem 14 **Q# 292/** IGCSE Chemistry/2016/w/Paper 42/

7(a)	large / big molecule made from (many) monomers (joined together)	2
7(b)(i)	hydrolysis	1
7(b)(ii)	acid (conditions) / enzyme	1
7(d)	fully displayed amide link between any two 'blocks' dipeptide 1: amino acid A on left-hand side and amino acid B on right-hand side AND dipeptide 2: amino acid B on left-hand side and amino acid A on right-hand side correct terminal amine and carboxylic acid group on both correct dipeptides	3

Topic Chem 14 **Q# 293/** IGCSE Chemistry/2016/w/Paper 41/

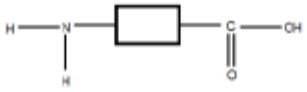
3(a)(i)	heated / evaporated / boiled	1
3(a)(ii)	any 2 from: (O is) more viscous / thicker (O is) darker (O has) longer / bigger molecules / more carbon atoms (O has a) higher boiling point OR melting point (O is) less flammable	2
3(b)	any 2 from: similar / same chemical properties same functional group trend / pattern in physical properties (neighbouring members) differ by CH_2 common methods of preparation	2
3(c)	any 2 structures from: pentane methylbutane dimethylpropane	2

3(d)	correct structure with any number from 1 to 6 of the hydrogen atoms replaced by chlorine atoms	1
3(e)(i)	(ends in) ene	1
3(e)(ii)	**M1** 88.24 / 12 **AND** 11.76 / 1 **M2** 7.353 / 7.353 (= 1) **AND** 11.76 / 7.353 = (1.6) **M3** C_5H_8	1 1 1
3(e)(iii)	relative molecular mass	1

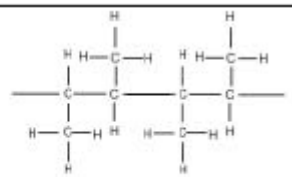
Topic Chem 14 **Q# 294/** IGCSE Chemistry/2016/w/Paper 41/

6(a)	large / big molecule made from (many) monomers (joined together)	1 1
6(b)(i)	amide / peptide	1
6(b)(ii)	(can be) broken down by microbes / bacteria	1 1
6(b)(iii)	starch / cellulose / DNA / RNA / polysaccharides /	1
6(c)(i)	**M1** at least one correct ester linkage between boxes **M2** at least two boxes shown and sufficient correct C and O atoms to make two correct ester linkages **M3** continuation bond(s) **AND** if more than one repeat unit is shown, the repeat unit must be correctly identified	1 1 1

Topic Chem 14 **Q# 295/** IGCSE Chemistry/2016/s/Paper 43/

6(d)(i)	amide;	1
6(d)(ii)	proteins are made from more than two monomers; **OR** nylon is made from 1 or 2 monomers (only);	1
6(d)(iii)	amino acids;	1
6(e)	 ;	1

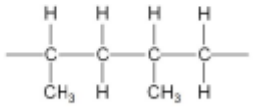
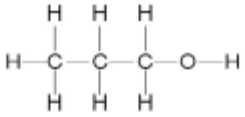
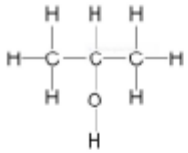
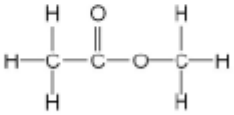
Topic Chem 14 **Q# 296/** IGCSE Chemistry/2016/s/Paper 43/

2(a)	butane;	1
2(b)	compounds: E **and** F; general formula: C_nH_{2n+2}; **OR** compounds: A **and** B; general formula: C_nH_{2n};	2 1 1 1 1
2(c)	compounds: E **and** F; explanation: same molecular formula / contain the same number of atoms each element; different structures / different structural formulae / different arrangement of atoms;	3 1 2
2(d)	contains a double bond / not all bonds are single bonds; C and H only;	2 1 1
2(e)	$C_2H_4 + H_2O \rightarrow C_2H_5OH$; any 2 from: high temperature / 220 °C–350 °C; high pressure / 60 atm–70 atm; phosphoric acid catalyst;	3 1 2
2(f)	 **M1** correct carbon structure with only single bonds; **M2** continuation bonds;	2

Topic Chem 14 **Q# 297/** IGCSE Chemistry/2016/s/Paper 42/

5(b)(i)	C_7H_{16};	1
5(b)(ii)	contains a double bond/triple bond/multiple bond; **OR** not all bonds are single bonds;	1
5(b)(iii)	test: aqueous bromine/bromine (water)/Br_2; result: (orange/yellow/brown) to colourless/decolourised/colour disappears;	2 1 1
5(c)(i)	addition;	1
5(c)(ii)	1 (kg);	1
5(c)(iii)	propene: CH_2; polypropene: CH_2;	2 1 1

Topic Chem 14 **Q# 298/** IGCSE Chemistry/2016/s/Paper 41/

Question	Answer	Marks
6(a)	fractional distillation; cracking;	2 1 1
6(b)(i)	addition;	1
6(b)(ii)	CH_2;	1
6(b)(iii)	 **M1** chain of 4 carbon atoms with single bonds and continuation bonds; **M2** correctly positioned CH_3 side chains;	2
6(c)	  ;	2
6(d)(i)	(concentrated) sulfuric acid;	1
6(d)(ii)	methyl ethanoate;	1
6(d)(iii)	 **M1** ester link; **M2** rest of molecule;	2
6(d)(iv)	terylene;	1

Topic Chem 14 **Q# 299/** IGCSE Chemistry/2016/m/Paper 42/

3(d)(i)	(complete) combustion/burning;	1
3(d)(ii)	photosynthesis;	1
3(d)(iii)	respiration;	1

Topic Chem 14 **Q# 300/** IGCSE Chemistry/2016/m/Paper 42/

7(a)(i)	compound containing carbon and hydrogen only;	1
7(a)(ii)	C_nH_{2n+2}; C_nH_{2n};	2
7(c)	methyl ethanoate; CH_3COOCH_3; / ethyl methanoate; $HCOOC_2H_5$;	4
7(d)	methyl propanoate;	1
7(e)(i)	condensation;	1
7(e)(ii)	water/H_2O;	1
7(e)(iii)	dicarboxylic acid or diacyl chloride; diol;	2