Name

iG Chem 1 EQ P4 FINAL Master NEW 2016m to 2019s 180marks

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	7:25 AM							
1	7:50 AM							
2	8:40 AM							
3	9:35 AM							
4	10:25 AM							
5	11:15 AM							
Lunch	12:10 PM							
6	1:10 PM							
7	2:00PM							
8	2:50 PM							
9	3:40 PM							
	4:20 PM							
	5:00 PM							
	5:30 PM							
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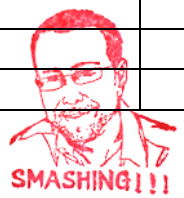


Name

End of Topic 3 Goals Checklist

For each topic you ought to try to do as many of the following things to get the most out of your time, the resources available to you and to help you grow as a student. Tick each goal off as you complete it. Growth is difficult and uncomfortable, but you should choose to do these things, and the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win!

Aspect	What you should have done	Yes/No	Level
Interacted with your teacher	Ask your teacher 1 question, about anything, once a week		FUNDAMENTAL
	Try to answer one question asked by your teacher at least once a week		ESSENTIAL
	Ask your teacher one question about something you do not understand in science once a week		ESSENTIAL
	Ask your teacher one question about something to do with science every lesson		EXTENSION
Notes and follow up notes	Complete set of class note		FUNDAMENTAL
	Cornell Notetaking Attempted		ESSENTIAL
	Cornell Notetaking Completed		EXTENSION
	Cornell Notetaking Completed to an exemplary standard		EXCEPTIONAL
	Attempted the Mind Map for this topic		ESSENTIAL
	Completed the Mind Map for this topic		EXTENSION
Textbook	Read ahead before the topic has been started		EXTESNION
	Highlighted key ideas and translate new words		FUNDAMENTAL
	Completed the questions at the end of each 2 page spread in your exercise book		EXTENSION
	Added to your class notes ideas and important information from the textbook that you learnt		EXTENSION
Past Exam Questions	Worked on at least 25% of the exam questions in this workbook		FUNDAMENTAL
	Attempted more than 25% of the questions and those questions you have completed you have marked in a different colour pen		ESSENTIAL
	Completed and marked all questions here		EXTENSION
	Completed, marked and additional key ideas where you have located the most difficult marks added to your notebook		EXCEPTIONAL
	Used the resources available online to answer additional questions not found in this workbook on the current topic.		EXCEPTIONAL
	Ask your teacher about an exam question that they cannot answer		EXCEPTIONALLY SMASHING!!!
Assessed Activities	Complete the word list activity using the word list at the front of each topic as little as possible		FUNDAMENTAL
	Complete 2 assessed activities, either in class or as homework		ESSENTIAL
	Complete 2 assessed activities and scored over 70% on average		ESSENTIAL
	Complete 2 assessed activities and scored over 80% on average		EXTENSION
	Complete 2 assessed activities and scored over 90% on average		EXCEPTIONAL
End of Topic Test	Revised sufficiently well to improve upon your score from the previous test (except if you are scoring over 90%, then just write Y for this goal)		ESSENTIAL
	Scored 10% higher than your current average		EXTENSION
	Scored 15% or more than your previous end of topic average		EXCEPTIONAL
	Scored over 90%		EXTESNION
	Scored over 95%		SMASHING!!!
Reading	Spend more than 1 hour a week reading a book **you enjoy** (in any language) about anything.		ESSENTIAL

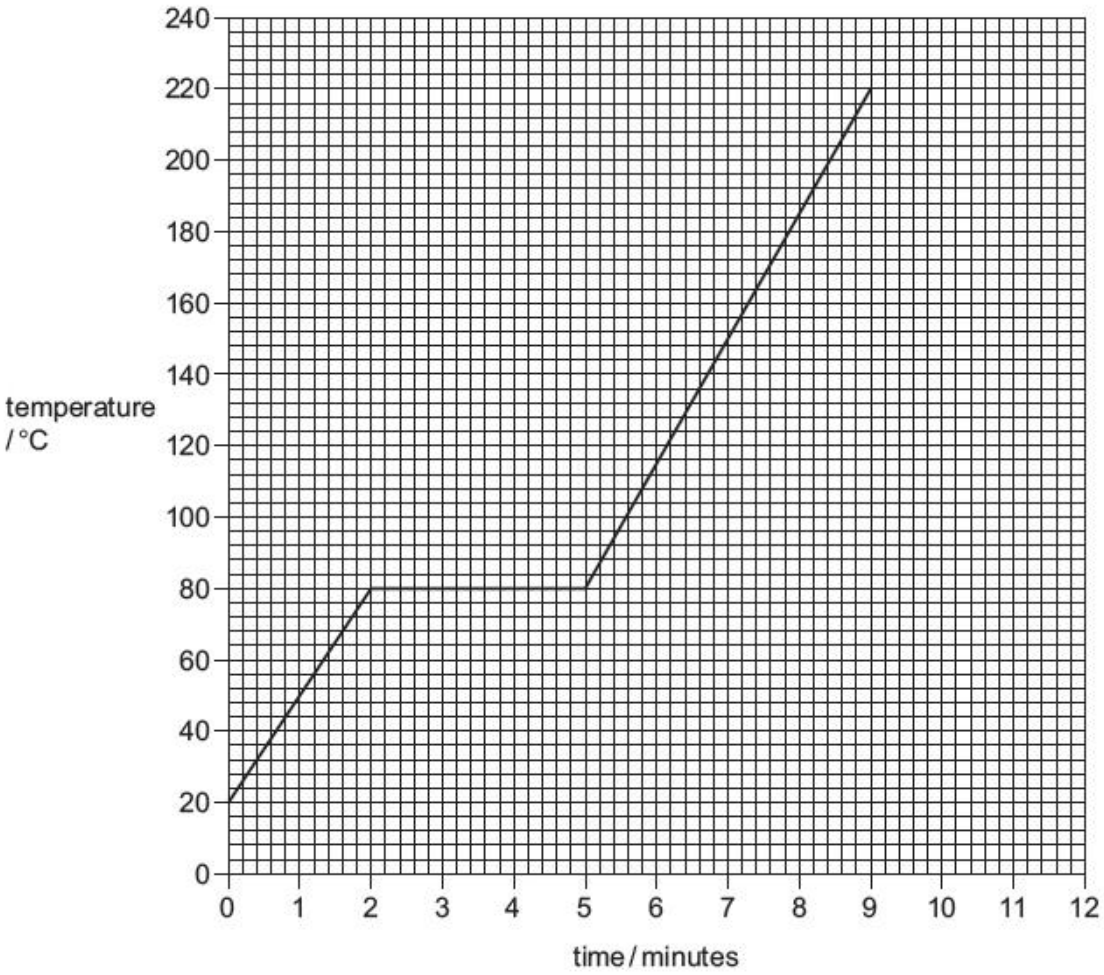
Aspect	What you should have done	Yes/No	Level
	Spend more than 3 hours a week reading a book **you enjoy** (in any language) about anything.		EXTENSION
	Spend more than 5 hours a week reading a book **you enjoy** (in any language) about anything.		EXCEPTIONAL
	Spend at least one hour a week reading a book **you enjoy** in English about anything.		EXTENSION
	Spend more than 3 hours a week reading a book **you enjoy** in English about anything.		EXCEPTIONAL
Reflection	You completed this goal setting table		FUNDAMENTAL
	You have looked at the goals you have achieved and the ones you have not and added them up and entered them into the table in the Review and Reflection section		ESSENTIAL
	You have given an answer for every question in the Review and Reflection section at the end of this topic		EXTENSION
	You have Given good and thoughtful answers for every question in the Review and Reflection section at the end of this topic		EXCEPTIONAL

For a variety of Keyword exercises, tests and flashcards for the first 3 topics

https://quizlet.com/652457468/ig-chem-1-to-3-kw-all-89-key-words-flash-cards/?i=ga2m8&x=1jqt

2 **Z** is a covalent substance. In an experiment, a sample of pure solid **Z** was continually heated for 11 minutes.

The graph shows how the temperature of the sample of pure **Z** changed during the first 9 minutes.



(a) What is the melting point of pure **Z**?

..... °C [1]

(b) The sample of pure **Z** began to boil at 9 minutes. It was boiled for 2 minutes.

Use this information to sketch on the grid how the temperature of the sample of pure **Z** changed between 9 minutes and 11 minutes. [1]

(c) The sample of pure **Z** was continually heated between 2 minutes and 5 minutes.

Explain, in terms of attractive forces, why there was no increase in the temperature of the sample of pure **Z** between 2 minutes and 5 minutes.

.....

.....

..... [2]

(d) Describe how the motion of particles of pure **Z** changed from 0 minutes to 2 minutes.

.....

..... [2]

(e) The experiment was repeated using a solid sample of **impure Z**.

Suggest the differences, if any, in the melting point and boiling point of the sample of impure **Z** compared to the sample of pure **Z**.

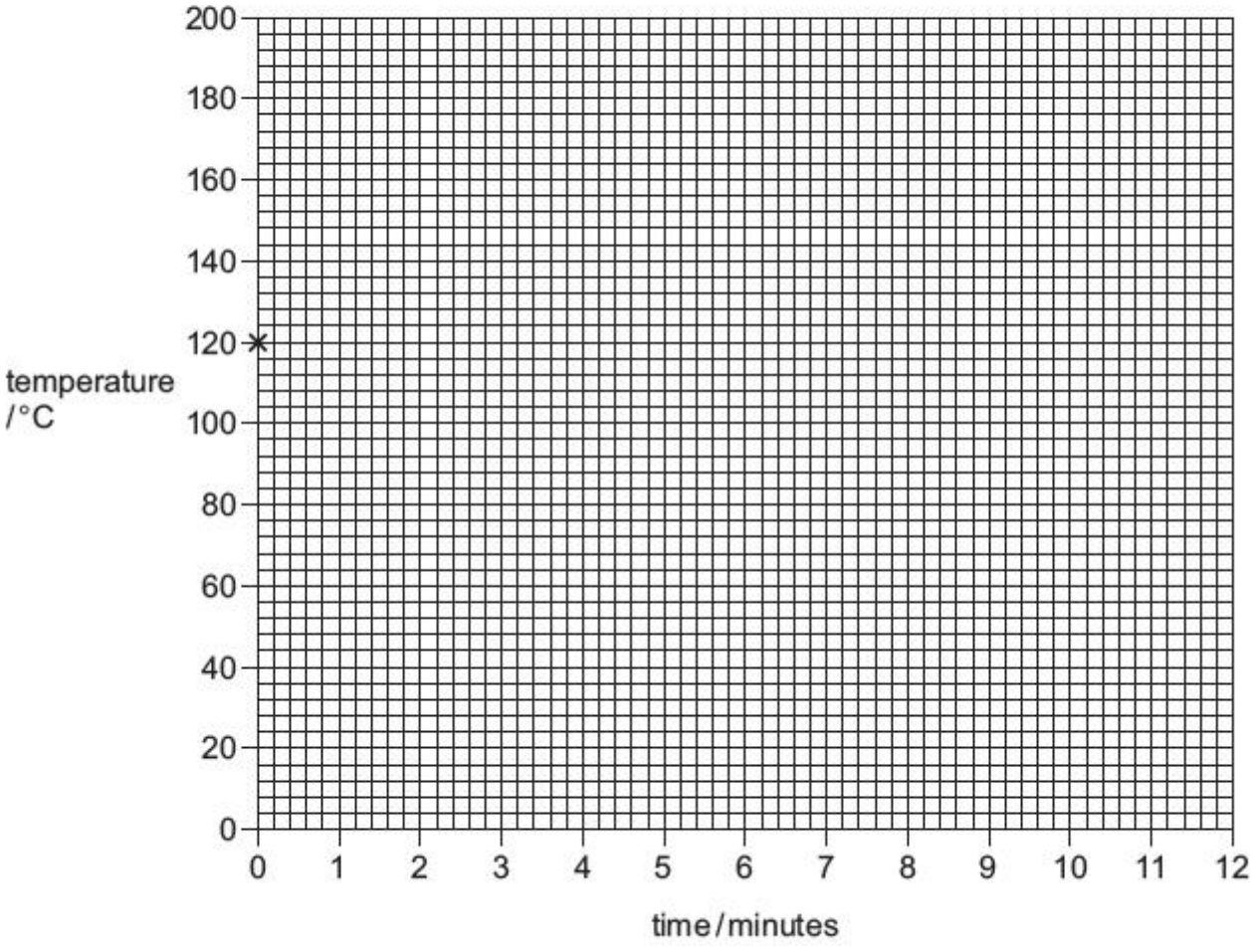
melting point .....

boiling point .....

[2]

(f) A sample of pure **Z** was allowed to cool from 120 °C to 20 °C. The total time taken was 8 minutes.

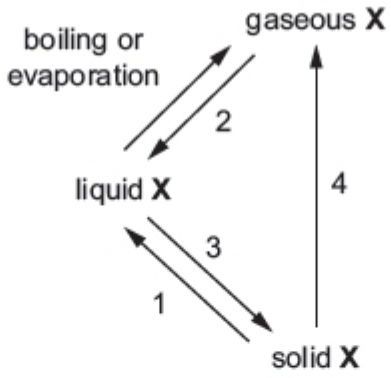
Starting from point **×**, sketch on the grid how the temperature of the sample of pure **Z** changed between 0 minutes and 8 minutes.



[2]

[Total: 10]

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.

.....

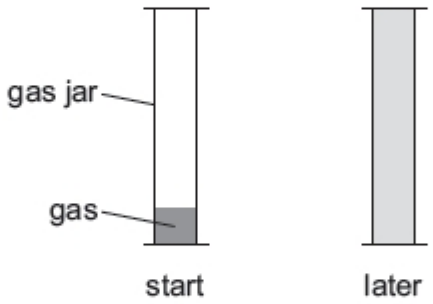
.....

..... [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]

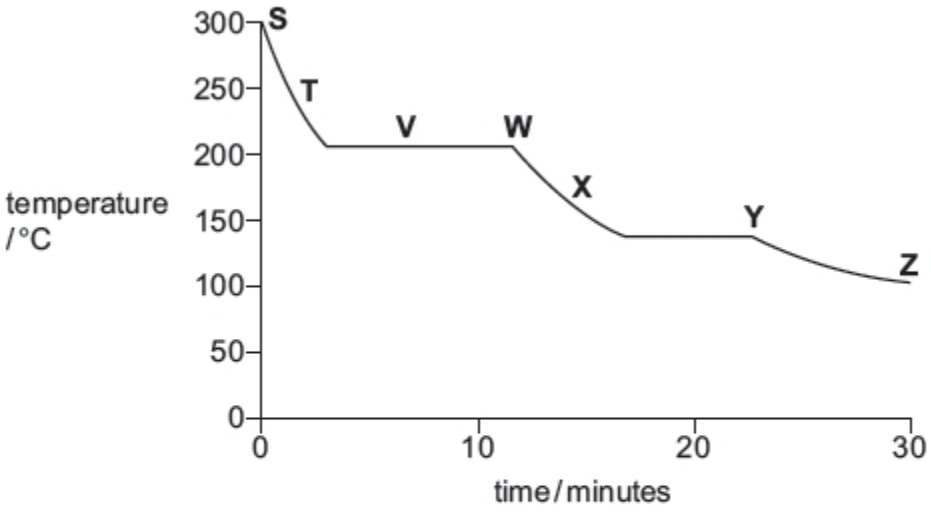
(iii) Explain why increasing the temperature increases the rate at which the gas particles spread out.

.....

..... [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]

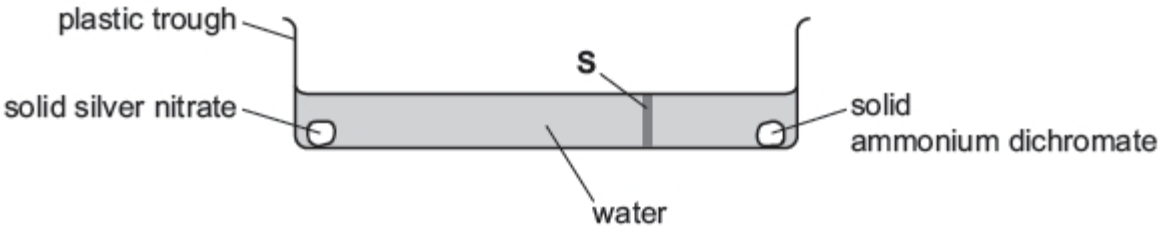
Topic Chem 1 **Q# 5/** IGCSE Chemistry/2017/m/Paper 42/

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# 6/** 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 3 **Q# 7/** iGCSE Chemistry2019/w/Paper 41/Q2/

2 **(a)** Sulfur exists as a number of different isotopes.

What is meant by the term *isotopes*?

.....

.....

..... [2]

(b) A sulfide ion has the symbol shown.

$$^{34}_{16}S^{2-}$$

(i) How many neutrons are contained in this sulfide ion?

..... [1]

(ii) How is a sulfide ion, S^{2-}, formed from a sulfur atom?

..... [1]

(iii) Which element forms an ion with a 2+ charge that has the same number of electrons as a S^{2-} ion?

..... [1]

Topic Chem 3 **Q# 8/** iGCSE Chemistry2019/s/Paper 41/Q1/

1 This question is about the structures of atoms and ions.

(a) Define the term *proton number*.

.....

..... [2]

(b) (i) Complete the table to show the number of protons, neutrons and electrons present in atoms of $^{24}_{12}Mg$ and $^{26}_{12}Mg$.

	number of protons	number of neutrons	number of electrons
$^{24}_{12}Mg$			
$^{26}_{12}Mg$			

[2]

(ii) What term is used to describe atoms of the same element, such as $^{24}_{12}Mg$ and $^{26}_{12}Mg$?

..... [1]

(iii) Explain why the chemical properties of $^{24}_{12}Mg$ and $^{26}_{12}Mg$ are the same.

.....

..... [2]

(c) Complete the table to identify the atoms and ions which have the following numbers of protons, neutrons and electrons.

	number of protons	number of neutrons	number of electrons
$^{23}_{11}Na^{+}$	11	12	10
	4	5	4
	17	20	18

[4]

(d) State the electronic structure of the following atom and ion.

Al .....

S^{2-} .....

[2]

Topic Chem 3 **Q# 9/** 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**

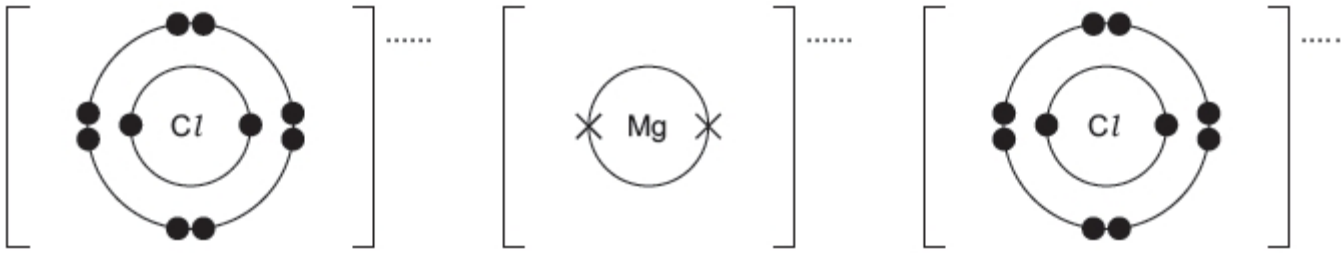
State which substance is:

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

Topic Chem 3 **Q# 10/** 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 .....

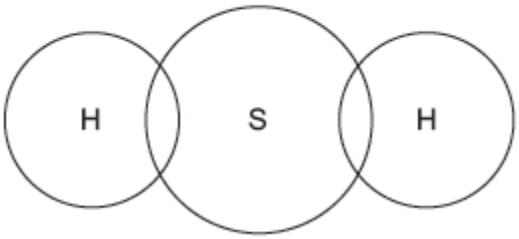
3 .....

[3]

Topic Chem 3 **Q# 11/** 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# 12/** 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		

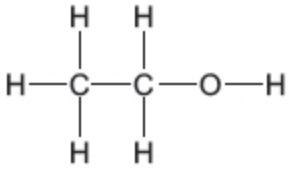
(a) Complete the table. The first row has been done for you. [4]

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

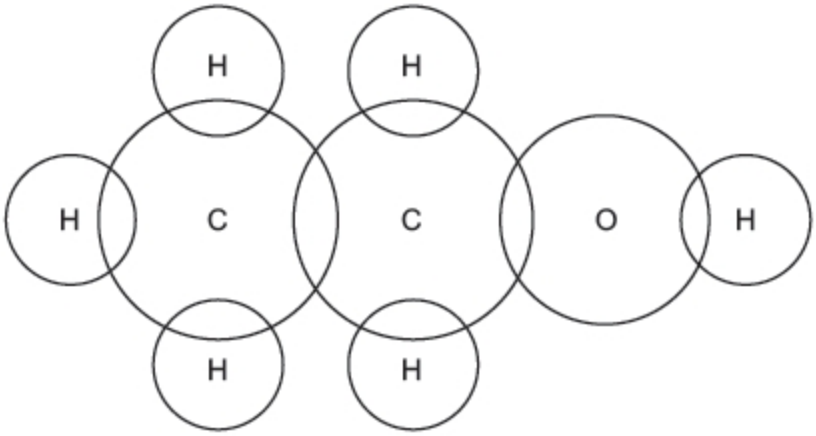
..... [1]

Topic Chem 3 **Q# 13/** 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# 14/** 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# 15/** 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# 16/** 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, I*Cl*, 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# 17/** 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# 18/** 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# 19/** 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}F*l* and ^{289}F*l*. 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}F*l*			
^{289}F*l*			

[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]

6 Dilute hydrochloric acid, $HCl(aq)$, reacts with aqueous sodium carbonate, $Na_2CO_3(aq)$.

The chemical equation for the reaction is shown.

$$2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$$

(a) A 25.0 cm^3 portion of $Na_2CO_3(aq)$ was placed in a conical flask with a few drops of a suitable indicator. It was titrated against $HCl(aq)$ of concentration 0.180 mol/dm^3.

20.0 cm^3 of $HCl(aq)$ was required to reach the end-point.

Calculate the concentration of the $Na_2CO_3(aq)$, in mol/dm^3, using the following steps.

- Calculate the number of moles of HCl used in the titration.

..... mol

- Calculate the number of moles of Na_2CO_3 contained in the 25.0 cm^3 portion of $Na_2CO_3(aq)$.

..... mol

- Calculate the concentration of the $Na_2CO_3(aq)$ in mol/dm^3.

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

(b) In another experiment, the volume of carbon dioxide, CO_2, produced was 48.0 cm^3, measured at room temperature and pressure.

How many moles of CO_2 is this?

moles of CO_2 = ... mol [1]

(c) A sample of concentrated hydrobromic acid, HBr(aq), was electrolysed using platinum electrodes.
The concentration of the hydrobromic acid was 8.89 mol/dm³.

(i) Calculate the concentration of the HBr(aq) in g/dm³.

concentration of HBr(aq) = ... g/dm³ [1]

Topic Chem 4 **Q# 21/** iGCSE Chemistry2019/w/Paper 41/Q2/

(e) Sulfur dioxide reacts with aqueous sodium sulfite to produce a compound with the following composition by mass: 29.1% Na, 40.5% S and 30.4% O.

Calculate the empirical formula of this compound.

empirical formula = ... [3]

Topic Chem 4 **Q# 22/** iGCSE Chemistry2019/s/Paper 41/Q4/

(c) Hydrochloric acid produces salts called chlorides.

Magnesium carbonate reacts with hydrochloric acid to produce magnesium chloride.

$$MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2O + CO_2$$

A student used 50.00 cm³ of 2.00 mol/dm³ hydrochloric acid in an experiment to produce magnesium chloride.

Calculate the mass, in g, of magnesium carbonate needed to react exactly with 50.00 cm³ of 2.00 mol/dm³ hydrochloric acid using the following steps.

- Calculate the number of moles of HCl present in 50.00 cm³ of 2.00 mol/dm³ HCl.

..... mol

- Determine the number of moles of $MgCO_3$ which would react with 50.00 cm^3 of 2.00 mol / dm^3 HC*l*.

..... mol

- Calculate the relative formula mass, M_r, of $MgCO_3$.

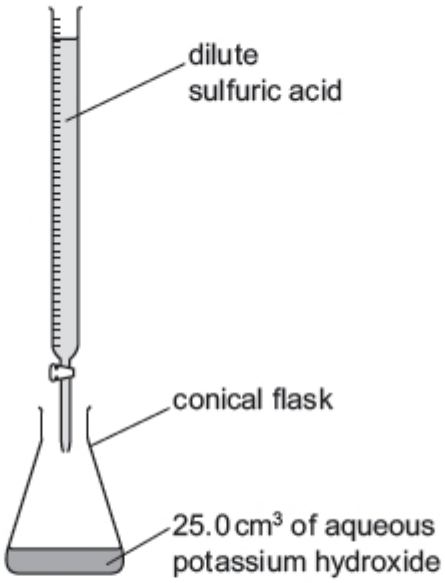
M_r of $MgCO_3$ = ...

- Calculate the mass of $MgCO_3$ needed to react exactly with 50.00 cm^3 of 2.00 mol / dm^3 HC*l*.

mass = ... g
[4]

Topic Chem 4 **Q# 23/** IGCSE Chemistry/2018/w/Paper 43/Q4/

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]

Topic Chem 4 **Q# 24/** 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.

(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# 26/** 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# 27/** 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# 28/** 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# 29/** 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# 30/** 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# 31/** 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]

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]

Mark Scheme

Q# 1/ iGCSE Chemistry2019/s/Paper 41/Q2/

2(a)	80(°C) (1)	1
2(b)	horizontal line from end of graph at minute 9 to minute 11 (1)	1
2(c)	energy is used to break bonds / overcome attraction (1) between molecules (1)	2
2(d)	vibrations (1) increase (1)	2
2(e)	melting point decreases (1) boiling point increases (1)	2
2(f)	decrease from 120 °C to 80 °C and horizontal line at 80 °C (1) decrease from horizontal line to finish at 20 °C at 8 mins (1)	2

Q# 2/ 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

Q# 3/ 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

Q# 4/ 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

Q# 5/ 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

Q# 6/ 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

Q# 7/ iGCSE Chemistry2019/w/Paper 41/Q2/

2(a)	atoms with same number of protons or atoms of the same element or atoms with same atomic number (1) atoms with different number of neutrons or atoms with different mass number or atoms with different nucleon number (1)	2
2(b)(i)	18	1
2(b)(ii)	gain of two electrons	1
2(b)(iii)	Ca / calcium	1

Q# 8/ iGCSE Chemistry2019/s/Paper 41/Q1/

1(a)	number of protons (1) protons in the nucleus (of an atom) (1)	2
1(b)(i)	12p 12n 12e (1) 12p 14n 12e (1)	2
1(b)(ii)	isotope(s)	1
1(b)(iii)	same number of electrons (1) (same number) of electrons in the outer shell (1)	2
1(c)	$^{9}_{4}Be$ any element symbol with a single negative charge (1) use of *Cl* (1) use of $^{37}_{17}$ (1)	4
1(d)	2 8 3 (1) 2 8 8 (1)	2

Q# 9/ IGCSE Chemistry/2018/w/Paper 43/

1(f)	sodium chloride	1

Q# 10/ 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

Q# 11/ 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

Q# 12/ 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

Q# 13/ 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

Q# 14/ 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

Q# 15/ IGCSE Chemistry/2018/s/Paper 42/

2(a)	silicon / Si	1

Q# 16/ 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)	$I_2 + Cl_2 \rightarrow 2ICl$ 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

Q# 17/ 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)					

Q# 18/ IGCSE Chemistry/2018/s/Paper 41/

1(a)	a substance made from two (or more) **elements**	1
	chemically combined	1

Q# 19/ 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

Q# 20/ iGCSE Chemistry2019/w/Paper 41/Q6/

6(a)	correct final answer = 0.072(0) **M1** moles $HCl = 0.0036(0)$ **M2** moles $Na_2CO_3 = 0.0018(0)$ (**M1** / 2) **M3** concentration $Na_2CO_3 = 0.072$ (**M2** / 0.025)	3
6(b)	0.002(00)	1
6(c)(i)	720(.09)	1

Q# 21/ iGCSE Chemistry2019/w/Paper 41/Q2/

2(e)	29.1 / 23 40.5 / 32 30.4 / 16 or 1.2(65) 1.2(65) 1.9 (1) 1:1:1.5 (1) $Na_2S_2O_3$ (1)	3

Q# 22/ iGCSE Chemistry2019/s/Paper 41/Q4/

4(c)	**M1** mol of $HCl = 2.00 \times \frac{50.0}{1000} = 0.1(00)$ mol (1) **M2** mol of $MgCO_3 = \frac{\text{M1}}{2} = 0.1(00) / 2 = 0.05(00)$ (1) **M3** M_r of $MgCO_3 = 84$ (1) **M4** mass of $MgCO_3$ = **M3** × **M2** = 84 × 0.05(00) = 4.2(0)g (1)	4

Q# 23/ 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

Q# 24/ 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

Q# 25/ 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

Q# 26/ IGCSE Chemistry/2018/w/Paper 42/

1(c)	$4X + O_2 \rightarrow 2X_2O$ M1 Species M2 Balance	2

Q# 27/ IGCSE Chemistry/2018/w/Paper 41/

4(d)(i)	0.003	1
4(d)(ii)	0.006	1
4(d)(iii)	30	1

Q# 28/ 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

Q# 29/ IGCSE Chemistry/2018/s/Paper 43/

3(f)	3+	1

Q# 30/ 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

Q# 31/ 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

Q# 32/ 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

Q# 33/ 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 and mol of O 1.68 / 31 OR 0.054.. 2.19 / 16 **OR** 0.13...	1
	ratio of P to O P = 0.054... / 0.054 O = 0.13... / 0.054... = 1 = 2.5	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

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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