IGCSE Edexcel Chemistry Revision

Revision Guide Section 4: Inorganic Chemistry

Paper 1 [All Pathways]

Please note, these questions may have parts related to **other** topics within the GCSE Chemistry course. However, all questions are related at least in part to Inorganic Chemistry

Topics included:

- Group 1: The Alkali Metals
- Group 7: The Halogens
- Reactions of Metals
- The reactivity series
- Redox reactions
- Acids, Bases and Salts
- Testing for ions and gases

Questions taken from 2019 and 2020 January, June and November Papers (C and CR)

- 16 questions
- 137 marks
- Recommended time: 150 minutes (just over 1 minute per mark)

1. The reactions of metals with water and with dilute sulfuric acid can be used to determine the order of reactivity of the metals.
The table shows the reactions of four metals, W, X, Y and Z, with water and with dilute sulfuric acid.

Metal	Reaction with water	Reaction with dilute sulfuric acid
W	no reaction	no reaction
X	very slow reaction	reacts quickly
Y	no reaction	reacts slowly
Z	reacts quickly	reacts violently

(a) What is the order of reactivity of these metals? (1)

	most reactive →			least reactive
☐ **A**	W	X	Y	Z
☐ **B**	Z	X	Y	W
☐ **C**	W	Y	X	Z
☐ **D**	Z	Y	X	W

(b) (i) State which metal, W, X, Y or Z, could be copper. (1)

.....

(ii) State which metal, W, X, Y or Z, could be magnesium. (1)

.....

(c) A displacement reaction can also be used to decide the order of reactivity of two metals.
State two observations made when an excess of magnesium powder is added to an aqueous solution of copper(II) sulfate. (2)

1 .....

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2 .....

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(Total for question = 5 marks)

2. Sodium chloride is a soluble salt.

(a) Name the acid and the alkali that can be used to make sodium chloride. (2)

Acid .....

Alkali .....

(b) A teacher drops a bottle containing sodium chloride. The bottle breaks when it hits the floor. The teacher sweeps up the mixture of sodium chloride and glass. Describe how the teacher can obtain a pure, dry sample of sodium chloride from the mixture. (4)

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(Total for question = 6 marks)

3. This question is about some elements in Group 1 of the Periodic Table.

(a) The table gives some statements about the reaction of potassium with water.
Place ticks (✓) in three boxes to show which three statements are correct. (3)

Statement	
potassium reacts more vigorously than sodium when added to water	
potassium sinks to the bottom of the water	
bubbles of oxygen gas are produced	
a lilac flame is seen	
potassium moves around	
a solution of potassium oxide is formed	

(b) After the reaction of potassium with water is complete, a few drops of universal indicator are added to the solution formed. The universal indicator turns purple.

(i) Suggest a value for the pH of the solution. (1)

.....

(ii) Give the formula of the ion responsible for this pH value. (1)

.....

(c) Sodium burns in oxygen to produce sodium oxide.
Complete the equation for this reaction. (1)

..... Na + ...O_2 → .....Na_2O

(Total for question = 6 marks)

4. A salt can be made by reacting an acid with an insoluble base.
A student has a sample of copper(II) oxide.
The student uses this method.

Stage 1 pour 50 cm^3 of dilute sulfuric acid into a beaker
Stage 2 warm the acid using a Bunsen burner
Stage 3 add a small amount of copper(II) oxide to the warm acid and stir the mixture
Stage 4 add further amounts of copper(II) oxide until copper(II) oxide is in excess
Stage 5 filter the mixture
Stage 6 obtain crystals from the filtrate

(a) State why the acid is warmed in stage 2. (1)

.....

.....

(b) State how the student would know that the copper(II) oxide is in excess in stage 4. (1)

.....

.....

(c) State why the mixture is filtered in stage 5. (1)

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.....

(d) State the colour of the filtrate obtained in stage 5. (1)

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(e) Describe how the student could obtain a pure, dry sample of hydrated copper(II) sulfate crystals from the filtrate in stage 6. (5)

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(f) The overall equation for the formation of hydrated copper(II) sulfate crystals from copper(II) oxide is

$$CuO(s) + H_2SO_4(aq) + 4H_2O(l) \rightarrow CuSO_4.5H_2O(s)$$

(i) In an experiment, a student completely reacts 9.54 g copper(II) oxide.
Show that the maximum possible mass of $CuSO_4.5H_2O$ crystals that can be obtained is about 30 g.
[M_r of CuO = 79.5 M_r of $CuSO_4.5H_2O$ = 249.5]
Give your answer to an appropriate number of significant figures. (3)

mass = ... g

(ii) In this experiment, the actual yield of $CuSO_4.5H_2O$ crystals is 23.92 g.
Calculate the percentage yield of $CuSO_4.5H_2O$ (2)

percentage yield = ... %

(Total for question = 14 marks)

5. This question is about metals in Group 1 of the Periodic Table.
When these metals are added to water, they form hydrogen gas and an alkaline solution.

(a) A teacher adds a small piece of lithium to a trough of water to form a solution.
She dips a piece of platinum wire into the solution. She then places the wire into a hot Bunsen flame and the flame changes colour.
(i) State the new colour of the flame. (1)

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(ii) Give the formula of the ion responsible for the new colour. (1)

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(iii) The teacher adds a few drops of litmus indicator to the solution.
Explain the colour of the litmus indicator after it is added to the solution. (2)

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(b) The teacher adds a small piece of sodium to a second trough of water.
The sodium floats and moves around the surface of the water as it reacts.
(i) Give two other observations that are made as sodium reacts with water. (2)

1 .....

.....

2 .....

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(ii) Complete the chemical equation for the reaction of sodium with water. (1)

..... Na + ... H_2O → ..... NaOH + ... H_2

(c) The teacher adds a small piece of potassium to a third trough of water.

(i) Give one observation that is different when using potassium instead of sodium. (1)

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(ii) Give a possible pH value for the solution that forms when potassium reacts with water. (1)

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(d) Explain why the reaction of rubidium with water is more vigorous than the reaction of potassium with water. (2)

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(Total for question = 11 marks)

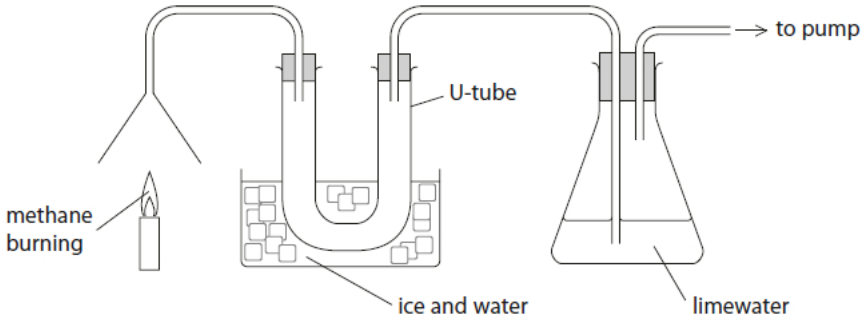
6. The gas burned in a Bunsen burner is methane.
The equation for the complete combustion of methane is

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$$

(a) Calculate the mass of oxygen required to react with 32 g of methane.
[M_r of methane = 16] (2)

mass of oxygen = ... g

(b) The diagram shows methane burning in air. It also shows how the two gases formed are collected and tested.



(i) Explain why water collects in the U-tube. (2)

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(ii) Describe how anhydrous copper(II) sulfate is used to test for water. (2)

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(iii) Explain the change in appearance of the limewater. (3)

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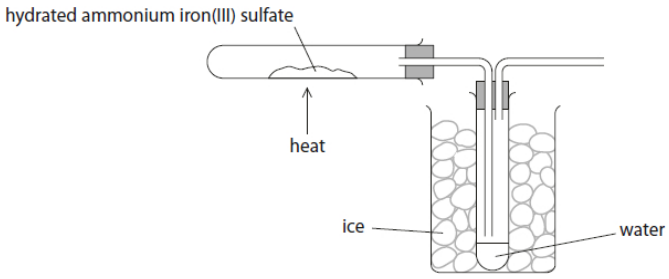
(Total for question = 9 marks)

7. Hydrated ammonium iron(III) sulfate is a violet solid that has the formula $(NH_4)_2SO_4.Fe_2(SO_4)_3.xH_2O$
The table shows some tests done on three separate samples of the solid.

Test	Observation
Dissolve the solid in water and add acidified barium chloride solution.	
Dissolve the solid in water and add sodium hydroxide solution.	
Add sodium hydroxide solution to the solid and warm the mixture. Test the gas given off with moist universal indicator paper.	

(a) Complete the table to show the observation made in each test. (3)

(b) A student needs to find the value of x in the formula $(NH_4)_2SO_4.Fe_2(SO_4)_3.xH_2O$
He uses this apparatus.



The hydrated solid decomposes when heated gently.
The equation for the reaction is

$$(NH_4)_2SO_4.Fe_2(SO_4)_3.xH_2O \rightarrow (NH_4)_2SO_4.Fe_2(SO_4)_3 + xH_2O$$

The table shows the student's results.

mass of empty test tube in g	22.04
mass of test tube and $(NH_4)_2SO_4.Fe_2(SO_4)_3.xH_2O$ in g	34.09
mass of test tube and $(NH_4)_2SO_4.Fe_2(SO_4)_3$ in g	28.69

(i) Calculate the mass of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ produced by heating. (1)

mass of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ = ... g

(ii) Calculate the mass of water produced. (1)

mass of water = ...g

(iii) Calculate the value of x.
[M_r of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ = 532 and M_r of H_2O = 18]
Give your answer to the nearest whole number. (4)

value of x = ...

(Total for question = 9 marks)

8. Iron reacts with dilute sulfuric acid to form a salt called iron(II) sulfate.
The formula of iron(II) sulfate is $FeSO_4$

(a) (i) How many different elements are there in iron(II) sulfate? (1)

- ☐ A 2
- ☐ B 3
- ☐ C 4
- ☐ D 6

(ii) Use information from the Periodic Table to calculate the relative formula mass of iron(II) sulfate. (2)

relative formula mass = ...

(b) Some iron filings are added to dilute sulfuric acid. The mixture is warmed and hydrogen gas is given off.

(i) State why the mixture is warmed. (1)

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(ii) State the observation that shows a gas is being given off. (1)

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(iii) Give the test for hydrogen gas. (1)

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(c) When the reaction stops, some iron filings remain.

(i) State why the reaction stops. (1)

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(ii) Give a chemical equation for the reaction between iron and sulfuric acid. (1)

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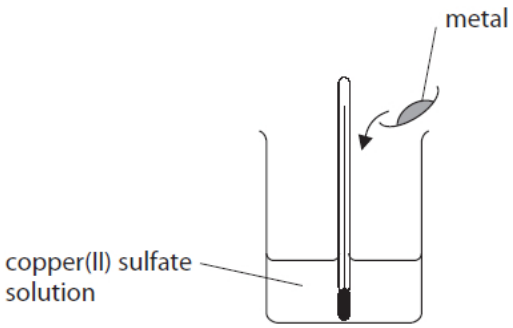
(Total for question = 8 marks)

9. A student uses this apparatus to investigate the temperature changes that occur when metals are added to copper(II) sulfate solution.

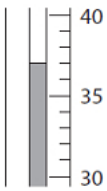
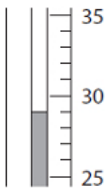
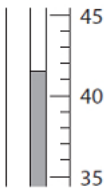
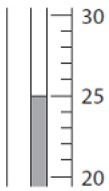
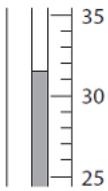


This is the student's method.

- add a sample of aluminium to a beaker containing 25 cm^3 of copper(II) sulfate solution
- stir the mixture and record the highest temperature reached

The student repeats the experiment four times, using the same amount of a different metal each time.

(a) The table shows the thermometer readings for each metal.

	Aluminium	Iron	Magnesium	Silver	Zinc
Thermometer reading					
Highest temperature reached in °C				25.0	

Complete the table by recording the highest temperature reached for each metal, giving all temperatures to the nearest 0.5 °C. (2)

(b) The initial temperature of the copper(II) sulfate solution in each experiment is 25.0 °C.

(i) Suggest why magnesium produces the largest temperature rise. (1)

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(ii) Explain why there is no temperature change with silver. (2)

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(c) In the experiment with magnesium, using 25 cm^3 of solution means that the copper(II) sulfate is in excess.
In another experiment, the student uses the same amount of magnesium but adds it to 50 cm^3 of copper(II) sulfate solution.
Explain how the change in volume affects the temperature rise. (2)

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(d) In another experiment, the student adds a metal to 45 cm^3 of copper(II) sulfate solution and obtains a temperature rise of 15.0 °C.
The mass of 1.0 cm^3 of the solution is 1.0 g.
The specific heat capacity, c, of the solution is 4.2 J/g/°C.
Calculate the heat energy, *Q*, in kilojoules (kJ), released in this reaction. (4)

Q ..... kJ

(Total for question = 11 marks)

10. A student does these two tests on a solution made from a white solid.

- flame test
- add acidified silver nitrate solution

The table shows his results.

Test	Result
flame test	red flame
add acidified silver nitrate solution	cream precipitate

(a) Give the formula of the ion that produces the red flame. (1)

.....

(b) Name the cream precipitate. (1)

.....

(c) Identify the white solid. (1)

.....

(d) The student uses a clean metal wire in the flame test.

(i) State why the wire should be clean when used in the flame test. (1)

.....

.....

(ii) The table lists properties of some metals.
Add ticks (✓) to the table to show the two properties needed in a metal wire used in a flame test. (2)

Property	
good conductor of electricity	
high density	
high melting point	
unreactive	

(Total for question = 6 marks)

11. A student makes some magnesium nitrate crystals from magnesium oxide and dilute nitric acid.
The equation for the reaction is

$$MgO(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2O(l)$$

(a) (i) Give the formula of each ion in magnesium nitrate. (2)

..... and .....

(ii) A student has a beaker containing dilute nitric acid.
Describe a method that she could use to prepare a pure, dry sample of magnesium nitrate crystals from magnesium oxide. (6)

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(b) Magnesium nitrate crystals contain water of crystallisation with the formula $Mg(NO_3)_2.6H_2O$

(i) Show by calculation that the relative formula mass of $Mg(NO_3)_2.6H_2O$ is 256. (1)

(ii) Show that the maximum mass of $Mg(NO_3)_2.6H_2O$ that could be made from 0.050 mol of nitric acid is about 6 g. (3)

(iii) The actual mass of crystals that the student obtains is 4.8 g.
Calculate the percentage yield of $Mg(NO_3)_2.6H_2O$ in this experiment. (2)

percentage yield = ... %

(Total for question = 14 marks)

12. This question is about lithium carbonate.

(a) The formula of lithium carbonate is Li_2CO_3

Calculate the relative formula mass (M_r) of lithium carbonate. (1)

M_r = ...

(b) (i) Give a test to show that lithium carbonate contains lithium ions. (2)

Test .....

.....

Result .....

.....

(ii) Describe a test to show that lithium carbonate contains carbonate ions. (3)

Test .....

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.....

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Result .....

.....

(c) Lithium carbonate decomposes when heated to produce lithium oxide and carbon dioxide.

Complete the chemical equation for this reaction. (1)

Li_2CO_3 → ..... + ...

(Total for question = 7 marks)

13.

(a) A piece of magnesium ribbon is ignited and placed in a gas jar of oxygen.
The equation for the reaction is

$$2Mg + O_2 \rightarrow 2MgO$$

(i) Give two observations that would be made in this reaction. (2)

1 .....

.....

2 .....

.....

(ii) State why this is an oxidation reaction. (1)

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(b) A second piece of magnesium ribbon is ignited and placed in a gas jar of carbon dioxide.
A very exothermic reaction occurs, forming magnesium oxide and carbon.
(i) State what is meant by the term **exothermic**. (1)

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.....

(ii) Give the chemical equation for this reaction. (1)

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(iii) A fire starts in a warehouse where magnesium is stored.
Suggest why it would not be suitable to use a carbon dioxide fire extinguisher to put out this fire. (1)

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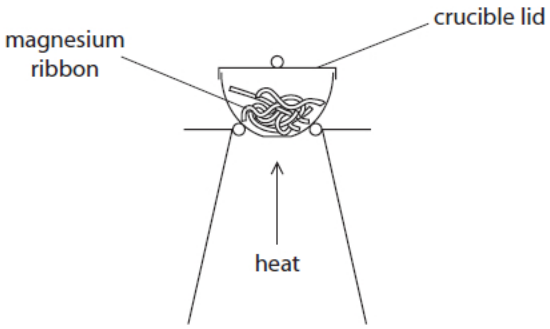
(c) (c) A student uses this apparatus to find the mass of magnesium oxide that forms when a known mass of magnesium is heated.



This is his method.

- find the mass of the crucible and lid
- place some magnesium ribbon in the crucible
- find the mass of the crucible, lid and magnesium
- heat the crucible with the lid on for a few minutes
- find the mass of the crucible, lid and magnesium oxide

Using this method, the mass of magnesium oxide formed is less than expected. Explain two changes that the student should make to his method to obtain a mass of magnesium oxide closer to the expected mass. (4)

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2 .....

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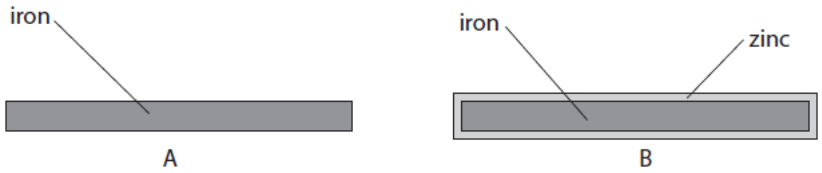
(Total for question = 10 marks)

14. The diagram shows two samples of iron, A and B.



Sample B is coated with a thin layer of zinc.

(a) Name the process used to coat iron with zinc. (1)

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(b) The two samples of iron are left outside for several weeks.
A brown solid containing hydrated iron(III) oxide forms on sample A.
(i) Give the common name for the brown solid. (1)

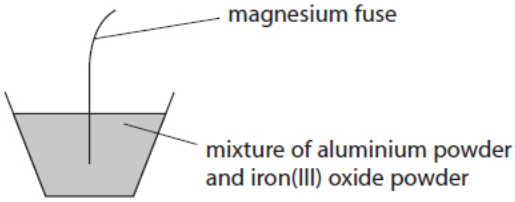
.....

(ii) Give the names of the two substances that react with the iron to form the brown solid. (2)

1 .....

2 .....

(c) Iron can be formed by reacting aluminium powder with iron(III) oxide.
The diagram shows how this reaction can be demonstrated.



When the magnesium fuse is lit, a very exothermic reaction occurs.
(i) State the meaning of the term exothermic. (1)

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.....

(ii) The equation for the reaction between aluminium and iron(III) oxide is

$$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$$

Explain what this reaction shows about the relative reactivities of aluminium and iron. (2)

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(iii) Explain why the reaction between aluminium and iron(III) oxide is a redox reaction. (3)

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(Total for question = 10 marks)

15. This question is about gases in the atmosphere.

(a) The box gives the names of some gases in the atmosphere.

argon	carbon dioxide	helium	nitrogen	oxygen

Choose gases from the box to answer these questions.
Each gas may be used once, more than once or not at all.

(i) Identify a noble gas. (1)

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(ii) Identify a gas that makes up about 78% of the atmosphere. (1)

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(iii) Identify a greenhouse gas. (1)

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(iv) Identify a gas produced by the thermal decomposition of calcium carbonate. (1)

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(b) Sulfur reacts with oxygen to produce sulfur dioxide gas.

(i) Write a chemical equation for this reaction. (1)

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(ii) State an environmental problem caused when sulfur dioxide gas dissolves in water in the atmosphere. (1)

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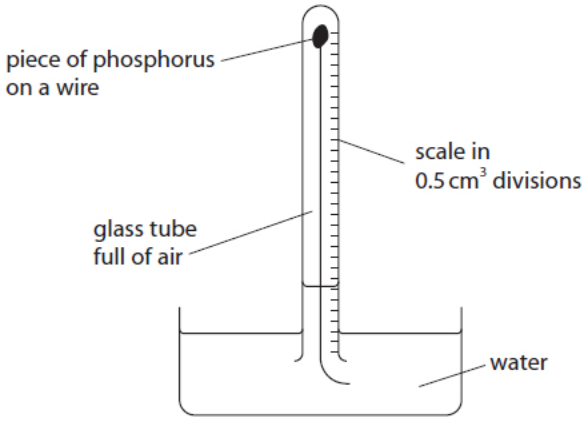
(Total for question = 6 marks)

16. A teacher uses the reaction between phosphorus and oxygen to calculate the percentage of oxygen in air.
She uses this apparatus and excess phosphorus.



The volume of gas in the tube decreases as the phosphorus reacts with oxygen.
The teacher measures the volume of gas in the tube at one-minute intervals.
The table shows the teacher's results.

Time in minutes	Volume of gas in tube in cm^3
0	48.5
1	41.0
2	38.0
4	37.5
5	37.0
6	37.0
7	37.0

(a) State how the results show that all the oxygen has reacted. (1)

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.....

(b) Give one change to this experiment that would make the results more accurate. (1)

.....

.....

(c) Use the results to calculate the percentage of oxygen in air.
Give your answer to one decimal place. (3)

percentage = ... %

(Total for question = 5 marks)

END OF QUESTIONS

Mark Scheme

Q1.

Question number	Answer	Notes	Marks
a	**B** (Z X Y W) A is not correct as Z is the most reactive metal C is not correct as Z is the most reactive metal D is not correct as X is more reactive than Y		**1**
b i	W		**1**
ii	X		**1**
c	**M1** brown/pink/pink-brown solid forms	**ALLOW** red-brown /orange-brown **IGNORE** red or orange alone **ALLOW** precipitate for solid	**2**
	M2 solution turns colourless	**ALLOW** solution becomes paler **IGNORE** clear **IGNORE** incorrect initial colour of solution **IGNORE** references to magnesium disappearing **IGNORE** references to heat	

(**Q06 4CH1/1C, June 2019**)

Q2.

Question number	Answer	Additional guidance	Marks
(a)	**M1** acid - hydrochloric acid / HCl **M2** alkali – sodium hydroxide / NaOH A description that makes reference to the following four points.	**REJECT** hydrogen chloride /HCl(g) **ALLOW** sodium carbonate If both name and formula given mark name only **IGNORE** state symbols with NaOH even if incorrect	2
(b)	**M1** add water (tc dissolve the sodium chloride/salt) **M2** warm / stir (to dissolve the sodium chloride/salt more quickly) **M3** filter (to remove the glass / to separate the glass from the solution) **M4** (heat/leave to) evaporate the water	 **ALLOW** decant / sieve **ALLOW** heat/distil / boil to remove the water **M2** dep on **M1** but **M3** and **M4** can still be awarded if **M1** is missing **M4** dep on **M3**	4
		Total	**6**

(**Q03 4SS0/1C, June 2019**)

Q3.

Question number	Answer	Notes	Marks
a	potassium reacts more vigorously with water than sodium ✓ potassium sinks to the bottom of the water bubbles of oxygen gas are produced a lilac flame is seen ✓ potassium moves around ✓ potassium oxide solution is formed		3
b (i)	any value or range between 11 and 14		1
(ii)	OH^-	**ACCEPT** HO^- **IGNORE** any name	1
c	**4**Na + (1)O_2 → **2**Na_2O	**ACCEPT** multiples or fractions	1
			Total 6

(**Q02 4CH1/1CR, June 2019**)

Q4.

Question number	Answer	Notes	Marks
a	to increase the rate of reaction	**ACCEPT** to make the reaction faster/ to speed up the reaction **REJECT** any reference to increasing the solubility of copper(II) oxide	**1**
b	(the copper(II) oxide/it) stops disappearing **OR** mixture turns cloudy (black) **OR** (black) solid settles (at the bottom of the beaker)	**ALLOW** stops dissolving **REJECT** any other colour **REJECT** any other colour **ALLOW** copper(II) oxide/ it settles (at the bottom of the beaker) **IGNORE** precipitate	**1**
c	to remove excess/unreacted copper(II) oxide/solid/base (from the mixture)	**ACCEPT** to separate the copper(II) sulfate solution (from the copper(II) oxide/unreacted solid/excess solid)	**1**
d	blue		**1**

Question number	Answer	Notes	Marks
e	**M1** heat/boil the filtrate	**NOTE:** If the solution is heated to remove all the water then only **M1** can be awarded **NOTE** If the solution is left to evaporate all the water without heating only 1 mark can be awarded	**5**
	M2 until crystals form in a cooled sample/ on a glass rod	**ACCEPT** to crystallisation point /to form a saturated solution /until crystals start to form /to remove some of the water **M2** dep on **M1**	
	M3 leave the solution to cool/crystallise	**NOTE:** If the solution is left to completely evaporate after heating then award MAX 3	
	M4 filter (to remove the crystals)	**ACCEPT** decant the (excess) solution **IGNORE** references to washing the crystals	
	M5 dry the crystals on filter paper/on paper towel/in a warm oven /in a desiccator /leave to dry	**REJECT** hot oven or any method of direct heating e.g. Bunsen burner No **M5** if crystals washed after drying	

Question number	Answer	Notes	Marks
f i	• calculate the moles of CuO • calculate the mass of $CuSO_4.5H_2O$ • give the answer to an appropriate number of significant figures Example calculation **M1** *n*[CuO] = 9.54 ÷ 79.5 OR 0.120 (mol) **M2** mass of $CuSO_4.5H_2O$ = 0.120 × 249.5 **OR** 29.94 (g) **M3** = 29.9 **OR** **M1** 79.5 (g) → 249.5 (g) **M2** 9.94 (g) → (249.5 ÷ 79.5) × 9.54 (g) **OR** 29.94 (g) **M3** = 29.9	Final answer must be to 3 sig figs Final answer must be to 3 sig figs 29.94 with no working scores 2 29.9 with no working scores 3	**3**

ii	**M1** (23.92 ÷ 29.9) × 100 OR (23.92 ÷ **M3** from (i)) × 100 **M2** = 80(%)	**ALLOW** use of **M2** from (i) 29.94 gives 79.89% **ALLOW** any number of sig figs **ACCEPT** answer of 79.7(3)% using 30g Correct answer without working scores 2	**2**

(Q14 4CH1/1C, June 2019)

Q5.

Question number	Answer	Additional guidance	Marks
(a) (i)	red	**REJECT** brick-red / orange-red and all other colours	1
(ii)	Li^+	**IGNORE** name even if incorrect	1
(iii)	An explanation that links the following two points **M1 (**litmus turns) blue **M2** (because) hydroxide (ion) / OH^- forms / solution is alkaline / an alkali	 **REJECT** purple	2

(b) (i)	Any two from: **M1** forms a ball **M2** disappears / gets smaller **M3** forms a white trail **M4** bubbles/fizzes/effervescence	 **ALLOW** melts **ALLOW** dissolves **IGNORE** hydrogen or gas given off/evolved/formed/ produced	2
(ii)	$2\,Na + 2\,H_2O \rightarrow 2\,NaOH + (1)\,H_2$	**ACCEPT** multiples and fractions **IGNORE** state symbols, even if incorrect	1

Question number			
(c) (i)	Any one from: **M1** burns / catches fire / (lilac/purple) flame produced **M2** moves (around the surface) more quickly	 **REJECT** any incorrect flame colour **ALLOW** reacts more vigorously	1
(ii)	Any number or range of numbers between 8 and 14 inclusive		1
(d)	An explanation that links together the following two points: **M1** rubidium/it is below potassium (in Group 1) **M2** and the reactivity (of the elements/metals) increases down the group/as the group is descended/as atomic number/ atomic mass increases	 **ACCEPT** rubidium/it is lower down in the Periodic Table **ACCEPT** rubidium/it has bigger atoms/more shells (of electrons)/more shielding **ACCEPT** rubidium (atom)/it loses electrons more easily/readily **ACCEPT** correct reverse argument	2
		Total	**11**

(Q05 4SS0/1C, June 2019)

Q6.

Question number	Answer	Notes	Marks
a	• calculate moles of methane • calculate mass of oxygen Example calculation **M1** $n[CH_4] = 32 \div 16$ OR 2 (mol) **M2** mass of O_2 = 128 (g) **OR** answer to **M1** x 2 x 32 **OR** **M1** 16 g (of methane) require 64 g (of oxygen) **M2** 32 g require 128 (g)	correct answer scores 2	**2**
b i	An explanation that links together the following two points: **M1** the water vapour/steam condenses **M2** because it is cooled (by the mixture of ice and water)	**ACCEPT** because (mixture of ice and water) is at a low temperature/ is cold **ALLOW** (the mixture of ice and water) is below the boiling point of water/below 100 °C	**2**
ii	A description that links together the following two points: **M1** white (anhydrous copper(II) sulfate) **M2** turns blue (in the presence of water)		**2**
iii	An explanation that links together the following three points: **M1** the limewater turns milky **M2** (because) carbon dioxide /CO_2 (is present) **M3** (and) calcium carbonate/$CaCO_3$/ an insoluble substance is formed	**ACCEPT** cloudy **ALLOW** white precipitate forms A word or chemical equation scores **M2** and **M3**	**3**

(**Q11 4CH1/1C, June 2019**)

Q7.

Question number	Answer	Notes	Marks
a	**Test** / **Observation** addition of acidified barium chloride solution — white precipitate addition of sodium hydroxide solution — brown precipitate Addition of sodium hydroxide and gas tested with universal indicator paper — (universal indicator) turns blue/indigo/purple	1 mark for each correct observation **ALLOW** red-brown /foxy brown /orange-brown **IGNORE** red or orange alone **ALLOW** litmus turns blue Penalise effervescence once only in tests 1 and 2	**3**
b i	6.65 (g)		**1**
ii	5.4(0) (g)		**1**
iii	• calculate moles of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ • calculate moles of H_2O • divide moles of water by moles of $(NH_4)_2SO_4.Fe_2(SO_4)_3$ • give the value of x to the nearest whole number Example calculation **M1** $n[(NH_4)_2SO_4.Fe_2(SO_4)_3]$ = 6.65 ÷ 532 **OR** 0.0125 (mol) **M2** $n[H_2O]$ = 5.4(0) ÷ 18 **OR** 0.3(00) (mol) **M3** x = 0.3(00) ÷ 0.0125 **M4** x = 24 **OR** **M2** ÷ **M1** evaluated correctly and quoted to the nearest whole number	correct answer without working scores 4	**4**

(Q15 4CH1/1C, June 2019)

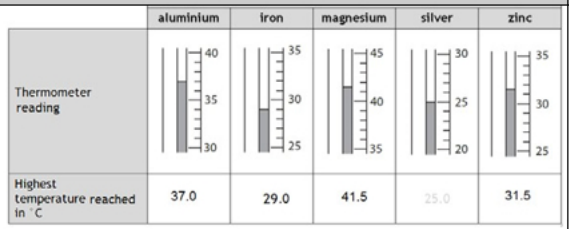
Q8.

Question number	Answer	Additional guidance	Marks
(a) (i)	**B** 3 **A** is incorrect as there are not only 2 different elements **C** is incorrect as there are not 4 different elements **D** is incorrect as 6 is the total number of atoms in the formula, not the number of different elements		1
(ii)	**M1** 56 **and** 32 **and** 16 used in calculation **M2** 152	152 without working scores both marks 104 without working scores 1	2

(b) (i)	to increase the rate of reaction / to speed up the reaction	**ALLOW** make the reaction quicker/faster **ALLOW** reference to more particles having the necessary activation energy **IGNORE** reference to dissolving	1
(ii)	bubbles / fizzing / effervescence		1
(iii)	(squeaky) pop with burning /lit/lighted splint	**IGNORE** squeaky pop test without mention of burning/lit splint **ALLOW** burns with a pop	1
(c) (i)	all of the (sulfuric) acid has reacted / the (sulfuric) acid has been used up / the acid is the limiting reagent	**REJECT** any reference to reactants used up or iron (filings) used up	1
(ii)	$Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$	**ACCEPT** multiples and fractions **IGNORE** state symbols, even if incorrect	1
		Total	**8**

(Q02 4SS0/1C, June 2019)

Q9.

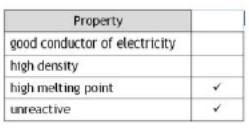
Question number	Answer	Additional guidance	Marks
(a)	 all 4 correct 2 marks 2 or 3 correct 1 mark	Penalise missing 0 once only	2
(b) (i)	magnesium is the most reactive (metal/element used) OR magnesium is higher in the reactivity series /more reactive than the other metals (used)	**ALLOW** references to generates more thermal energy/heat (energy)	1
(ii)	An explanation that links together **two** of the following points: **M1** silver/it does not react (with copper(II) sulfate solution) **M2** silver/it is less reactive than copper / silver/it is below copper in the reactivity series **M3** (and therefore silver/it) does not displace copper	**ALLOW** silver is the least reactive (metal /element used) **ACCEPT** does not reduce copper(II) ions	2

Question number			
(c)	An explanation that links together the following two points: **M1** the temperature rise will be smaller (than with 25 cm^3) **M2** because the same amount of thermal energy/heat (energy) is being used to heat a larger volume of solution	**ACCEPT** less than 16.5 (°C) **ACCEPT** lower than the value given in the table in (a) **ALLOW** as there is a larger volume of /a larger amount of /more solution to heat up	2

(d)	**M1** $Q = mc\Delta T$ **M2** $45 \times 4.2 \times 15.0$ **M3** = 2835 (J) **M4** = 2.8(35) (kJ)	 **M2** subsumes **M1** **ALLOW** ECF for **M3** and **M4** on incorrect values in **M2** **ACCEPT** answers correctly rounded to two or more significant figures Correct answer without working scores 4 2835, 2840, 2800 all score 3 **ALLOW** use of 4.18 which gives an answer of 2.8(215)	4
		Total	**11**

(**Q06 4SS0/1C, June 2019**)

Q10.

Question number		Answer	Notes	Marks
a		Li^+	**ALLOW** Sr^{2+}	**1**
b		silver bromide / AgBr	If correct name given ignore incorrect formula	**1**
c		lithium bromide / LiBr	Mark CSQ on (a) and (b) If both name and formula given both must be correct	**1**
d	i	Impurities/ other ions/ other substances could alter/interfere with the colour of the flame /with the results of the test OWTTE	**ALLOW** impurities/other ions/ other substances contaminate the flame/the test /the wire /it	**1**
	ii			**2**

Property	
good conductor of electricity	
high density	
high melting point	✓
unreactive	✓

(**Q03 4CH1/1C, June 2019**)

Q11.

Question number	Answer	Notes	Marks
a (i)	**M1** Mg^{2+} **M2** NO_3^-		2
a (ii)	**Part 1** making magnesium nitrate solution - a description linking any **three** of the following points **M1** warm / heat the acid (in a beaker/flask) **M2** add magnesium oxide (to acid a little at a time) until in excess /no more dissolves **M3** stir **M4** filter to remove excess magnesium oxide/excess solid	REJECT boil **M3 DEP** on use of acid and oxide	6
	Part 2 using (magnesium nitrate) solution/filtrate - a description linking any three of the following points M5 heat/boil (magnesium nitrate solution/filtrate) M6 until crystals form in a cooled sample/on glass rod M7 leave the solution to cool/crystallise M8 filter (to remove crystals) M9 suitable method to dry the crystals eg using filter paper/using paper towel/in warm oven/in a desiccator	**NOTE if added excess but not filtered off – MAX 2 for Part 2** **ACCEPT to crystallisation point /to form a saturated solution /until crystals start to form /to remove some of the water** **M6 DEP M5** **ACCEPT decant the (excess) solution IGNORE references to washing the crystals** **REJECT hot oven or any method of direct heating e.g. Bunsen** **ALLOW leave to dry but not just dry the crystals** **M9 DEP M8** **No M9 if then wash crystals after drying**	

(b) (i)	24 + (2 x 14) + (6 x 16) + (12 x 1) + (6 x 16) or equivalent working	Some working must be seen **ALLOW** 24 + 124 +108	1
(ii)	• Calculate moles of magnesium nitrate • Setting out of calculation of mass • Final answer **M1** moles = (0.05 / 2) **OR** 0.025 **M2** mass = 0.025 x 256 **M3** 6.4 (g)	 6.4(g) with no working scores 3 only **ALLOW** ECF M2 from M1	3

(iii)	• Setting out of calculation • Final answer **M1** $\frac{4.8}{6.4} \times 100$ **M2** 75 (%) OR **M1** $\frac{4.8}{6} \times 100$ **M2** 80 (%)	 75 (%) with or without working scores 2 marks 80 (%) with or without working scores 2 marks **ALLOW** ECF from b(ii) $\frac{6.4}{4.8} \times 100$ AND $\frac{6}{4.8} \times 100$ both score 0 Answers of 25% and 20% score 1	2 **Total 14**

(Q07 4CH1/1CR, June 2019)

Q12.

Question number	Answer	Notes	Marks
(a)	74		1 Cler
(b) (i)	**M1** flame test	**ALLOW** any description of a flame test	2 Grad
	M2 (flame colour is) red	**ALLOW** crimson or crimson red **M2** is dependent on **M1**	
(ii)	**M1** add (dilute) hydrochloric acid	**ALLOW** any acid **IGNORE** refs to concentration **REJECT** additional reagents	3 Exp
	M2 bubble the gas/CO_2 produced through limewater / test the gas/CO_2 with limewater	**ALLOW** calcium hydroxide	
	M3 which turns cloudy / milky / white precipitate	**M3** is dependent on use of limewater	
(c)	$Li_2O + CO_2$		1 Grad
		Total for question	7

(**Q04 4SS0/1C, Nov 2020**)

Q13.

Question number		Answer	Notes	Marks
(a)	(i)	**M1** white flame/light **M2** white powder/solid (formed)	 **ALLOW** white smoke **ALLOW** white ash **REJECT** white precipitate	2
	(ii)	magnesium gains oxygen	**ACCEPT** magnesium loses electrons/ oxidation state (of Mg) increases / goes from / changes from 0 to +2	1
(b)	(i)	gives out/releases heat (energy)/thermal energy	**IGNORE** energy alone	1
	(ii)	$2Mg + CO_2 \rightarrow 2MgO + C$	**ALLOW** multiples and fractions	1
	(iii)	Any one from the fire would keep burning OR the carbon dioxide would not put out the fire OR a large amount of heat/thermal energy would be released	 **ALLOW** Any other sensible suggestion	1

Question number	Answer	Notes	Marks
(c)	An explanation giving two linked changes **M1** (the student should) lift and replace the lid **M2** (to allow) oxygen/air to enter the crucible (to react with the magnesium) AND **M3** reheat and reweigh / heat to constant mass **M4** to make sure that all the magnesium has reacted		4 **Total 10**

(**Q08 4CH1/1CR, Nov 2020**)

Q14.

Question number	Answer	Notes	Marks
(a)	galvanising	**ACCEPT** galvanisation	1
(b) (i)	rust		1
(ii)	**M1** oxygen / air	**ACCEPT** O_2 **IGNORE** O	2
	M2 water	**ACCEPT** H_2O/moisture	
		ACCEPT in either order	
(c) (i)	(a reaction which) gives out / produces / releases heat (energy) / thermal energy	**IGNORE** energy without mention of heat or thermal	1
(ii)	An explanation that links the following two points		2
	M1 aluminium/Al is more reactive than iron/Fe	**ACCEPT** aluminium/Al is higher in reactivity series than iron/Fe	
		ACCEPT reverse argument	
	M2 (because) aluminium/Al displaces iron/Fe (from its oxide)	**ALLOW** replaces/takes place of	
(iii)	An explanation that links the following three points		3
	M1 aluminium is oxidised and iron/iron oxide is reduced	**ALLOW** both oxidation and reduction occur	
	M2 aluminium gains oxygen	**ALLOW** aluminium/Al loses electrons	
	M3 iron oxide/iron loses oxygen	**ALLOW** iron ions /Fe^{3+} gains electrons	
		ALLOW correct references to changes in oxidation number for M2 and M3	
			Total 10

(**Q03 4CH1/1C, Jan 2020**)

Q15.

Question number	Answer	Notes	Marks
(a) (i)	argon / helium	**ACCEPT** Ar / He	1
(ii)	nitrogen	**ACCEPT** N_2	1
(iii)	carbon dioxide	**ACCEPT** CO_2	1
(iv)	carbon dioxide	**ACCEPT** CO_2	1
(b) (i)	$S + O_2 \rightarrow SO_2$		1
(ii)	acid rain	**ACCEPT** an adverse effect of acid rain e.g. kills fish, damages plants, corrodes limestone/marble buildings/statues etc. **IGNORE** toxic/pollutant	1
			Total 6

(**Q01 4CH1/1C, Jan 2020**)

Q16.

Question number	Answer	Notes	Marks
(a)	Results are the same at the end	**ALLOW** there is a constant volume in the tube **ALLOW** the volume of gas stops decreasing **ALLOW** no change after 4 / 5 minutes **IGNORE** references to time **REJECT** the volume of gas stops increasing	1
(b)	(use a glass tube / scale with) smaller divisions.	**ALLOW** use a glass tube / scale with 0.1cm^3 divisions **ALLOW** use a smaller scale **IGNORE** references to repeating the experiment **IGNORE** references to temperature	1
(c)	**M1** Volume of oxygen = 11.5(cm^3) **M2** (11.5 ÷ 48.5) x 100 **M3** 23.7%	Correct answer to 1 dp with or without working scores 3 **ALLOW** ecf from M1 **M3** must be to 1dp	3

(**Q05 4CH1/1CR, Jan 2020**)