Collins

AQA

GCSE

Chemistry

F

SET A – Paper 1 Foundation Tier

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Materials

Time allowed: 1 hour 45 minutes

For this paper you must have:

- a ruler
- a calculator
- the Periodic Table (found at the end of the paper).

Instructions

- Answer all questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- There are 100 marks available on this paper.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions 02.2 and 06.3 you need to make sure that your answer:
  – is clear, logical, sensibly structured
  – fully meets the requirements of the question
  – shows that each separate point or step supports the overall answer.

Advice

- In all calculations, show clearly how you work out your answer.

Name: .....

01 This question is about the Periodic Table.

01.1 Which of the statements below is **true**?

Tick **one** box.

Columns in the Periodic Table are known as periods. ☐

Rows in the Periodic Table are known as groups. ☐

The top right corner contains non-metals only. ☐

The first column contains transition metals only. ☐

[1 mark]

01.2 Complete the sentence below.

Tick **one** box.

Noble gases are unreactive because they…

are covalently bonded molecules ☐

have low melting points ☐

are gases at room temperature ☐

have a full outer shell of electrons ☐

[1 mark]

01.3 Which of the statements below are **true**?

Tick **two** boxes.

Group 7 elements have seven electrons in the outer most shell. ☐

Group 7 elements have very high melting and boiling points. ☐

Group 7 elements conduct electricity as liquids and gases. ☐

Group 7 elements form both ionic compounds and covalent molecules. ☐

[2 marks]

01.4 Describe how the reactivity of Group 1 elements changes as you look down the group in the Periodic Table.

.....

..... **[1 mark]**

01.5 Describe how the reactivity of Group 7 elements changes as you look down the group in the Periodic Table.

.....

..... **[1 mark]**

01.6 Describe how the boiling points of Group 0 elements change as you look down the group in the Periodic Table.

.....

..... **[1 mark]**

01.7 Give **two** ways in which the physical properties of transition metals **differ** from Group 1 metals.

1. .....

2. ..... **[2 marks]**

02 Magnesium oxide reacts with sulfuric acid to make a salt.

02.1 What is the name of the **salt** that is formed?

.....

[1 mark]

02.2 Describe a method to make magnesium sulfate from insoluble magnesium oxide and sulfuric acid.

.....

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[6 marks]

02.3 Magnesium also reacts with sulfuric acid to make the **same** salt.

What would you expect to **see** when magnesium reacts with sulfuric acid?

.....

.....

[1 mark]

02.4 Some students wanted to measure the temperature change in the reaction between magnesium and sulfuric acid.

Which of the following methods might provide them with the data they need?

Tick **one** box.

Measure the initial volume of gas and final volume of gas, using a gas syringe. ☐

Measure the initial mass and the final mass, using a balance. ☐

Measure the initial and maximum temperature of the sulfuric acid, using a thermometer. ☐

Measure the initial acidity of the sulfuric acid, using an indicator and a pH scale. ☐

[1 mark]

02.5 The students repeated the method using a range of other metals.

In each case, the temperature increased, though not by the same amount.

Table 2.1 shows the students' results.

Table 2.1

Metal	Temperature change (°C)
zinc	9
copper	3
magnesium	50
iron	5

Use the results to write the metals in order of reactivity, from most to least reactive.

1. .....

2. .....

3. .....

4. .....

[2 marks]

03 This question is about **nanoparticles**.

03.1 Which of the following statements about nanostructures are **true**?

Tick **one** box.

Nanoparticles have a low surface area to volume ratio. ☐

Nanoparticles have a diameter less than 2500 nm. ☐

Nanoparticles have a diameter larger than 2500 nm. ☐

Nanoparticles have a diameter less than 1 nm. ☐

[1 mark]

03.2 Which of the following is **not** likely to be a potential application of nanoparticles?

Tick **one** box.

New deodorants ☐

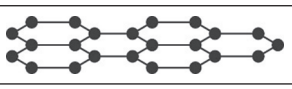
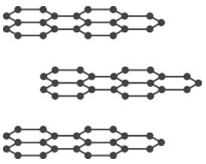
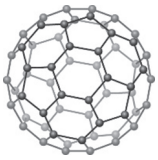
New catalysts ☐

New computers ☐

New jewellery ☐

[1 mark]

03.3 Draw one line from each substance to its structure.

Substance	Structure
buckminsterfullerene	
diamond	
graphite	
graphene	

[3 marks]

03.4 Which **two** of the following statements apply to **all** the structures in question 03.3?

Tick **two** boxes.

- The atoms are joined by ionic bonds. ☐
- They are made from carbon atoms only. ☐
- The atoms are joined by covalent bonds. ☐
- They conduct electricity. ☐

[2 marks]

Question 3 continues on the next page

03.5 Write down **three** properties that are shown by both ionic compounds **and** metals.

1. .....

2. .....

3. ..... **[3 marks]**

03.6 State **three similarities** and **two differences** between graphite and diamond in terms of their bonding and structures.

.....

.....

.....

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.....

..... **[5 marks]**

04 Sodium oxide is formed when sodium metal reacts with oxygen.

04.1 Write a word equation for the reaction.

.....

[1 mark]

04.2 What **type of reaction is this?**

Reduction ☐

Oxidation ☐

Neutralisation ☐

Displacement ☐

[1 mark]

04.3 Describe how the mass of sodium changes during the reaction.

.....

[1 mark]

04.4 Sodium atoms transfer electrons and form sodium ions.

Oxygen atoms accept electrons and form oxide ions.

Explain why the formula of sodium oxide is Na_2O

.....

.....

.....

.....

.....

.....

[4 marks]

Question 4 continues on the next page

04.5 Complete the **balanced** symbol equation for the reaction.

..... Na + O_2 → ..... Na_2O

[1 mark]

04.6 Manufacturers calculate that theoretically they might obtain 62.0 tonnes of sodium oxide from 46.0 tonnes of sodium.

They **actually** obtain 55.0 tonnes of sodium oxide.

Calculate the percentage yield.

.....

.....

Percentage yield = ... % **[1 mark]**

04.7 The percentage atom economy of a reaction is calculated using the balanced equation for the reaction as follows:

$$\frac{\text{Relative formula mass of desired product from equation}}{\text{Sum of relative formula mass of all reactants from equation}} \times 100$$

What is the atom economy for the reaction to make sodium oxide?

Give a reason for your answer.

Percentage atom economy: .....

Reason: .....

..... **[2 marks]**

04.8 Sodium oxide can also be made by the thermal decomposition of sodium carbonate.

The other product is carbon dioxide.

Write a **balanced** symbol equation for this reaction.

.....

[1 mark]

04.9 How would you expect the mass of the solid sodium carbonate to have changed after this reaction is complete?

.....

[1 mark]

04.10 How is the atom economy different in this reaction compared to the reaction in 04.5?

Explain your answer.

.....

.....

.....

.....

[2 marks]

05 A student wanted to find out if reactions were exothermic or endothermic.

They carried out four different reactions and measured the temperature changes.

They repeated each reaction three times.

Table 5.1 shows the results.

Table 5.1

Reaction	Temperature change (°C)			Mean temperature change (°C)
	Exp 1	Exp 2	Exp 3	
A	5	10	11	
B	–5	–6	–6	
C	25	19	26	
D	–10	–12	–11	

05.1 Calculate the mean temperature change for each reaction, to 3 significant figures.

Omit any anomalous results.

Add your answers to **Table 5.1**

[4 marks]

05.2 Are the anomalous results caused by random **or** systematic error?

Explain your answer.

.....

.....

.....

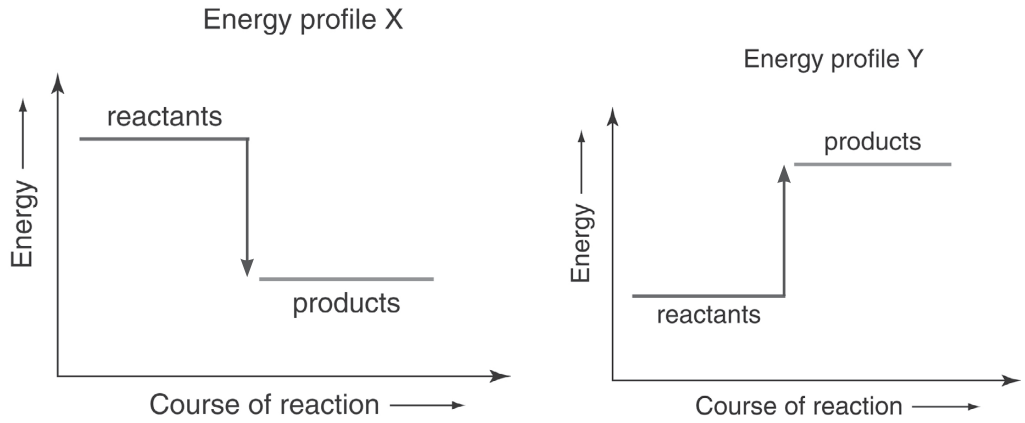
..... **[2 marks]**

05.3 Give **three** conclusions about the four reactions that you can draw from this data.

[3 marks]

05.4 Match each of the four reactions, A, B, C and D, to one of the energy profiles in **Figure 5.1**

Figure 5.1



Reaction	Energy profile (X or Y)
A	
B	
C	
D	

[2 marks]

06 A student carries out a titration between 25 cm^3 potassium hydroxide and nitric acid.

06.1 What are the names of the products formed?

.....

[1 mark]

06.2 The concentration of potassium hydroxide needs to be 10 g/dm^3

Calculate the amount of potassium hydroxide that needs to be dissolved to make 25 cm^3 of solution.

.....

.....

Amount of potassium hydroxide = ... g **[2 marks]**

06.3 Describe how to carry out the titration.

Include any chemicals and equipment needed.

.....

.....

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.....

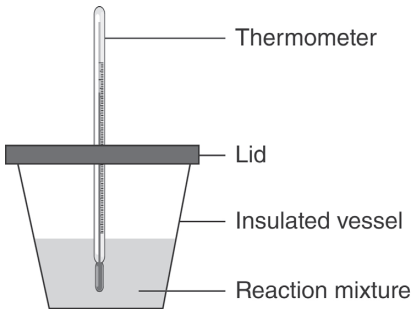
.....

[6 marks]

07 Some students investigated the temperature during the neutralisation of sodium hydroxide and hydrochloric acid.

The students used the apparatus in **Figure 7.1** to collect the data.

Figure 7.1



The students carried out eight experiments. In each experiment, they added a volume of 2 mol/dm^3 sodium hydroxide to a fixed volume and concentration of hydrochloric acid.

The volumes of 2 mol/dm^3 sodium hydroxide added and the temperatures recorded are shown in **Table 7.1**

Table 7.1

Volume of NaOH (cm^3)	Temperature (°C)
5	25.80
10	26.40
15	27.00
20	27.60
25	27.40
30	27.20
35	27.00
40	26.80

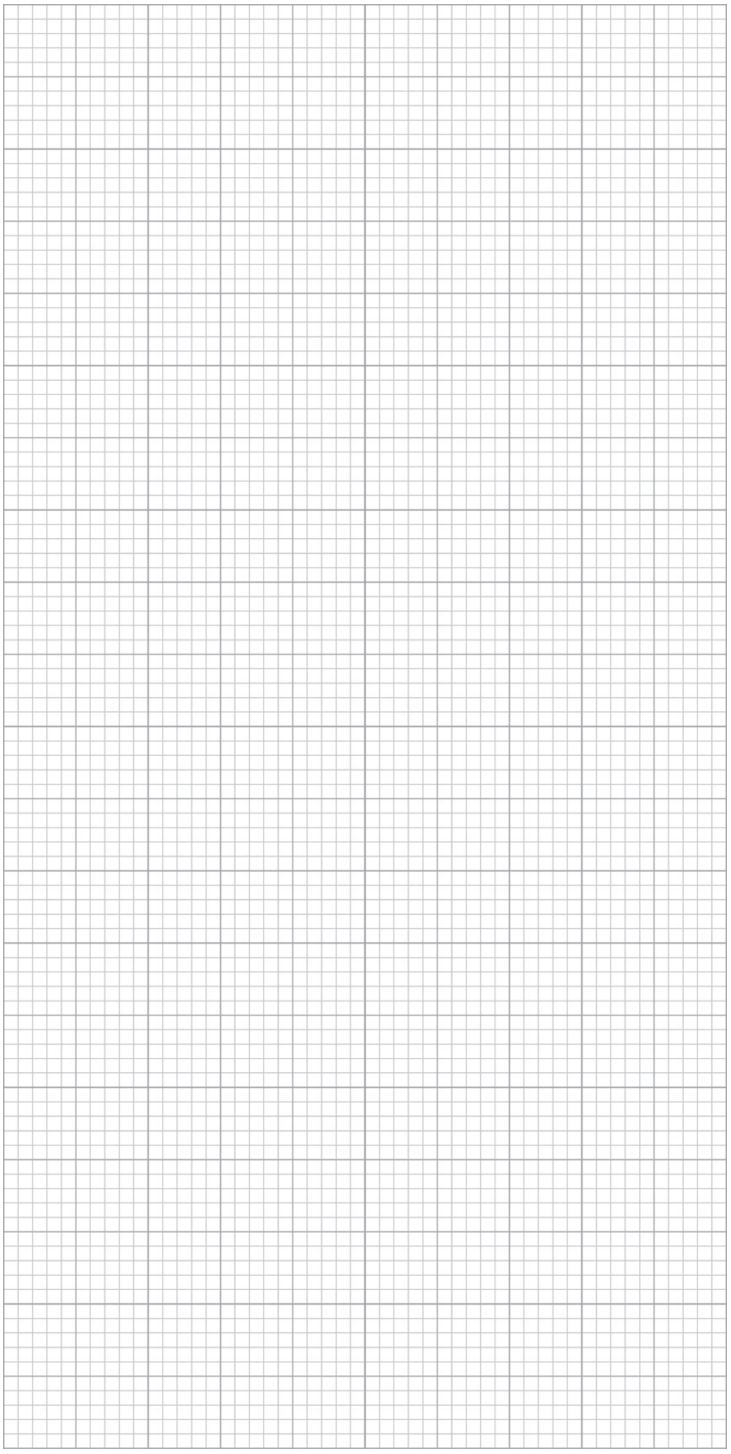
07.1 Name a suitable material to make the insulating material and the lid in **Figure 7.1**

.....

[1 mark]

Question 7 continues on the next page

07.2 Using a suitable scale on your axes, plot **all** the points from **Table 7.1** on the grid below.



[4 marks]

07.3 Draw two straight lines of best fit on the graph to show how the temperature changes as the volume increases.

[2 marks]

07.4 The **point of neutralisation** occurs at the highest temperature rise.

What is the volume of sodium hydroxide at the point of neutralisation?

..... **[1 mark]**

07.5 Add state symbols to complete the equation for this reaction.

H^+ (.....) + OH^- (.....) → H_2O (.....) **[1 mark]**

07.6 Draw **one** line from each volume of sodium hydroxide added to the acid to the acid's expected pH range.

Volume of sodium hydroxide (cm^3)	pH range
	0–2
10	2–4
25	4–6
40	6–8
15	8–10
	10–12

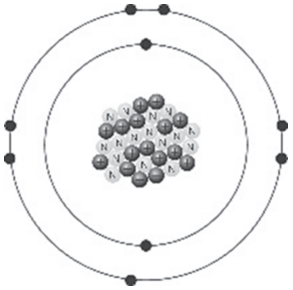
[4 marks]

Turn over >

08.1 Which diagram represents the correct atomic structure for oxygen?

$^{16}_{8}O$

Tick **one** box.



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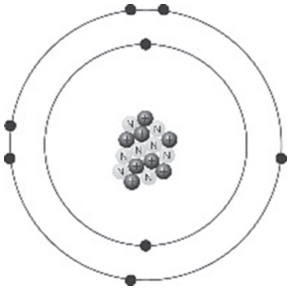

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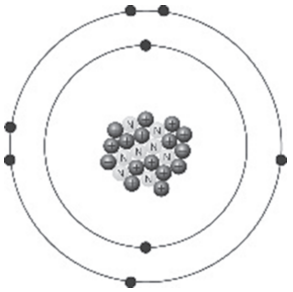


☐

[1 mark]

08.2 Draw the electronic structure of the **oxide ion.**

[2 marks]

08.3 Which statement about the sizes of the atoms and the nucleus is true?

Tick **one** box.

The radius of an atom is about 10 nm ☐

The radius of a nucleus is about 10 nm ☐

The radius of an atom is about 0.1 nm ☐

The radius of a nucleus is about 0.1 nm ☐

[1 mark]

08.4 Which **two** statements about isotopes are true?

Tick **two** boxes.

Isotopes have the same physical properties. ☐

Isotopes contain the same number of protons. ☐

Isotopes contain the same number of neutrons. ☐

Isotopes contain the same number of electrons. ☐

[2 marks]

08.5 Oxygen has three isotopes:

$^{16}_{8}O$ $^{17}_{8}O$ $^{18}_{8}O$

Describe the **similarities** and **differences** between the three isotopes of oxygen.

.....

.....

.....

..... **[2 marks]**

Question 8 continues on the next page

08.6 **Table 8.1** shows the percentage of each isotope in a sample of oxygen.

Table 8.1

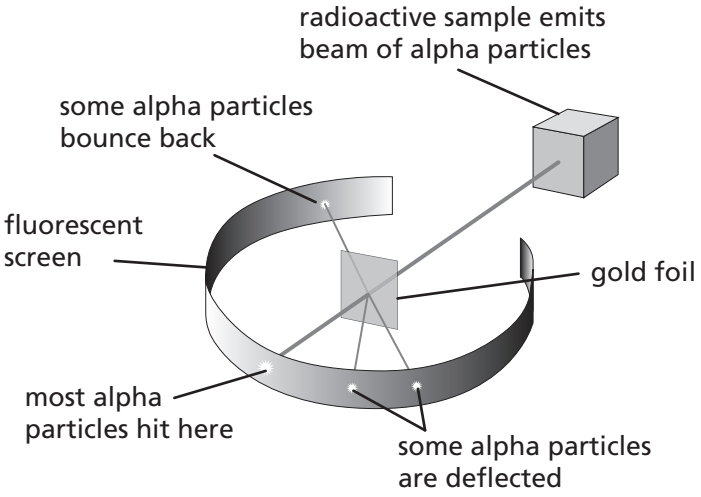
Percentage	Isotope
70	$^{16}_{8}O$
25	$^{17}_{8}O$
5	$^{18}_{8}O$

Calculate the relative atomic mass of oxygen in the sample.

Give your answer to 4 significant figures.

[3 marks]

09 Scientists used to think that atoms were like 'plum puddings'. An experiment using positively charged alpha particles and gold foil changed scientists' ideas.



1. Scientists thought the alpha particles would pass straight through the gold foil.
2. Alpha particles were fired at a sheet of gold foil.
3. Some alpha particles did go straight through the gold foil; others were deflected.

09.1 Which **two** statements about Rutherford's experiment **provided evidence** for the nuclear model of the atom?

Tick **two** boxes.

The beam produced is deflected by an electric field. ☐

Alpha particles were fired at a thin piece of gold foil. ☐

A high voltage was applied to produce a beam. ☐

Flashes of light were observed when particles hit a screen. ☐ **[2 marks]**

09.2 Describe the evidence collected through this experiment.

Explain how the evidence led to new conclusions about the structure of the atom.

[4 marks]

END OF QUESTIONS

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Key

Metals

Non-metals

Relative atomic mass — 1
Atomic symbol — H
Name — hydrogen
Atomic/proton number — 1

1	2											3	4	5	6	7	0 or 8
																	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	63.5 **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	[98] **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	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	[285] **Cn** copernicium 112	[286] **Uut** ununtrium 113	[289] **Fl** flerovium 114	[289] **Uup** ununpentium 115	[293] **Lv** livermorium 116	[294] **Uus** ununseptium 117	[294] **Uuo** ununoctium 118

*The lanthanides (atomic numbers 58–71) and the actinides (atomic numbers 90–103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.