

Combined Science
PAPER 2
Foundation Tier

Total Marks

Time: 1 hour 10 minutes

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Booklet, Periodic Table

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – there may be more space than you need.

Calculators may be used.

Any diagrams may NOT be accurately drawn, unless otherwise indicated.

You must show all your working out with your answer clearly identified at the end of your solution.

INFORMATION

The total mark for this paper is 60.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

In questions marked with an ASTERISK (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

A periodic table is provided as a separate insert.

There may be spare copies of some diagrams.

ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

- 1 A metal spoon and two test tubes are heated in a water bath.**

One test tube contains a piece of chocolate, the other some liquid egg white.

After heating, the spoon, the chocolate and the egg white are allowed to cool to room temperature.

Look at Figure 2 for Question 1 in the Diagram Booklet. It shows the state of the three different substances before heating, when hot and after cooling.

(continued on the next page)

1 continued.

- (a) Describe the differences in the arrangement and movement of the particles in a solid and in a liquid.
(2 marks)**

difference in arrangement of particles

difference in movement of particles

(continued on the next page)

Turn over

1 continued.

**(b) What name is given to the process when the chocolate changes from a solid to a liquid?
(1 mark)**

☐ **A condensing**

☐ **B evaporating**

☐ **C freezing**

☐ **D melting**

**(c) Give a reason why the metal spoon has not changed state during the experiment.
(1 mark)**

(continued on the next page)

1 continued.

- (d) Explain how we know the change to the egg white is a chemical change rather than a physical change.
(2 marks)**

(Total for Question 1 = 6 marks)

2 Potable water is water that is suitable for drinking.

(a) River water can be treated to make it potable.

Chlorination, filtration and sedimentation are three of the processes involved in making the river water potable.

**(i) Which row of the table shows these three processes in the order in which they are carried out?
(1 mark)**

	first	second	third
<input type="checkbox"/> A	chlorination	sedimentation	filtration
<input type="checkbox"/> B	chlorination	filtration	sedimentation
<input type="checkbox"/> C	sedimentation	filtration	chlorination
<input type="checkbox"/> D	sedimentation	chlorination	filtration

(continued on the next page)

2 continued.

- (ii) State the reason why chlorine is added during the water treatment.
(1 mark)**

- (iii) Describe how sedimentation is carried out.
(2 marks)**

(continued on the next page)

2 continued.

(iv) Look at Figure 3 for Question 2(a)(iv) in the Diagram Booklet. It shows the results of an analysis of a sample of potable water.

Using this information, explain why this sample of potable water is not the same as pure water.

(2 marks)

(continued on the next page)

2 continued.

(b) A student wanted to distil a sample of potable water.

Look at Figure 4 for Question 2(b) in the Diagram Booklet. It shows apparatus the student used.

**(i) Name the piece of equipment labelled X in Figure 4.
(1 mark)**

(continued on the next page)

2 continued.

- (ii) The student made an error when setting up the equipment in Figure 4. This error meant no water could be collected in the test tube.**

Explain what the student needs to do so water can be collected.

(2 marks)

(Total for Question 2 = 9 marks)

- 3 (a) An atom of aluminium has an atomic mass of 27.

Aluminium has an atomic number of 13.

State the number of electrons, neutrons and protons in this atom.

(3 marks)

number of electrons = _____

number of neutrons = _____

number of protons = _____

- (b) Aluminium reacts with bromine to form aluminium bromide.

A sample of aluminium bromide contains 1.35 g of aluminium atoms and 12.00 g of bromine atoms.

Calculate the empirical formula of this sample of aluminium bromide.

(3 marks)

(relative atomic masses: Al = 27.0, Br = 80.0)

3 continued.

empirical formula = _____

(continued on the next page)

3 continued.

(c) Gallium is in the same group in the periodic table as aluminium and in the same period in the periodic table as bromine.

**(i) State in which group and period of the periodic table gallium can be found.
(2 marks)**

You may want to refer to the periodic table.

group = _____

period = _____

(continued on the next page)

3 continued.

- (ii) Gallium had not been discovered when Mendeleev created his first periodic table.**

Look at Figure 5 for Question 3(c)(ii) in the Diagram Booklet. It shows some properties of gallium that Mendeleev predicted and some of the actual properties of gallium.

Describe how Mendeleev predicted these properties of gallium.

(2 marks)

(Total for Question 3 = 10 marks)

- 4 (a) 3.14 g of solid copper sulfate was dissolved in water and made up to 250 cm³ of solution.

$$\text{concentration (g dm}^{-3}\text{)} = \frac{\text{mass of solid (g)}}{\text{volume of solution (dm}^3\text{)}}$$

Calculate the concentration of this copper sulfate solution in g dm⁻³.

(2 marks)

concentration = _____ g dm⁻³

(continued on the next page)

4 continued.

- (b) Sodium hydroxide solution was added to a solution of copper sulfate.

A precipitate of copper hydroxide and a solution of sodium sulfate were formed.

- (i) State what would be SEEN in the reaction.
(1 mark)

- (ii) Complete the balanced equation for the reaction by adding a number in front of NaOH.
(1 mark)



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4 continued.

(iii) Describe how to obtain a pure, dry sample of the precipitate of copper hydroxide from the reaction mixture.

(3 marks)

(continued on the next page)

4 continued.

- (c) Look at Figure 6 for Question 4(c) in the Diagram Booklet. It shows the equipment used to electrolyse a sample of sodium sulfate solution.**

Graphite electrodes are used in the electrolysis of sodium sulfate solution.

Graphite is used because it is inert and conducts electricity.

- (i) Look at Figure 7 for Question 4(c)(i) in the Diagram Booklet. It shows the ions in the sodium sulfate solution.**

**Draw a circle around each of the ions in Figure 7 that are attracted to the negative graphite electrode during the electrolysis.
(1 mark)**

- (ii) State why it is important that the electrodes are inert.
(1 mark)**

(continued on the next page)

Turn over

4 continued.

- (iii) Explain, in terms of its structure, how graphite conducts electricity.
(2 marks)**

(Total for Question 4 = 11 marks)

- 5 Barium hydroxide reacts with dilute hydrochloric acid to form barium chloride and water.

(a) The equation for the reaction is



Which row of the table shows the correct state of each of the substances in the equation for the reaction?

(1 mark)

	barium hydroxide	hydrochloric acid	barium chloride	water
<input type="checkbox"/> A	solid	aqueous	aqueous	liquid
<input type="checkbox"/> B	solid	liquid	solid	aqueous
<input type="checkbox"/> C	aqueous	aqueous	solid	liquid
<input type="checkbox"/> D	aqueous	liquid	aqueous	aqueous

(continued on the next page)

5 continued.

- (b) A student wanted to investigate how the pH of the mixture changes as barium hydroxide is added to dilute hydrochloric acid.**

They followed this method.

STEP 1 measure out 50.0 cm^3 of dilute hydrochloric acid into a beaker using a measuring cylinder

STEP 2 use a glass rod to place a drop of the acid onto a piece of universal indicator paper and record the pH

STEP 3 add 0.2 g of barium hydroxide to the acid in the beaker and stir

STEP 4 use the glass rod to place a drop of the mixture onto a new piece of universal indicator paper and record the pH again

STEP 5 repeat steps 3–4 until there is no further change in the pH.

(continued on the next page)

5 continued.

- (i) Name a piece of equipment which could be used to measure out 50.0 cm^3 of dilute hydrochloric acid more accurately than the measuring cylinder.**
(1 mark)

- (ii) Describe how the pH of the mixture is determined when a drop of it is placed on the universal indicator paper.**
(2 marks)

(continued on the next page)

Turn over

5 continued.

(iii) In the method, universal indicator paper is used to determine the pH.

**Explain why litmus paper would not be a suitable indicator to use in this experiment.
(2 marks)**

(continued on the next page)

5 continued.

(iv) Figure 8 shows the student's results.

FIGURE 8

mass of barium hydroxide in g	pH of mixture
0.0	1
0.2	1
0.4	1
0.6	1
0.8	2
1.0	7
1.2	12
1.4	13
1.6	13

Look at the grid for Question 5(b)(iv) in the Diagram Booklet. On the grid:

- **Add suitable scales to the vertical and horizontal axes.**
- **Plot a graph of the pH of the mixture against the mass of barium hydroxide.**

(3 marks)

(continued on the next page)

Turn over

5 continued.

(c) Look at Figure 9 for Question 5(c) in the Diagram Booklet. It shows a hazard symbol placed on a container of barium hydroxide.

**(i) What is the meaning of the hazard symbol in Figure 9?
(1 mark)**

- ☐ **A flammable**
- ☐ **B health hazard**
- ☐ **C oxidising**
- ☐ **D toxic**

(continued on the next page)

5 continued.

(ii) Barium hydroxide is also corrosive.

Give ONE precaution that the student should take when using barium hydroxide.

(1 mark)

(Total for Question 5 = 11 marks)

6 Magnesium carbonate has the formula MgCO_3 .

(a) Magnesium carbonate contains Mg^{2+} and CO_3^{2-} ions.

(i) The atomic number of magnesium is 12.

What is the electronic configuration of the Mg^{2+} ion?

(1 mark)

☐ A 2

☐ B 2.8

☐ C 2.8.2

☐ D 2.8.4

(continued on the next page)

6 continued.

- (ii) Explain why solid magnesium carbonate cannot conduct electricity but solid magnesium can.
(3 marks)**

(continued on the next page)

6 continued.

- (b) Calculate the percentage by mass of magnesium in magnesium carbonate, MgCO_3 .
(3 marks)

(relative atomic masses: C = 12.0, O = 16.0, Mg = 24.0)

percentage by mass of magnesium = _____

(continued on the next page)

6 continued.

- *(c) A student has two separate test tubes containing sulfuric acid.**

The student adds a spatula measure of magnesium carbonate, MgCO_3 , to the first test tube and a piece of magnesium to the second test tube.

Explain what the student would see in each test tube and the tests that they should carry out to identify the gases produced.

**Your answer should include word equations for the reactions that would take place.
(6 marks)**

(continued on the next page)

Turn over

6 continued.

[illegible]

(continued on the next page)

Turn over

6 continued.

[illegible]

(continued on the next page)

Turn over

6 continued.

[illegible]

(continued on the next page)

Turn over

6 continued.

[illegible]

(continued on the next page)

Turn over

6 continued.

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS
END OF PAPER