1. Question part 1/2 | 5070 May-June 2023 P4 V2 Q1

1 A student investigates the rusting of iron.

Fig. 1.1 shows the apparatus the student uses.

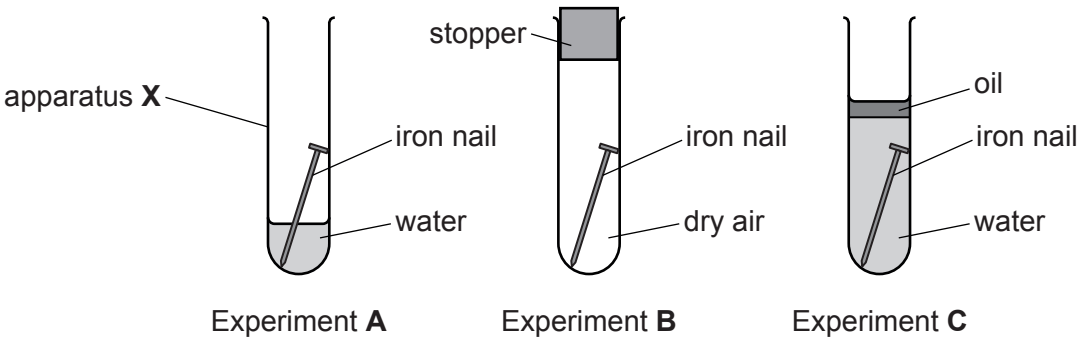

Fig. 1.1

(a) Name apparatus **X**.

..... [1]

(b) State why a stopper is used in Experiment **B**.

.....

..... [1]

(c) State why the water in Experiment **C** is boiled before use.

.....

..... [1]

(d) State why a layer of oil is used in Experiment **C**.

.....

..... [1]

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(e) The experiments are left for one week.

Predict in which of the experiments the nail will have rusted.

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Explain your prediction.

.....

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[2]

[Total: 6]

2 **(a)** A student investigates the reaction of four metals, **A**, **B**, **C** and **D**, with aqueous copper(II) sulfate.

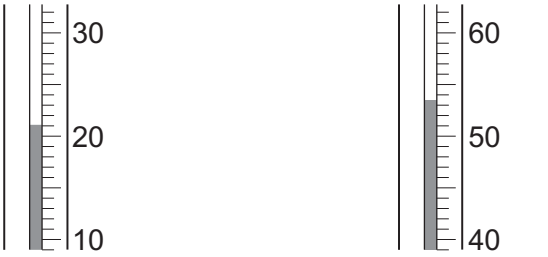
The four metals are all grey solids.

The student:

- puts 25 cm^3 of aqueous copper(II) sulfate into a beaker and measures its temperature
- records this temperature in Table 2.1
- adds a sample of **A** to the aqueous copper(II) sulfate
- stirs the reaction mixture until there is no further increase in temperature
- measures the highest temperature of the mixture and records this temperature in Table 2.1
- observes any changes in the appearance of the mixture in the beaker.

The student repeats the experiment three more times using **B**, **C** and **D** instead of **A**.

The results for **D** are shown in Fig. 2.1.



initial temperature for **D**

highest temperature for **D**

Fig. 2.1

The results for **A**, **B** and **C** are shown in Table 2.1.

Table 2.1

metal	initial temperature / °C	highest temperature / °C	temperature increase / °C
A	20	69.5	49.5
B	24.5	46.0	
C	22.0	61.0	39.0
D			

2. Question part 2/3 | 5070 May-June 2024 P4 V1 Q2

(i) State the value in Table 2.1 which the student records to an incorrect degree of precision.

..... [1]

(ii) The temperatures for **D** are shown in Fig. 2.1.

Record these temperatures in Table 2.1.

Calculate and record the temperature increases for **B** and **D** in Table 2.1.

[3]

(iii) The equation for the reaction between **B** and aqueous copper(II) sulfate is shown.

$$\mathbf{B}(s) + CuSO_4(aq) \rightarrow \mathbf{B}SO_4(aq) + Cu(s)$$

Copper(II) sulfate is a blue solution.

At the end of the experiment, the student observes a colourless solution, a grey solid and a brown solid.

Explain how these observations show that **B** is in excess in this reaction.

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..... [1]

(iv) Using the equation in **(iii)**, write the formula for:

- the colourless solution
- the grey solid
- the brown solid.

colourless solution .....

grey solid .....

brown solid .....

[1]

(b) Use your results to arrange **A**, **B**, **C** and **D** in decreasing order of reactivity.

Explain how the results give this order of reactivity.

most reactive .....



.....

.....

least reactive .....

explanation .....

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.....

[2]

(c) A student repeats the experiment using a fifth metal.

This metal is the second most reactive of the five metals.

Suggest a temperature increase for this experiment.

..... [1]

(d) The temperature increases measured are less than the true values for these experiments.

Suggest a reason for this.

Describe an improvement to the method which makes the results closer to the true values.

reason .....

.....

improvement .....

.....

[2]

(e) State and explain the effect of using half the concentration of aqueous copper(II) sulfate on the temperature increase for metal **A**.

effect .....

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explanation .....

.....

.....

[3]

[Total: 14]

3. Question part 1/2 | 5070 Oct-Nov 2024 P4 V1 Q4

4 Argentan is an alloy containing only zinc, nickel and copper.

Zinc and nickel both react with dilute hydrochloric acid. Copper does **not** react with dilute hydrochloric acid.

Plan an investigation to find the percentage by mass of copper in a powdered sample of argentan.

Your plan must include the use of common laboratory apparatus, argentan and dilute hydrochloric acid. No other chemicals should be used.

Your plan must include:

- the apparatus needed
- the method to use and the measurements to take
- procedures to ensure that the percentage determined is as accurate as possible
- how the measurements are used to determine the percentage by mass of copper in the sample.

You may draw a diagram to help answer the question.

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[6]