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CO-ORDINATED SCIENCES

0654/61

Paper 6 Alternative to Practical

May/June 2024

1 hour 30 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Any blank pages are indicated.

1 Fig. 1.1 is a photograph of a slice of an orange shown actual size.



Fig. 1.1

(a) In the box, make a large, detailed, pencil drawing of the slice of the orange shown in Fig. 1.1.

[3]

(b) (i) Draw a line to join points **A** and **B** on Fig. 1.1.

Record the length of this line **AB** in millimetres to the nearest millimetre.

length of line **AB** on Fig. 1.1 = mm [1]

(ii) Draw the line **AB** on your drawing in (a).

Record the length of this line in millimetres to the nearest millimetre.

length of line **AB** on your drawing = mm [1]

(iii) Calculate the magnification *m* of your drawing.

Use your measurements in (b)(i) and (b)(ii) and the equation shown.

$$m = \frac{\text{length of line AB on your drawing}}{\text{length of line AB on Fig. 1.1}}$$

Record your value to **two** significant figures.

magnification *m* = [2]

(c) Fig. 1.2 is a photograph of a slice of a kiwi fruit shown actual size.

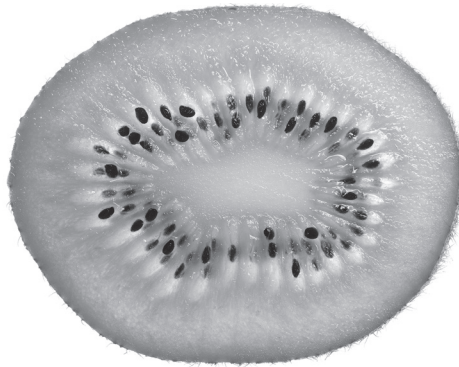


Fig. 1.2

State **two visible** differences between the slice of orange shown in Fig. 1.1 and the slice of kiwi fruit shown in Fig. 1.2.

difference 1

.....

difference 2

.....

[2]

(d) Suggest how the mean diameter of the kiwi fruit is determined.

.....

..... [1]

[Total: 10]

2 A student compares the vitamin C concentration of orange juice with three other fruit juices, **D**, **E** and **F**.

DCPIP is a blue solution that decolourises (goes colourless) when vitamin C is added to it.

DCPIP is used as an indicator for vitamin C concentration as shown in Fig. 2.1.

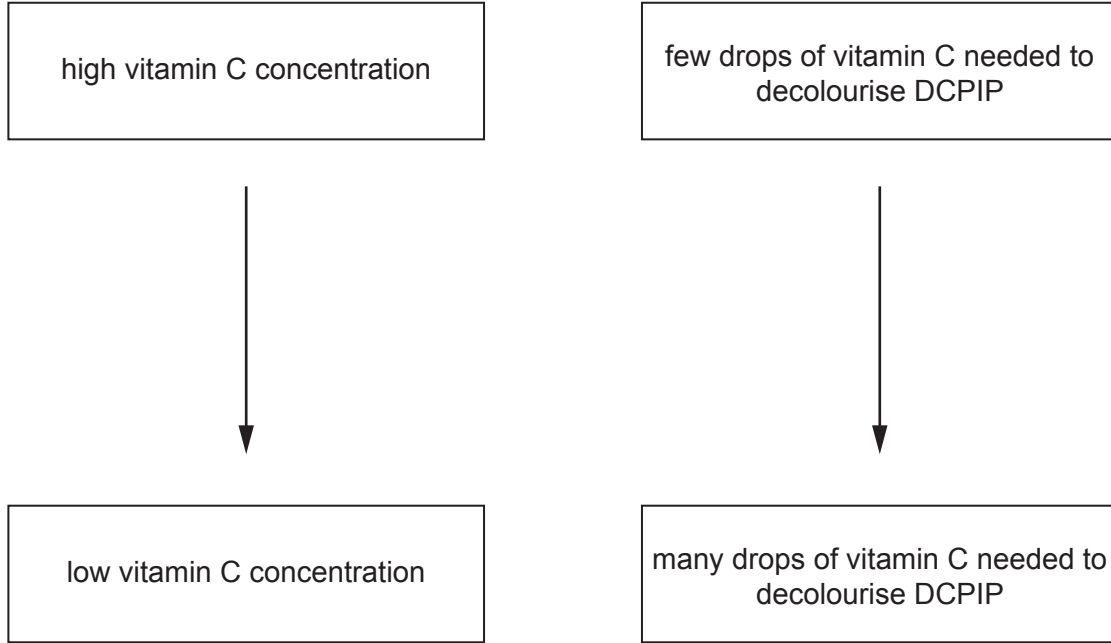


Fig. 2.1

(a) Procedure

The student:

- places two drops of DCPIP into a well of a spotting tile
- adds drops of orange juice to the well of DCPIP
- records how many drops of orange juice are needed to decolourise the DCPIP.

The student repeats the procedure with the other fruit juices.

(i) Name a piece of equipment suitable for putting the DCPIP in the well.

..... [1]

(ii) Suggest a suitable colour for the spotting tile.

Explain your answer.

colour

explanation

.....

[1]

(iii) Fig. 2.2 shows part of the student's notebook.

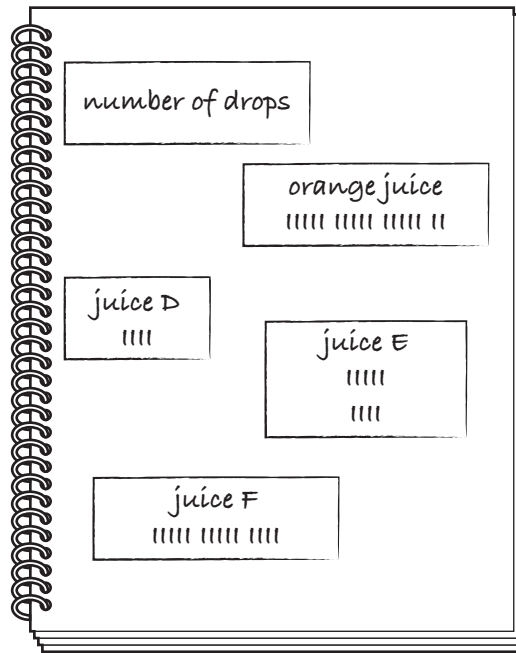


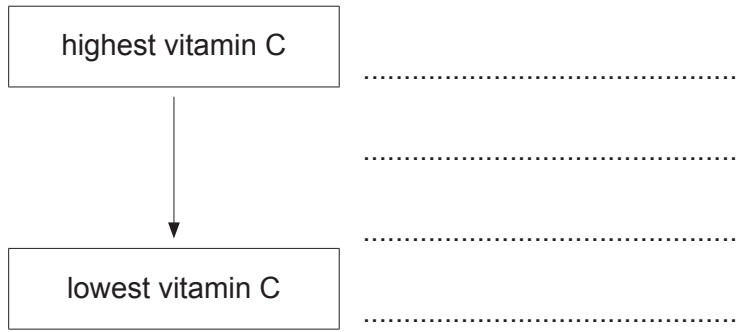
Fig. 2.2

Draw a table for the student's results shown in Fig. 2.2.

Record the student's results in your table.

[3]

(iv) Use the student's results and Fig. 2.1 to place the juices in order of their vitamin C concentration.



[1]

(b) (i) Explain why repeating the procedure allows the student to have more confidence in their results.

.....
..... [1]

(ii) Counting the number of drops is **one** source of error in this procedure.

Explain why this is a source of error.

Suggest **one** improvement. Do **not** include repeating the procedure.

explanation

.....

improvement

..... [2]

(c) Scurvy is a disease caused by a lack of vitamin C in the diet.

A student does **not** drink orange juice or fruit juices **D, E** and **F**.

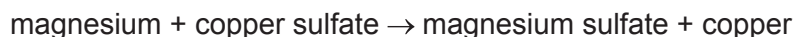
Suggest why the student does **not** get scurvy.

.....
..... [1]

[Total: 10]

3 A student investigates the reaction between magnesium and aqueous copper sulfate.

More reactive metals displace less reactive metals from solutions of their salts.



The unit M is used to measure the concentration of a solution.

The higher the value of M, the more concentrated the solution.

A 1 M solution is two times more concentrated than a 0.5 M solution.

(a) Procedure

The student:

- places a polystyrene cup into a beaker
- uses a measuring cylinder to add 25 cm^3 of 1.00 M aqueous copper sulfate to the polystyrene cup as shown in Fig. 3.1

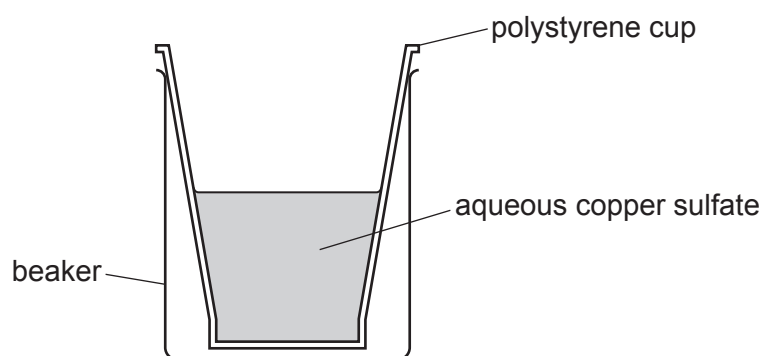


Fig. 3.1

- places a thermometer into the polystyrene cup and records in Table 3.1 the temperature of the aqueous copper sulfate to the nearest 0.5°C
- adds magnesium powder to the aqueous copper sulfate in the cup
- stirs the mixture and records in Table 3.1 the highest temperature reached to the nearest 0.5°C .

The student repeats the procedure using the concentrations of aqueous copper sulfate shown in Table 3.1.

Table 3.1

concentration of aqueous copper sulfate / M	initial temperature of aqueous copper sulfate / $^\circ\text{C}$	highest temperature of the mixture / $^\circ\text{C}$	temperature increase ΔT / $^\circ\text{C}$
1.00	21.5	85.5	64.0
0.75	22.0		
0.50	22.5	54.0	31.5
0.25	21.0		
0.00	21.5	21.5	0.0

Fig. 3.2 shows the thermometer readings for the highest temperatures for 0.75 M aqueous copper sulfate and 0.25 M aqueous copper sulfate.

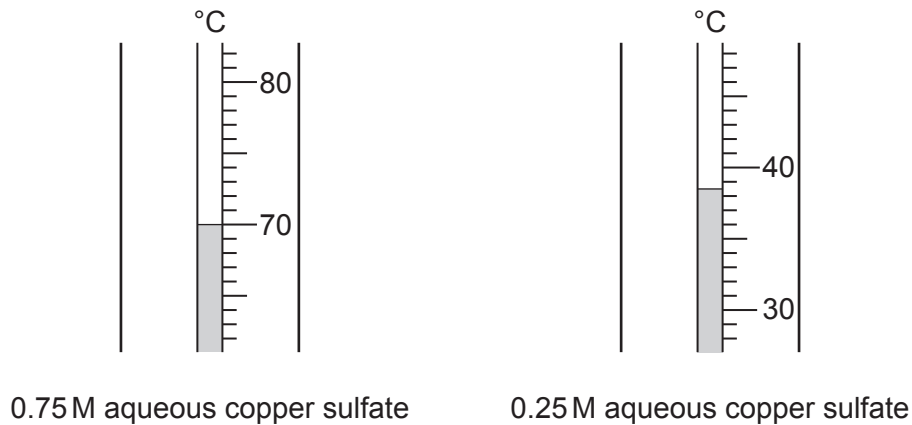


Fig. 3.2

Record in Table 3.1 these temperatures to the nearest 0.5 °C. [2]

(b) The student observes that the mixture left at the end of the reaction is a colourless solution with pieces of grey solid and pink solid.

(i) Explain how this observation shows that the magnesium powder is in excess.

.....
 [1]

(ii) Suggest the identity of the pink solid.

..... [1]

(c) (i) Explain why the polystyrene cup is placed in the beaker.

.....
 [1]

(ii) State the name of a piece of apparatus suitable for measuring the 25 cm³ of aqueous copper sulfate more accurately than the measuring cylinder.

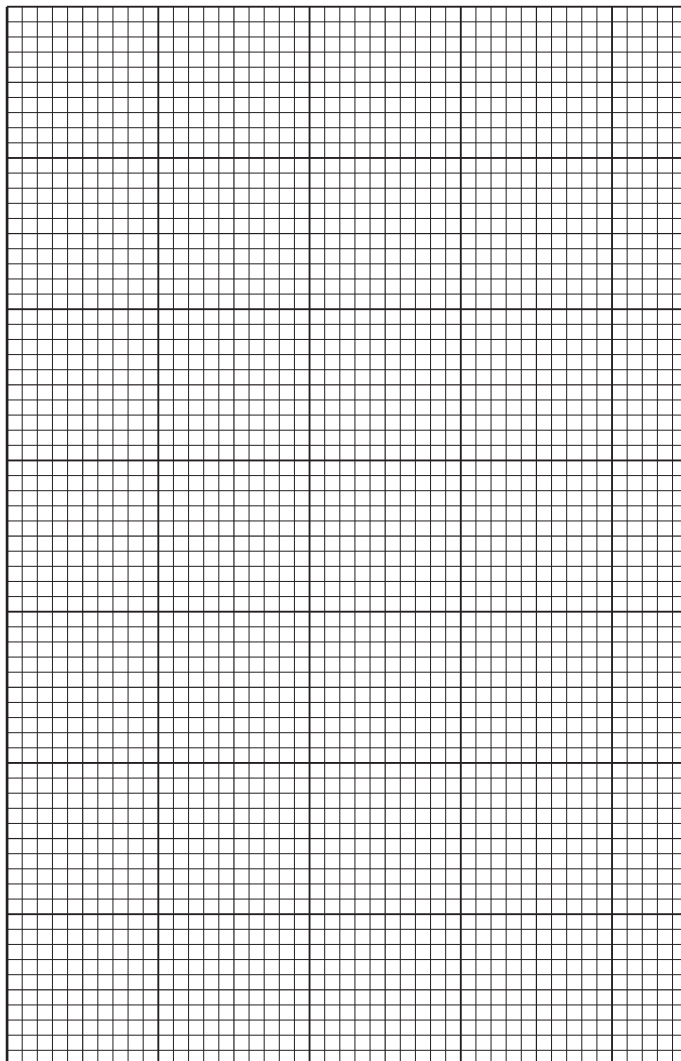
..... [1]

- (d) (i) Calculate the temperature increase ΔT for 0.75 M aqueous copper sulfate and 0.25 M aqueous copper sulfate.

Record these values in Table 3.1.

[1]

- (ii) On the grid, plot a graph of temperature increase ΔT (vertical axis) against concentration of aqueous copper sulfate.



[3]

- (iii) Draw the best-fit straight line.

[1]

- (iv) A teacher says that the temperature increase is proportional to the concentration of aqueous copper sulfate.

Suggest if this is supported by the student's data.

Explain your answer.

.....

..... [1]

- (v) Use your graph to estimate the temperature increase ΔT when 0.35M aqueous copper sulfate is used in the procedure.

$\Delta T = \dots\dots\dots$ °C [1]

- (e) Suggest **one** improvement to the procedure which will give more confidence in the values of ΔT .

Do **not** include repeating the procedure.

Explain your answer.

improvement

.....

explanation

.....

[1]

[Total: 14]

4 A student identifies a solution labelled **H**.

(a) The student puts solution **H** into five test-tubes and does the tests in Table 4.1.

The student identifies **H** as aqueous potassium chloride.

Complete Table 4.1 with the student's observations.

Table 4.1

test	observation
add dilute nitric acid followed by a few drops of aqueous silver nitrate	
add dilute nitric acid followed by aqueous barium nitrate	
flame test	
add aqueous ammonia	
add aqueous sodium hydroxide	

[5]

(b) Explain why a flame test uses a blue Bunsen burner flame instead of a yellow one.

.....

..... [1]

[Total: 6]

- 5 A student investigates how the resistance R of a lamp changes as the current I flowing through the lamp changes.

The student assembles the circuit shown in Fig. 5.1.

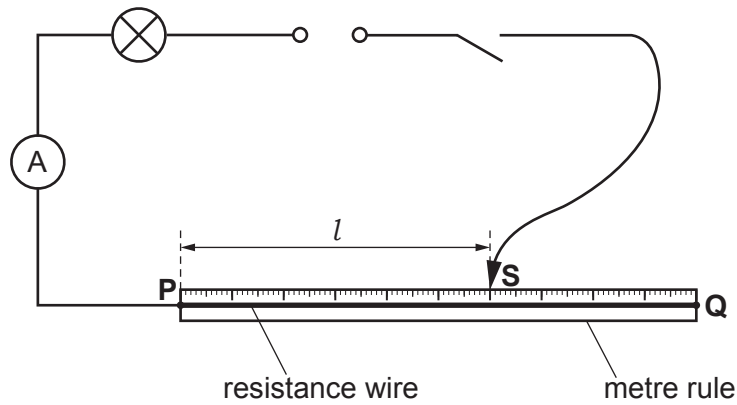


Fig. 5.1

(a) Procedure

The student:

- connects a voltmeter to measure the potential difference across the lamp
- closes the switch
- places the sliding contact **S** on the resistance wire at a distance $l = 20.0$ cm from end **P**
- records in Table 5.1 the current I in the lamp and the potential difference V across the lamp
- opens the switch.

- (i) Using the correct circuit symbol, add a voltmeter to Fig. 5.1 to measure the potential difference across the lamp. [2]

- (ii) The ammeter and voltmeter readings are shown in Fig. 5.2.

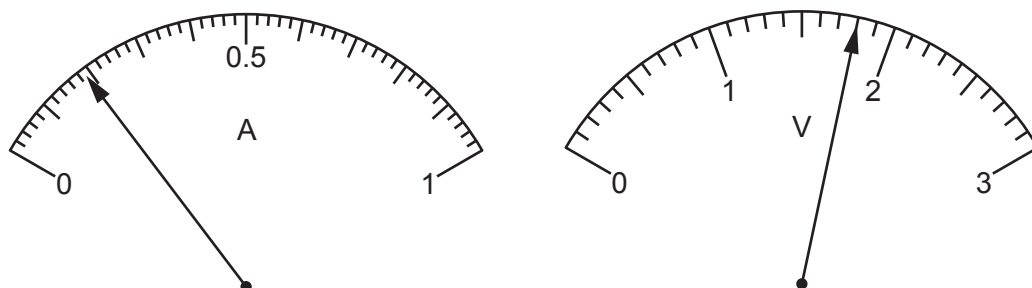


Fig. 5.2

Record in Table 5.1 the current I in the lamp and the potential difference V across the lamp.

Table 5.1

length of resistance wire l /cm	current I /A	potential difference V /V	resistance R / Ω
20.0			9.5
40.0	0.17	1.4	2.8
60.0	0.15	1.2	
80.0	0.13	1.0	7.7

[2]

- (b) The student repeats the procedure in (a) for values of $l = 40.0$ cm, 60.0 cm and 80.0 cm.

Suggest why the student opens the switch after taking each pair of readings of the current I and the potential difference V .

.....
 [1]

- (c) (i) Calculate the resistance R of the lamp when $l = 60.0$ cm.

Use the equation shown.

$$R = \frac{V}{I}$$

Record your value of R in Table 5.1. [1]

- (ii) One of the values of resistance R in Table 5.1 is incorrect.

State which value of R is incorrect.

Suggest the error the student makes to get this value.

value

error

[2]

- (d) (i) Describe how the resistance R of the lamp changes as the length l of resistance wire changes.

..... [1]

- (ii) Describe how the resistance R of the lamp changes as the current I flowing through the lamp changes.

..... [1]

- (e) A student suggests that the resistance R of the lamp is proportional to the potential difference V across it.

State if the values of R and V in Table 5.1 support the student's suggestion.

Use values from Table 5.1 to explain your answer.

.....

.....

.....

..... [2]

- (f) As the length l of the resistance wire increases, the brightness of the lamp decreases.

A student finds that when l is greater than 80.0 cm, the lamp does **not** glow.

Suggest how the student checks that the lamp is **not** broken.

.....

..... [1]

[Total: 13]

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6 A student investigates the cooling of hot water in a beaker.

Plan an experiment to investigate the relationship between the thickness of the cardboard insulation wrapped around a beaker and the rate of cooling of hot water in the beaker.

You are provided with:

- a supply of hot water
- a beaker
- a measuring cylinder
- thin sheets of cardboard.

You may use any other common laboratory apparatus.

In your plan include:

- any other apparatus needed
- a brief description of the method, including what you will measure and how you will make sure your measurements are accurate
- the variables you will control
- a results table to record your measurements (you are **not** required to enter any readings in the table)
- how you will process your results to draw a conclusion.

You may include a labelled diagram if you wish.

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