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CO-ORDINATED SCIENCES

0654/52

Paper 5 Practical Test

May/June 2021

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

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 [].
- Notes for use in qualitative analysis are provided in the question paper.

For Examiner's Use	
1	
2	
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4	
5	
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7	
Total	

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

1 You are going to investigate the nutrient content of three solutions, **A**, **B** and **C**.

You are provided with Benedict's solution, biuret solution and iodine solution.

(a) Procedure

- Add about 1 cm depth of solution **A** to each of three test-tubes.
- Add the same depth of Benedict's solution to one test-tube and place it in a hot water-bath for at least 3 minutes. You should continue with the rest of this procedure while you are waiting.
- Add the same depth of biuret solution into the second test-tube.
- Add a few drops of iodine solution to the third test-tube.

Record in Table 1.1 your observations of the final colours observed for each of the test-tubes.

Table 1.1

solution	final colour with biuret solution	final colour with iodine solution	final colour with Benedict's solution
A			
B			
C			

[3]

(b) Using clean test-tubes repeat the procedure in **(a)** with solution **B** instead of solution **A**.

Record in Table 1.1 your observations of the final colours observed for each of the test-tubes.

[2]

(c) Using clean test-tubes repeat the procedure in **(a)** with solution **C** instead of solution **A**.

Record in Table 1.1 your observations of the final colours observed for each of the test-tubes.

[2]

(d) Use your results in Table 1.1 to state the nutrients present in each solution.

solution **A** contains

solution **B** contains

solution **C** contains

[3]

(e) State and explain **one** safety precaution you used when doing these tests.

safety precaution

explanation

[1]

(f) A student investigates the nutrient concentration in some food samples using Benedict's solution.

Benedict's solution will give a range of colours depending on the concentration of the nutrient for which it is testing.

State two variables which need to be controlled in this investigation.

variable 1

variable 2

[2]

[Total: 13]

- 2 Small maggots (insect larvae), as shown in Fig. 2.1, live in damp, warm environments.

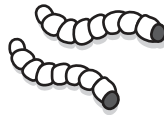


Fig. 2.1

A student wants to find out if maggots are attracted to different colours of light.

Plan an investigation to find out to which colour of light maggots are most attracted.

The student is provided with some maggots which need to be kept alive during the investigation, lamps of different colours and any other common laboratory apparatus.

You will **not** be doing this experiment.

Include in your plan:

- the apparatus needed
- a brief description of the method, explaining any safety precautions
- the measurements you will make, including how to make them as accurate as possible
- the variables you will control
- how you will use your results to draw a conclusion.

You may include a labelled diagram if you wish.

You may also include a table that can be used to record results if you wish. You are **not** required to include any results.

..... [7]

[Total: 7]

- 3 In this investigation you are going to find the amount of heat energy released when magnesium reacts with dilute hydrochloric acid.

(a) (i) Procedure

- Add 15 cm³ of dilute hydrochloric acid into a boiling tube (large test-tube).
- Measure the initial temperature of the dilute hydrochloric acid in the boiling tube.
- Record in Table 3.1, for 2 cm of magnesium ribbon added, this temperature to the nearest 0.5 °C.
- Add two 1 cm pieces of magnesium ribbon to the dilute hydrochloric acid in the boiling tube.
- Stir the mixture and measure the highest temperature reached.
- Record in Table 3.1 this temperature to the nearest 0.5 °C for 2 cm of magnesium ribbon added.

Repeat the procedure with a clean boiling tube using four 1 cm pieces of magnesium ribbon instead of two 1 cm pieces.

Record in Table 3.1 the initial and highest temperatures to the nearest 0.5 °C for 4 cm of magnesium ribbon added.

Table 3.1

	2 cm of magnesium ribbon added	4 cm of magnesium ribbon added
initial temperature of dilute hydrochloric acid / °C		
highest temperature of mixture / °C		
change in temperature ΔT / °C		

[3]

- (ii)** Calculate the change in temperature, ΔT , for each reaction.

Record these values in Table 3.1.

[1]

- (b) (i) Calculate the heat energy released when 2 cm of magnesium ribbon and when 4 cm of magnesium ribbon are added to dilute hydrochloric acid.

Use the equation shown.

$$\text{heat energy released} = 63 \times \Delta T$$

Give your answers to **two** significant figures.

Heat energy released when 2 cm of magnesium ribbon is added.

$$\text{heat energy released} = \dots\dots\dots \text{ J}$$

Heat energy released when 4 cm of magnesium ribbon is added.

$$\text{heat energy released} = \dots\dots\dots \text{ J}$$

[2]

- (ii) Two experimental results are considered similar and within experimental error if they are within 10% of each other.

A student suggests that the heat energy released when 4 cm of magnesium ribbon is added to dilute hydrochloric acid should be two times the energy released when 2 cm of magnesium ribbon is added.

State and explain if your results support the student's suggestion.

Include a calculation in your answer.

.....

 [2]

- (iii) Suggest two changes to the apparatus which would make the measurement of the change of temperature more accurate.

change 1

.....

change 2

..... [2]

- (iv) The student repeats the experiment but finds that the change in temperature for ten 1 cm pieces (10 cm), fifteen 1 cm pieces (15 cm) and twenty 1 cm pieces (20 cm) of magnesium added all give the same rise in temperature.

Suggest why the changes in temperature are all the same.

.....

..... [1]

[Total: 11]

[Turn over

4 In this investigation you are going to identify an unknown white solid, **X**.

(a) Procedure

- Half-fill a boiling tube (large test-tube) with distilled water.
- Add the white solid, **X**, to the water and stir.
- Add 2 cm depth of the solution of **X** to two test-tubes.
- To one test-tube add a wooden splint and leave to soak.
- To the second test-tube add about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Describe the contents of the second test-tube after dilute nitric acid and aqueous silver nitrate have been added.

..... [1]

(b) Procedure

- Take the wooden splint from the test-tube and place it in the top of a blue Bunsen burner flame.
- Record the colour you see immediately the splint is placed into the flame.
- If you are not sure, place the splint back into the solution and do the flame test again.

Colour of flame [1]

(c) State the name of solid **X.**

..... [2]

[Total: 4]

5 In this question you will draw the apparatus required for separating a mixture.

A student has a mixture of sand, salt and water.

The student separates the mixture to obtain pure sand, pure salt and pure water.

The student uses the three steps shown.

step 1: stirs the mixture

step 2: filters the mixture

step 3: distils the filtrate

The pieces of apparatus available for this separation are shown in Fig. 5.1.

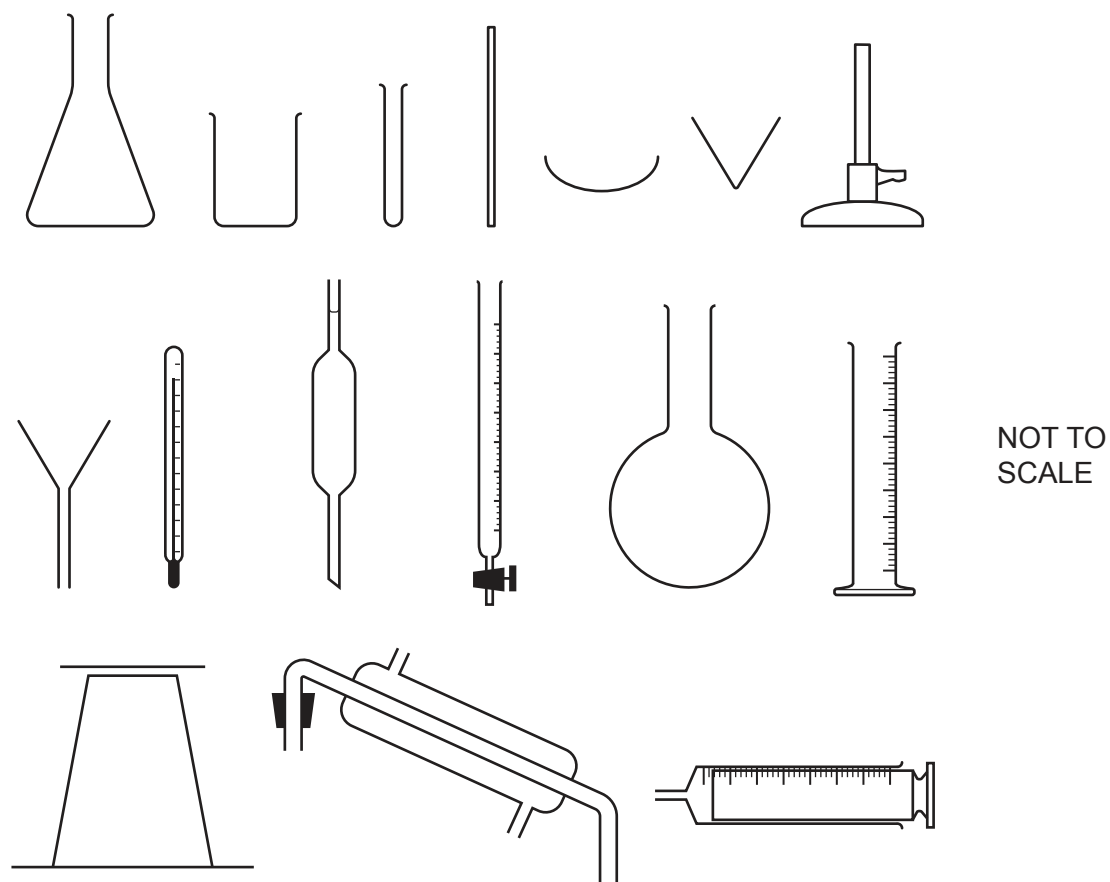


Fig. 5.1

(a) Choose the apparatus from Fig. 5.1 suitable for doing **step 2**.

Draw a large, clear, labelled diagram of the assembled apparatus for **step 2**.

Use a ruler.

Label the substances separated.

[2]

(b) Choose the apparatus from Fig. 5.1 suitable for doing **step 3**.

Draw a large, clear, labelled diagram of the assembled apparatus for **step 3**.

Use a ruler.

Label the substances separated.

[3]

[Total: 5]

[Turn over

- 6 You are going to find an approximate value for the internal diameter d of a boiling tube (large test-tube).

The internal diameter d is estimated by measuring the height h and volume V of water in the boiling tube.

The boiling tube is considered to be an approximate cylinder.

The boiling tube has been set up for you as shown in Fig. 6.1.

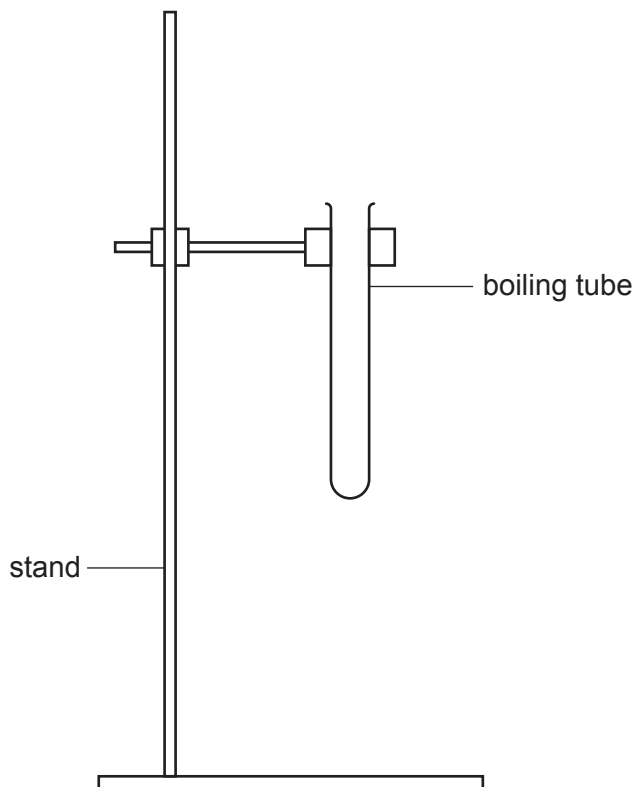


Fig. 6.1

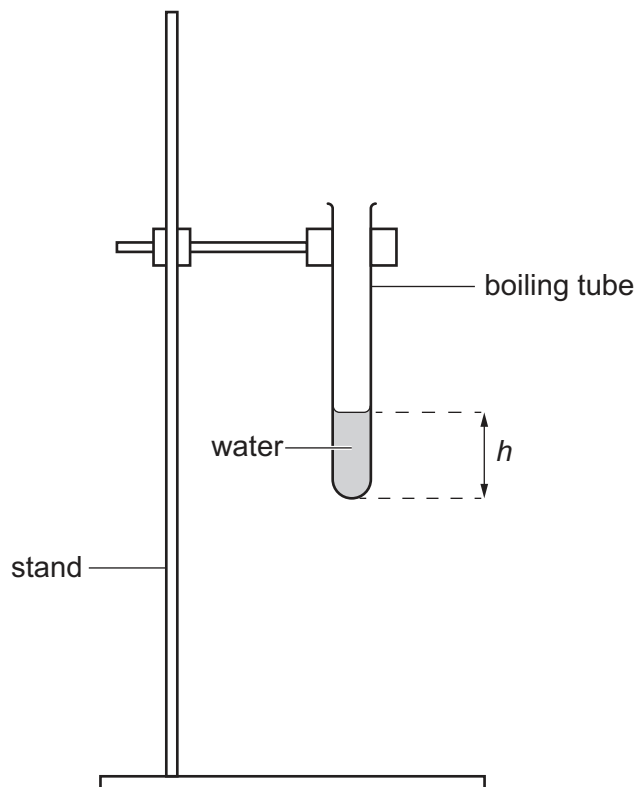


Fig. 6.2

(a) Procedure

- Pour water from the beaker into the measuring cylinder up to the 100 cm^3 mark.
- Add water from the measuring cylinder into the boiling tube until the height h of the water level above the bottom of the boiling tube is approximately 2 cm, as shown in Fig. 6.2.
- keep the water in the boiling tube and the water in the measuring cylinder for use in part (b).

- (i) Measure h in centimetres to the nearest millimetre, and record h in Table 6.1.

Table 6.1

h/cm	R/cm^3	V/cm^3

[1]

(ii) Measure and record in Table 6.1 the reading R of the water remaining in the measuring cylinder. [1]

(iii) Calculate the volume V of water in the boiling tube.

Use the equation shown.

$$V = 100 - R$$

Record your answer in Table 6.1.

[1]

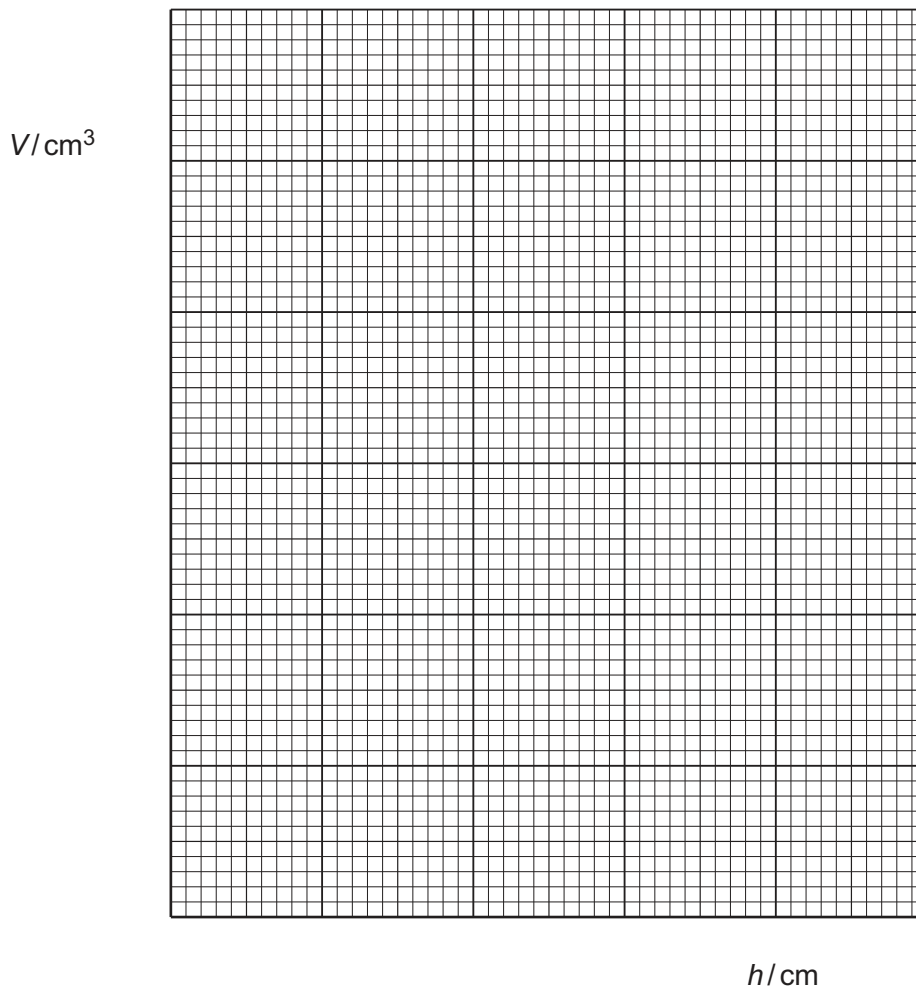
(b) Procedure

- Add approximately another 2 cm depth of water from the measuring cylinder to the boiling tube.
- Measure and record in Table 6.1 the new values of h and R .

(i) Repeat the procedure in (b) for another three more values of h and R . [1]

(ii) Complete Table 6.1 by calculating the values of V and recording them in Table 6.1. [1]

(c) (i) Plot on the grid provided a graph of V (vertical axis) against h .



[2]

(ii) Draw the best-fit straight line.

[1]

(d) Calculate the gradient m of your line.

Show all working and indicate on your graph the values you chose to enable the gradient to be calculated.

$$m = \dots\dots\dots [2]$$

(e) Calculate the internal diameter d of the boiling tube.

Use the equation shown.

$$d = 0.59 \times m$$

$$d = \dots\dots\dots \text{ cm } [1]$$

(f) (i) State **one** practical problem which makes it difficult to get an accurate value of h in this experiment.

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

(ii) Suggest **one** other reason why your value for the internal diameter d of the boiling tube is only approximate.

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

[Total: 13]

7 You are going to investigate how the resistance of a metal wire depends upon its length.

The circuit shown in Fig. 7.1 has been set up for you.

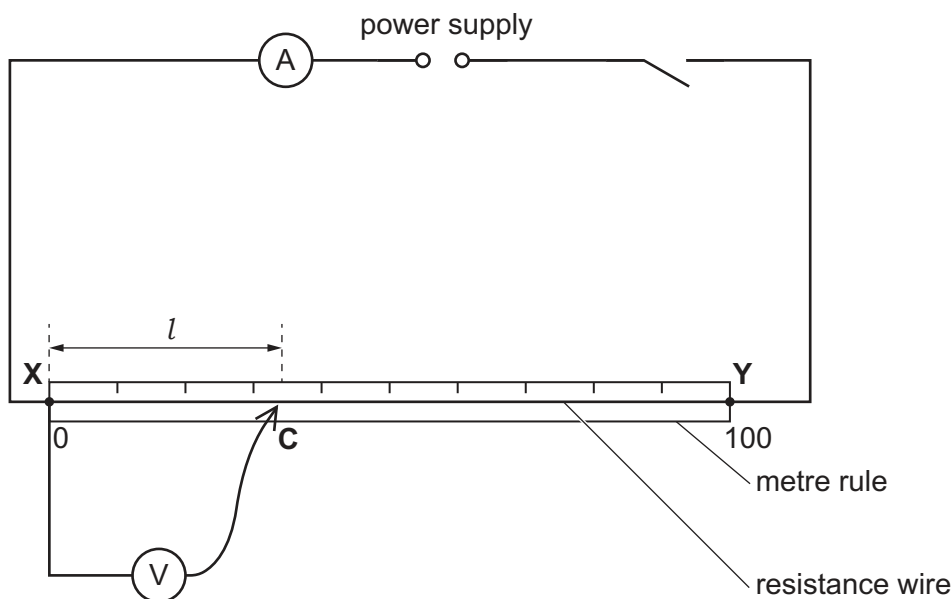


Fig. 7.1

(a) (i) Procedure

- Connect the crocodile clip **C** to the resistance wire **XY** at a length $l = 10.0$ cm from **X**.
- Close the switch.
- Record in Table 7.1 the current I flowing through the wire and the potential difference V .
- Open the switch.

Table 7.1

length l /cm	current I /A	potential difference V /V	resistance R / Ω	$\frac{R}{l}$ in Ω /cm
10.0				
20.0				
40.0				

[1]

(ii) Repeat the procedure for values of $l = 20.0$ cm and 40.0 cm.

[2]

(b) (i) Calculate the resistance R for each length of wire.

Use the equation shown.

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

Record your values of R in Table 7.1.

[1]

(ii) Calculate the ratio $\frac{R}{l}$ for each length of wire.

Record your answers in Table 7.1.

[1]

(c) The teacher states that the resistance of a wire is directly proportional to its length.

State if your results agree with this statement within the limits of experimental error.

Use values from Table 7.1 to support your answer.

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

(d) Suggest why the switch is opened whilst the length of the wire is changed between taking the readings.

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

[Total: 7]

NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

<i>anion</i>	<i>test</i>	<i>test result</i>
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide (Br^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

<i>cation</i>	<i>effect of aqueous sodium hydroxide</i>	<i>effect of aqueous ammonia</i>
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt., or very slight white ppt.
copper (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

<i>gas</i>	<i>test and test result</i>
ammonia (NH_3)	turns damp, red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	'pops' with a lighted splint
oxygen (O_2)	relights a glowing splint

Flame tests for metal ions

<i>metal ion</i>	<i>flame colour</i>
lithium (Li^+)	red
sodium (Na^+)	yellow
potassium (K^+)	lilac
copper(II) (Cu^{2+})	blue-green

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