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4858799765

COMBINED SCIENCE **0653/51**

Paper 5 Practical Test **May/June 2023**

1 hour 15 minutes

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 40.
- 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	
3	
4	
Total	

This document has **16** pages. Any blank pages are indicated.

1 **(a)** You will estimate the concentration of vitamin C in a sample of fruit juice.

When iodine solution is added to a mixture of starch and fruit juice the starch turns the iodine blue-black. The vitamin C turns the iodine colourless.

The amount of iodine needed to keep the blue-black colour is an indicator of the concentration of vitamin C.

You are provided with four different concentrations of vitamin C and a fruit juice with an unknown vitamin C concentration.

Procedure

Step 1 Label four boiling tubes (large test-tubes) **1.00**, **0.75**, **0.50** and **0.25**.

Step 2 Use a measuring cylinder to add 10 cm^3 of the **1.00%** vitamin C solution to boiling tube **1.00**.

Step 3 Use the 1 cm^3 syringe to add 0.5 cm^3 of starch solution to the boiling tube and swirl to mix.

Step 4 Fill the 20 cm^3 syringe with 20 cm^3 of iodine solution.

Step 5 Add a drop of the iodine solution to the mixture in the boiling tube and stir gently to mix.

A blue-black colour appears briefly which then disappears when mixed.

Step 6 Continue adding drops of iodine solution and mixing until the blue-black colour remains.

(i) Record in Table 1.1, the volume of iodine solution **remaining** in the 20 cm^3 syringe.

Table 1.1

percentage concentration of vitamin C	volume of iodine solution **remaining** / cm^3	volume of iodine solution **added** / cm^3
1.00		
0.75		
0.50		
0.25		

[1]

Procedure continued

Step 7 Refill the syringe to contain 20 cm^3 of iodine solution.

Step 8 Repeat **Step 2** to **Step 7** using the other three concentrations of vitamin C and the appropriately labelled boiling tubes.

(ii) Record in Table 1.1, the volumes of iodine solution **remaining** in the 20 cm^3 syringe for each concentration of vitamin C. [3]

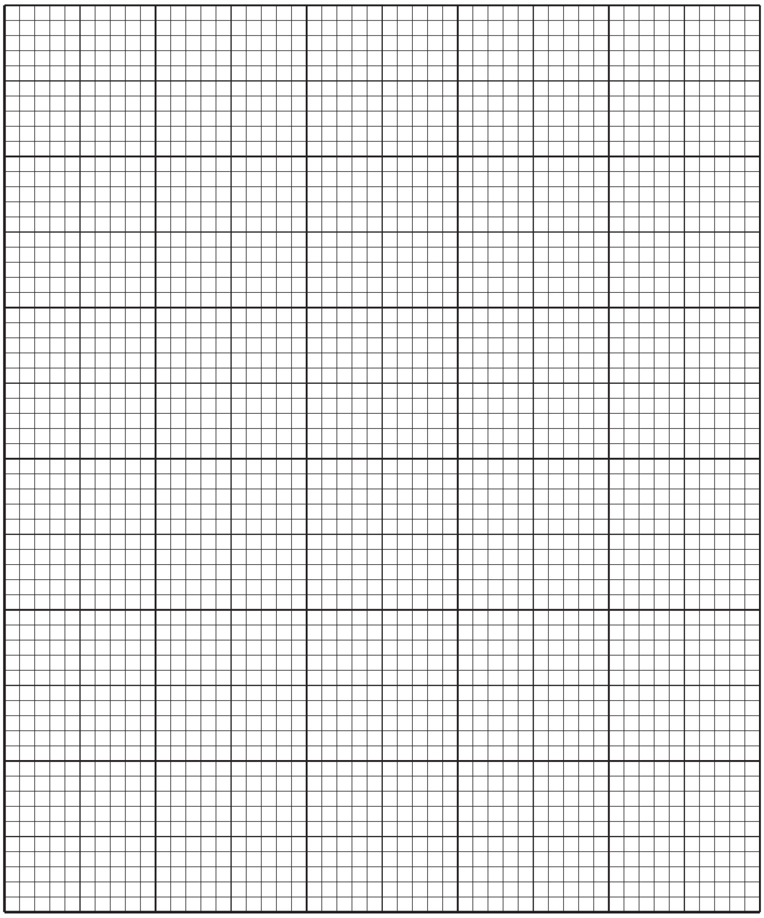
(iii) Calculate the volume of iodine solution **added** to each boiling tube.

Use the equation shown.

volume of iodine solution **added**	=	20	−	volume of iodine solution **remaining**

Record these values in Table 1.1. [1]

(iv) On the grid, plot a graph of the volume of iodine solution **added** (vertical axis) against the percentage concentration of vitamin C.



[3]

(v) Draw the line of best-fit. [1]

(vi) Repeat **Step 2** to **Step 6** of the procedure in **(a)** using a clean boiling tube and 10 cm^3 of fruit juice, instead of the vitamin C concentrations.

Record the volume of iodine solution remaining and the volume of iodine solution added.

volume of iodine solution **remaining** = ... cm^3

volume of iodine solution **added** = ... cm^3

[1]

(vii) Use your graph to estimate the percentage concentration of vitamin C in the fruit juice.

percentage concentration of vitamin C in fruit juice = ... [1]

(b) Repeating the procedure increases confidence in the results.

(i) Suggest one **other** reason why the procedure for each concentration should be repeated.

....

.... [1]

(ii) Suggest one **other** way to improve confidence in your estimate in **(a)(vii)**.

....

.... [1]

[Total: 13]

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2 You will investigate the components of a fertiliser.

The fertiliser contains an insoluble substance and a soluble salt.

You are provided with a sample of the fertiliser.

Procedure

- Pour all of the fertiliser into a glass beaker.
- Add about 20 cm^3 of distilled water to the glass beaker.
- Stir the mixture in the beaker with a glass rod for about one minute.
- Filter the mixture into a boiling tube (large test-tube).
- Keep the residue on the filter paper.
- Keep the filtrate in the boiling tube.

(a) Describe the appearance of the residue and the filtrate.

residue ....

filtrate ....
[2]

(b) Explain why the mixture is stirred.

....

.... [1]

(c) **Procedure**

- Put a wooden splint into the filtrate and leave it there for a few minutes.

  While you wait complete part (d).

- Place the wooden splint into the top of the blue flame of a Bunsen burner.
- Record the immediate colour of the flame.
- If you do not see a colour, put the splint back into the filtrate and then back into the flame.

(i) State the immediate colour of the flame.

.... [1]

(ii) Identify the cation (positive ion) in the filtrate.

.... [1]

(d) Procedure

- Pour about 2 cm depth of the filtrate into a test-tube.
- Add about 1 cm depth of dilute nitric acid to the filtrate in the test-tube.
- Add about 1 cm depth of aqueous barium nitrate to the mixture in the test-tube.

(i) Describe your observations.

.... [1]

(ii) Identify the anion (negative ion) present in the filtrate.

.... [1]

Go back and complete the flame test in (c).

[Total: 7]

3 Cetyl alcohol is a white solid with a melting point of 49 °C. If salt is mixed with cetyl alcohol the melting point decreases.

Some of the apparatus needed to determine the melting point of cetyl alcohol is shown in Fig. 3.1.

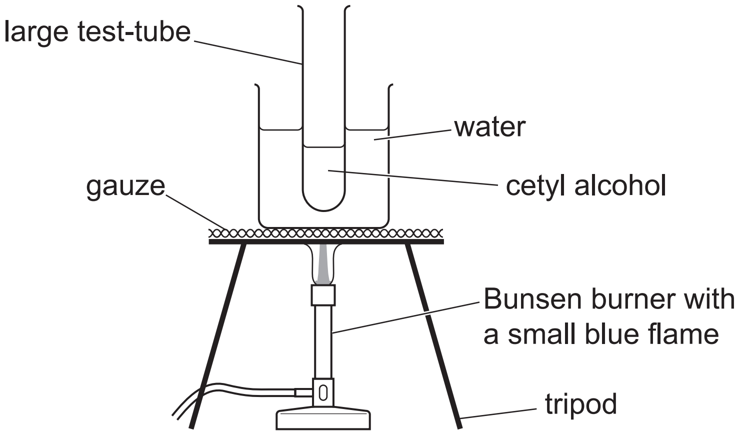

Fig. 3.1

Plan an investigation to find the relationship between the mass of salt added and the decrease in the melting point of cetyl alcohol.

You may use any common laboratory apparatus in your plan.

You are provided with:

- powdered cetyl alcohol
- powdered salt
- the apparatus shown in Fig. 3.1.

You are not required to do this investigation.

In your plan include:

- the additional apparatus needed
- a brief description of the method and an explanation of any safety precautions you will take
- what you will measure
- which variables you will keep constant
- how you will process your results to draw a conclusion.

You may include a table that can be used to record the results.

You do **not** need to include any results in the table.

....

....

....

....

....

....

....

....

....

....

....

....

....

.... [7]

4 You will investigate the resistance of different combinations of two identical lamps **L** and **M**.

(a) Fig. 4.1 shows a circuit using lamp **L**. The circuit is assembled for you.

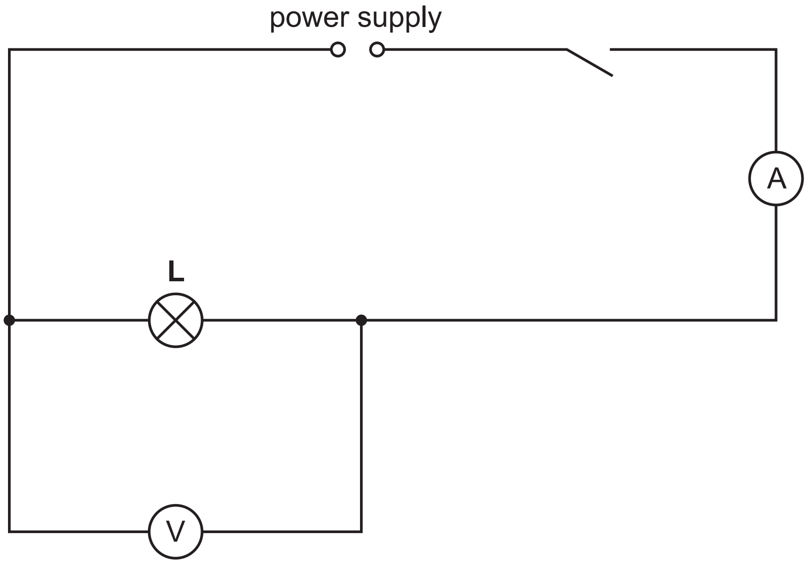

Fig. 4.1

Close the switch. Lamp **L** will light up.

(i) Record the potential difference V_L across lamp **L**.

V_L .... [1]

(ii) Record the current I_L in the circuit.

I_L .... [1]

(iii) Open the switch.

Calculate the resistance R_L of lamp **L**.
Use the equation shown.

$$R_L = \frac{V_L}{I_L}$$

R_L .... Ω [1]

(b) Procedure

- Disconnect the voltmeter.
- Add a second identical lamp **M** in series with lamp **L** as shown in Fig. 4.2.
- Reconnect the voltmeter to measure the combined potential difference across lamps **L** and **M**.

(i) Complete the circuit diagram in Fig. 4.2 to show how you connect the voltmeter.

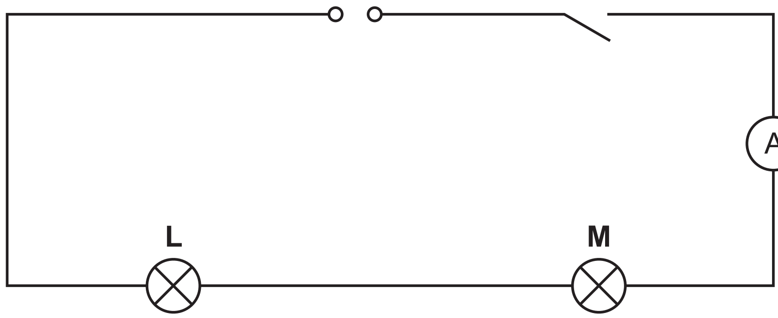

Fig. 4.2

[1]

(ii) Close the switch. Both lamps will light up.

Record the combined potential difference V_S across lamps **L** and **M**.
Include the unit in your answer.

V_S .... unit ....

Record the current I_S in the circuit.
Include the unit in your answer.

I_S .... unit ....
[1]

(iii) Open the switch.

Calculate the combined resistance R_S of lamps **L** and **M** in series.

Use the equation shown.

$$R_S = \frac{V_S}{I_S}$$

R_S .... Ω [1]

(c) Procedure

- Disconnect the voltmeter.
- Disconnect the lamps.
- Change the circuit to connect lamp **L** in **parallel** with lamp **M**.
- Connect the ammeter to measure the total current through the circuit.
- Connect the voltmeter to measure the potential difference across the **parallel** lamps.

(i) Complete the circuit diagram in Fig. 4.3 to show the parallel circuit. The power supply and switch are already shown.

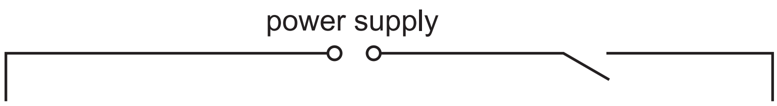

Fig. 4.3

[2]

(ii) Close the switch.
Record the combined potential difference V_P across lamps **L** and **M**.

V_P ....

Record the current I_P in the circuit.

I_P ....
[1]

(iii) Open the switch.
Calculate the combined resistance R_P of lamps **L** and **M** in parallel.
Use the equation shown.

$$R_P = \frac{V_P}{I_P}$$

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

R_P .... Ω [1]

(d) Suggest why the switch is opened after each measurement.

....

.... [1]

(e) A student predicts that the combined resistance of lamps **L** and **M** in series is twice the resistance of lamp **L**.

State if your measurements support the student's prediction.

Use your values from **(a)(iii)** and **(b)(iii)** to explain your answer.

statement ....

explanation ....

....

.... [2]

[Total: 13]

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NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	test	test result
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.
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

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt. or very slight white ppt.
copper(II) (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

gas	test and test results
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

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