



CANDIDATE  
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**0653/53**

October/November 2024

**1 hour 15 minutes**

You must answer on the question paper.

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

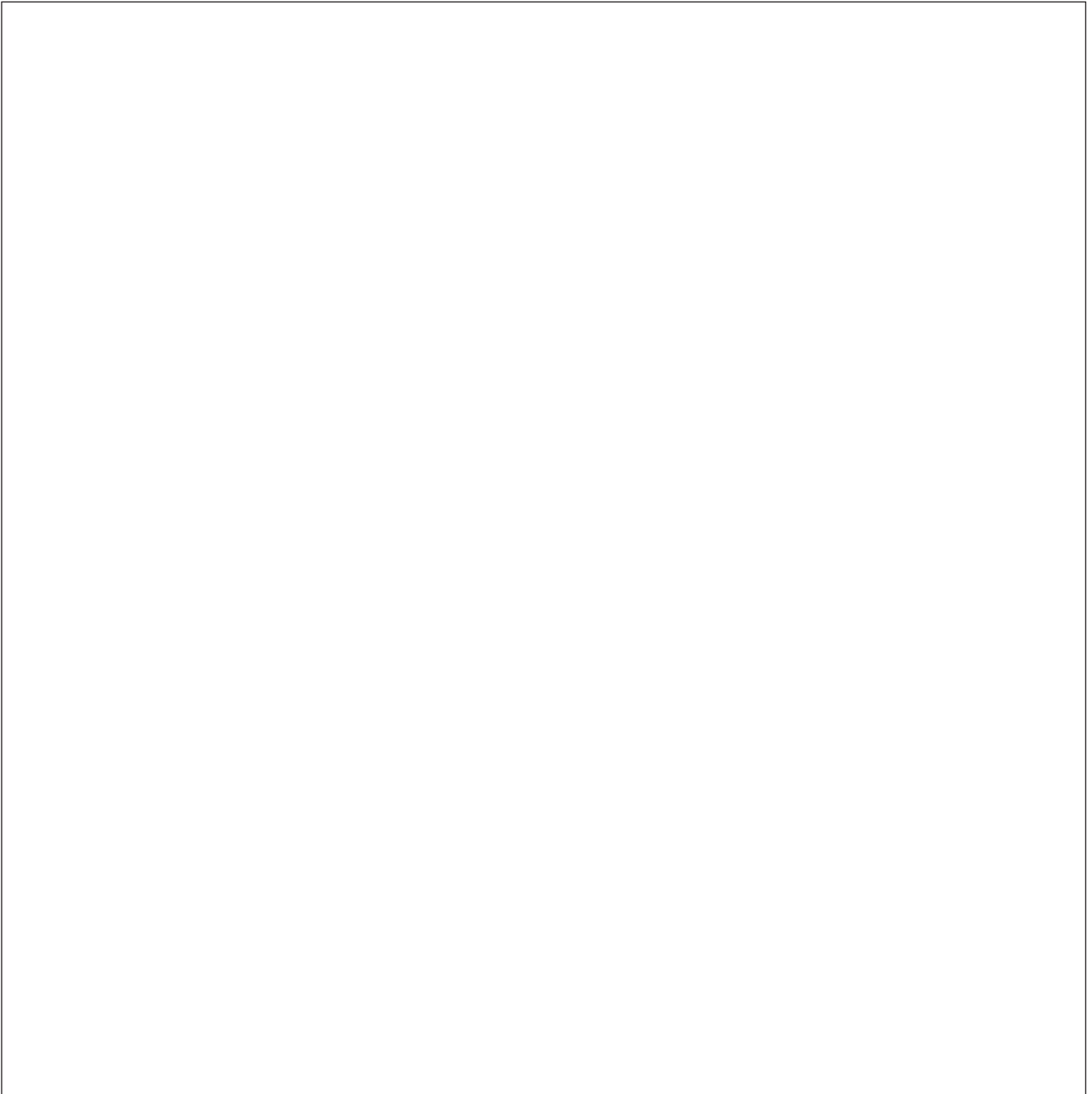
- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].
- Notes for use in qualitative analysis are provided in the question paper.

| For Examiner's Use |  |
|--------------------|--|
| 1                  |  |
| 2                  |  |
| 3                  |  |
| 4                  |  |
| Total              |  |

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

1 You are provided with one half of an onion on a white tile.

(a) In the box, make a large and detailed pencil drawing of the cut surface of the onion.

A large, empty rectangular box with a thin black border, intended for a pencil drawing of the cut surface of an onion.

[3]

- (b) (i) Measure the diameter  $d$  of the cut surface of the onion on the white tile.

$d =$  ..... mm [1]

- (ii) Draw a straight line on your drawing in (a) to show the diameter of the cut surface of the onion.

Measure the length  $D$  of the line on your drawing in (a).

$D =$  ..... mm [1]

- (iii) Calculate the magnification of your drawing.

Use the equation shown.

$$\text{magnification} = \frac{D}{d}$$

magnification = ..... [1]

- (c) Add a few drops of iodine solution to the cut surface of the onion on the white tile.

Record the result of the test and state a conclusion.

result .....

conclusion .....

[1]

[Total: 7]

- 2 Plants such as onions need minerals in the soil to grow.

Fig. 2.1 shows an onion plant.



**Fig. 2.1**

Plan an investigation to determine the relationship between the concentration of minerals in the soil and the growth of onion plants.

You are provided with:

- onion plants
- soil
- planting containers
- 10% mineral solution
- distilled water.

You may also use any other common laboratory apparatus.

**You are not required to do this investigation.**

In your plan, include:

- the additional apparatus needed
- a brief description of the method
- what you will measure
- which variables you will keep constant
- how you will process your results to draw a conclusion.

You may include a results table if you wish (you are not required to enter any readings in the table).



3 You are going to investigate the white solid provided, **solid H**.

(a) **Procedure**

- step 1** Measure the mass of an empty test-tube. Record this value in Table 3.1.
- step 2** Place three spatulas of **solid H** into the test-tube.
- step 3** Measure the total mass of the test-tube and **solid H**. Record this value in Table 3.1.
- step 4** Hold the test-tube with a test-tube holder.
- step 5** Heat the test-tube in a blue Bunsen burner flame for at least three minutes. Record your observation in Table 3.1.
- step 6** Leave the test-tube to cool down.

Continue with (f) while you are waiting for the test-tube to cool down.

- step 7** When cool, measure the mass of the test-tube and its contents. Record this value in Table 3.1.

**Table 3.1**

|                                                             |  |
|-------------------------------------------------------------|--|
| mass of empty test-tube<br>at <b>step 1</b> /g              |  |
| mass of test-tube and <b>solid H</b><br>at <b>step 3</b> /g |  |
| mass of test-tube and contents<br>at <b>step 7</b> /g       |  |
| observation during heating<br>in <b>step 5</b>              |  |

[4]

(b) Calculate the mass of **solid H** heated.

Use the equation shown.

$$\text{mass of solid H} = \text{mass at step 3} - \text{mass at step 1}$$

mass of **solid H** = ..... g [1]

(c) The mass of **solid H** changes when it is heated.

(i) Calculate the change in mass of **solid H**.

Use the equation shown.

$$\text{change in mass} = \text{mass at step 3} - \text{mass at step 7}$$

$$\text{change in mass} = \dots\dots\dots \text{ g [1]}$$

(ii) Suggest a reason for this change in mass.

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

(iii) Calculate the percentage change in mass of **solid H**.

Use the equation shown.

$$\text{percentage change in mass} = \frac{\text{change in mass in (c)(i)}}{\text{mass of solid H in (b)}} \times 100$$

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

$$\text{percentage change in mass} = \dots\dots\dots \% [2]$$

(d) Explain why it is important to heat **solid H** with a blue Bunsen burner flame instead of a yellow flame.

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

(e) Explain how to improve the procedure to make sure that **solid H** has the maximum change in mass.

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

- (f) You are going to add **solid H** to dilute nitric acid. You will need to identify the gas that is formed.

**Procedure**

- Add about 3 cm depth of dilute nitric acid to a clean test-tube.
- Add a spatula of **solid H** to the test-tube.

Identify the gas formed.

You may need to add more **solid H** to the dilute nitric acid if the mixture stops fizzing.

Describe the test and observation used to identify the gas.

test .....

observation .....

identity of gas .....

[2]

[Total: 13]

**Check that you have completed (a)–(e).**

- 4 You are going to investigate the stretching of identical springs.

The apparatus has been assembled for you as shown in Fig. 4.1.

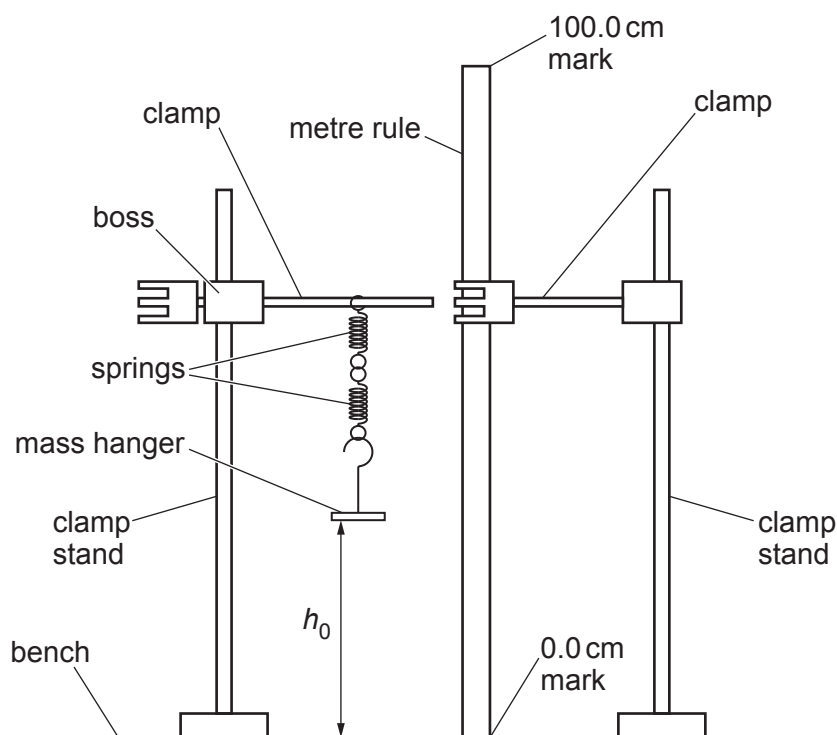


Fig. 4.1

Do **not** adjust the height of the clamps.

- (a) The height of the bottom of the mass hanger above the bench is  $h_0$ .

- (i) Use the set square to help you take the reading of height  $h_0$  on the metre rule.

Record  $h_0$  to the nearest 0.1 cm.

$h_0 = \dots\dots\dots$  cm [1]

- (ii) Using the set square improves the accuracy of your reading of  $h_0$  on the metre rule.

Draw on Fig. 4.1 to show the position of the set square when taking the  $h_0$  reading. [1]

- (iii) Describe how you avoid a parallax (line-of-sight) error when taking the reading of  $h_0$  on the metre rule.

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

(b) Add load  $L$  to the mass hanger, where  $L = 0.5\text{ N}$ .

- (i) Record to the nearest 0.1 cm the new height  $h$  of the bottom of the mass hanger above the bench.

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

- (ii) Calculate the extension  $e$  of the springs.

Use your values from (a)(i) and (b)(i) and the equation shown.

$$e = h_0 - h$$

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

(c) Repeat (b) for loads of  $L = 1.0\text{ N}$ ,  $1.5\text{ N}$ ,  $2.0\text{ N}$  and  $2.5\text{ N}$ .

Record all your values of  $h$  and  $e$  in Table 4.1.

**Table 4.1**

| $L/\text{N}$ | $h/\text{cm}$ | $e/\text{cm}$ |
|--------------|---------------|---------------|
| 0.0          | —             | 0.0           |
| 0.5          |               |               |
| 1.0          |               |               |
| 1.5          |               |               |
| 2.0          |               |               |
| 2.5          |               |               |

[2]

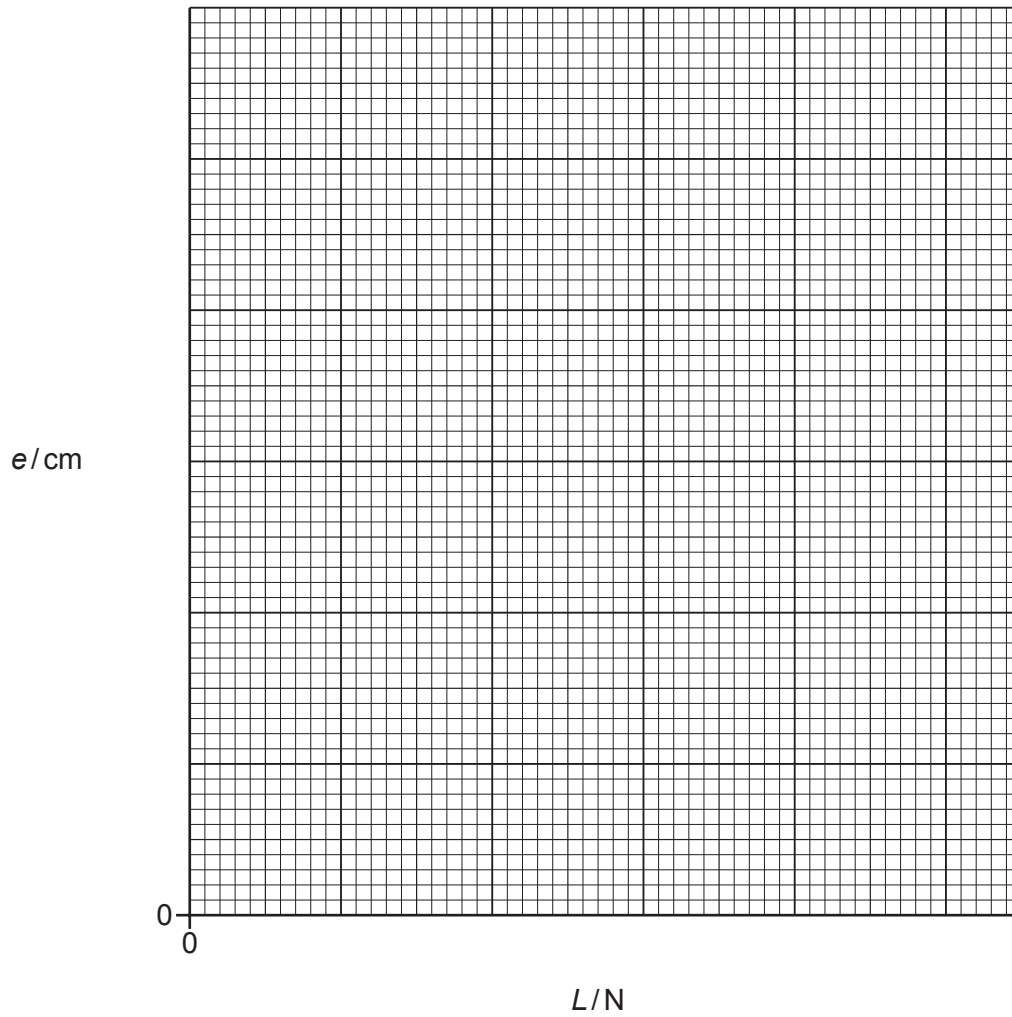
(d) Using a set square helps overcome one practical difficulty when reading  $h$  on the metre rule.

Describe **one** other practical difficulty in measuring  $h$ .

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

- (e) (i) On the grid, plot a graph of  $e$  (vertical axis) against  $L$ .

Start both axes from the origin (0, 0).



[2]

- (ii) Draw the straight line of best fit.

[1]

(f) You are now going to investigate the stretching of a **single** spring.

- Carefully remove the loads from the mass hanger.
- Remove the mass hanger from the springs.
- Remove the pair of springs from the clamp.
- Suspend the **single** spring from the clamp.
- Suspend the mass hanger from the **single** spring on the clamp.

(i) Record to the nearest 0.1 cm the **new** value of  $h_0$ .

$h_0 =$  ..... cm

- Add a load  $L$  to the mass hanger, where  $L = 1.0\text{ N}$ .

Record to the nearest 0.1 cm the **new** value of  $h$ .

$h =$  ..... cm

Calculate the extension  $e_s$  of the **single** spring.

Use your **new** values for  $h_0$  and  $h$  and the equation shown.

$$e_s = h_0 - h$$

$e_s =$  ..... cm  
[1]

(ii) You do **not** need to make any other measurements for the single spring.

On the grid in (e)(i), plot extension  $e_s$  against load  $L = 1.0\text{ N}$ .

Use this plot to draw an estimated line of best fit for the single spring. Label your estimated line of best fit, **single spring**.

[1]

[Total: 13]







## NOTES FOR USE IN QUALITATIVE ANALYSIS

## Tests for anions

| anion                                           | test                                                              | test result                            |
|-------------------------------------------------|-------------------------------------------------------------------|----------------------------------------|
| carbonate ( $\text{CO}_3^{2-}$ )                | add dilute acid                                                   | effervescence, carbon dioxide produced |
| chloride ( $\text{Cl}^-$ )<br>[in solution]     | acidify with dilute nitric acid, then add aqueous silver nitrate  | white ppt.                             |
| nitrate ( $\text{NO}_3^-$ )<br>[in solution]    | add aqueous sodium hydroxide, then aluminium foil; warm carefully | ammonia produced                       |
| sulfate ( $\text{SO}_4^{2-}$ )<br>[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 ( $\text{NH}_4^+$ )    | ammonia produced on warming                                 | —                                                               |
| calcium ( $\text{Ca}^{2+}$ )    | white ppt., insoluble in excess                             | no ppt., or very slight white ppt.                              |
| copper(II) ( $\text{Cu}^{2+}$ ) | light blue ppt., insoluble in excess                        | light blue ppt., soluble in excess, giving a dark blue solution |
| iron(II) ( $\text{Fe}^{2+}$ )   | green ppt., insoluble in excess                             | green ppt., insoluble in excess                                 |
| iron(III) ( $\text{Fe}^{3+}$ )  | red-brown ppt., insoluble in excess                         | red-brown ppt., insoluble in excess                             |
| zinc ( $\text{Zn}^{2+}$ )       | 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 result             |
|----------------------------------|----------------------------------|
| ammonia ( $\text{NH}_3$ )        | turns damp red litmus paper blue |
| carbon dioxide ( $\text{CO}_2$ ) | turns limewater milky            |
| chlorine ( $\text{Cl}_2$ )       | bleaches damp litmus paper       |
| hydrogen ( $\text{H}_2$ )        | 'pops' with a lighted splint     |
| oxygen ( $\text{O}_2$ )          | relights a glowing splint        |

## Flame tests for metal ions

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

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