



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0654/61

October/November 2021

1 hour 30 minutes

No additional materials are needed.

- 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 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 full-size photograph of a flower with some of the petals removed.

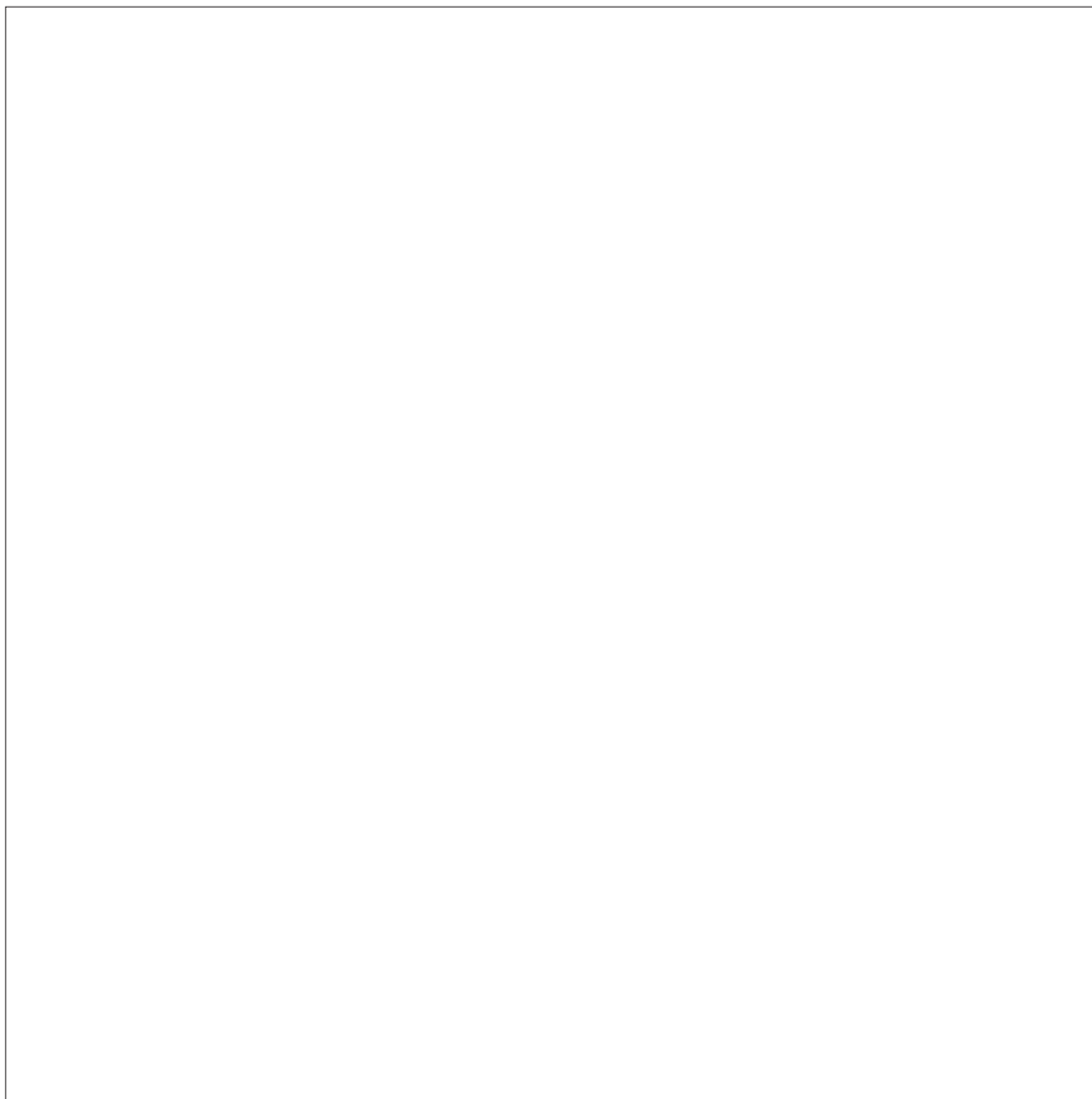


Fig. 1.1

- (a) (i) In the box, make a large, detailed pencil drawing of the flower.

Include the internal parts of the flower.

[3]



- (ii) On your drawing, add a labelled line to identify an anther.

[1]

- (b) (i) On Fig. 1.1 draw a line to join points **A** and **B**, which shows the width of one petal.

Record this width, **AB**, in millimetres to the nearest millimetre.

width of petal **AB** on Fig. 1.1 = mm [1]

- (ii) Draw a line to show the same width, **AB**, of the petal on your drawing.

Record this width in millimetres to the nearest millimetre.

width of petal on drawing = mm [2]

- (iii) Use your measurements in (b)(i) and (b)(ii) to calculate the magnification M of your drawing. Use the equation shown.

$$M = \frac{\text{width of petal on drawing}}{\text{width of petal AB on Fig. 1.1}}$$

$$M = \dots\dots\dots [1]$$

- (c) A student takes the real flower shown in Fig. 1.1 and removes the petal **AB**. The student measures the width of this petal.

Suggest why the width of the real petal is larger than the measurement **AB** in (b)(i). You can assume all of the widths have been measured accurately.

..... [1]

- (d) The student removes three more petals from the flower.

Their widths are shown in Table 1.1.

Table 1.1

petal	width /mm
1	53
2	55
3	51

Calculate the average width of these three petals.

Show your working.

$$\text{average width} = \dots\dots\dots \text{ mm } [1]$$

[Total: 10]

- 2 A student investigates the nutrient content of samples of honey, milk and rice.

The student tests the samples with Benedict's solution, biuret solution and iodine solution.

- (a) Table 2.1 shows the student's observations.

Table 2.1

food sample	final colour observed with		
	Benedict's solution	biuret solution	iodine solution
honey	red	blue	brown
milk	green	purple	brown
rice	blue	blue	blue-black

- (i) Name a piece of apparatus suitable to measure 1 cm³ of the testing solution.

..... [1]

- (ii) State which test solution requires the use of heat.

..... [1]

- (iii) Use the observations in Table 2.1 to identify and compare the nutrients present in honey, milk and rice.

honey

milk

rice

[5]

- (b) (i) A student tests the honey for the presence of fat.

State the two reagents the student needs to use.

..... and

State the observation for a positive result.

..... [2]

- (ii) The test in (b)(i) is **not** suitable for testing the presence of fat in milk.

Suggest a reason why.

..... [1]

[Total: 10]

- 3 A student investigates the effect of dissolving salt on the boiling point temperature of water.

(a) **Procedure**

The student:

- step 1 half fills a boiling tube (large test-tube) with distilled water
- step 2 heats the water until it boils
- step 3 records the boiling point temperature in Table 3.1
- step 4 adds one spatula of salt to the water in the boiling tube
- step 5 heats the salt solution until it boils and records the boiling point temperature in Table 3.1.

The student repeats steps 4 and 5 until **seven** spatulas of salt have been added.

Table 3.1

spatulas of salt added	boiling point temperature / °C
0	100.0
1	101.5
2	
3	106.0
4	107.5
5	
6	108.0
7	108.0

- (i) Fig. 3.1 shows the thermometer readings for 2 and 5 spatulas of salt added.

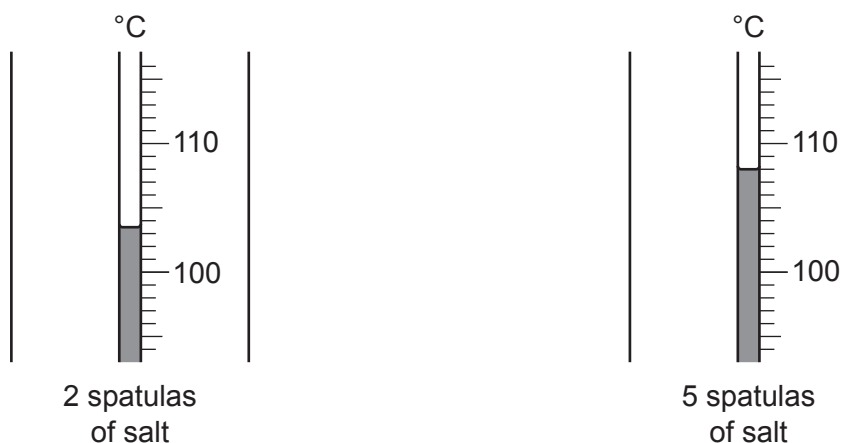


Fig. 3.1

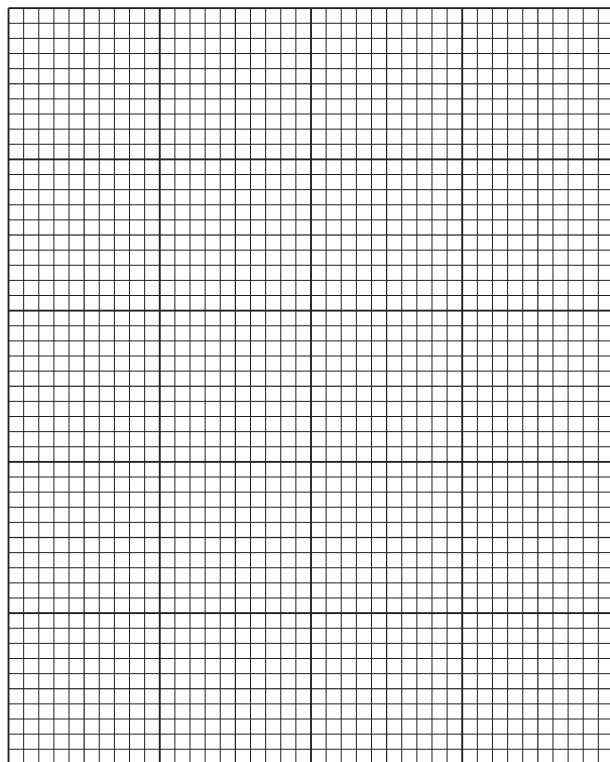
Record in Table 3.1 these values to the nearest 0.5 °C.

[2]

- (ii) State an improvement to the procedure that will make the results more reliable.

..... [1]

- (b) (i) On the grid draw a graph of boiling point temperature (vertical axis) against number of spatulas of salt added. Do **not** start the y-axis at 0. [3]



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

- (iii) State the relationship between amount of salt added and boiling point temperature.

.....

..... [2]

- (iv) Use your graph to estimate the boiling point temperature of water when 3.5 spatulas of salt are added.

Show on your graph how you arrived at your answer.

boiling point temperature = °C [2]

- (v) The boiling point temperature is the same when 6 and 7 spatulas of salt are added.

Suggest why.

.....

..... [1]

[Total: 12]

4 A student investigates boiling and purity.

Methanol and water are both liquids and they have been mixed together.

The boiling point of methanol is 65°C and the boiling point of water is 100°C .

The methanol can be separated from the water by **distillation**.

Fig. 4.1 shows some apparatus.

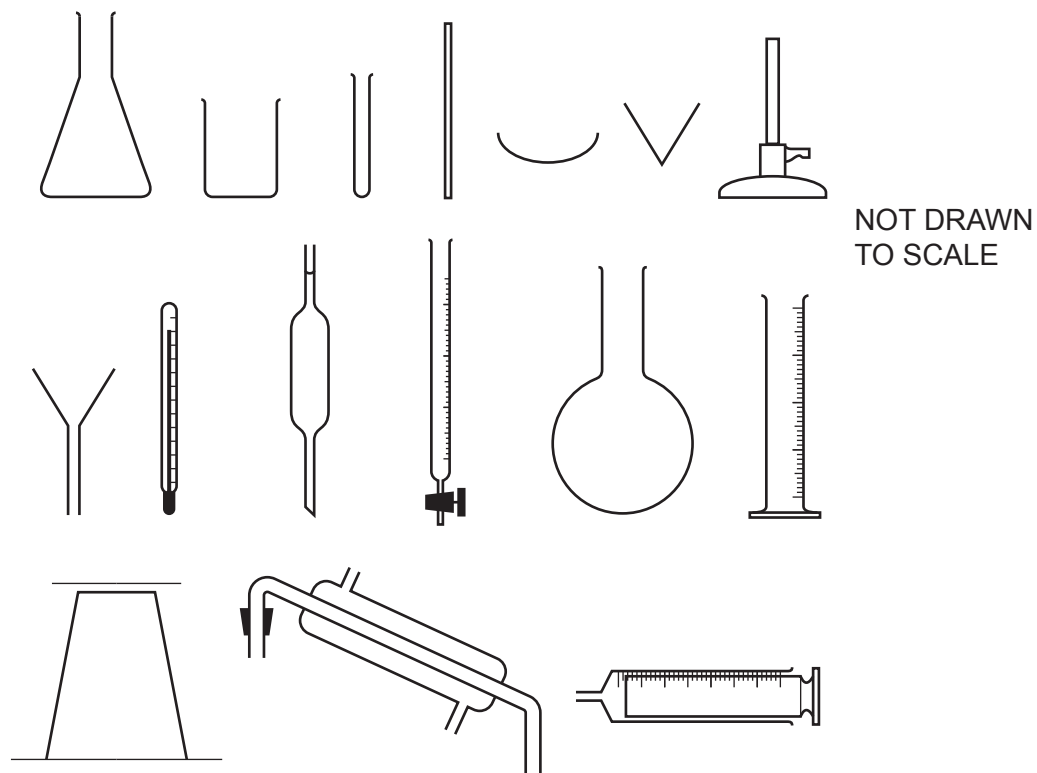


Fig. 4.1

- (a) (i) Draw a diagram of the assembled apparatus used for separating the methanol from the water by distillation.

The boiling temperature of the methanol needs to be measured.

Use the following apparatus from Fig. 4.1.

- a flask
- a thermometer
- heating apparatus
- a condenser
- a beaker
- any other pieces of apparatus necessary

[3]

- (ii) On your diagram label:

- the thermometer
- the condenser.

[2]

- (iii) On your diagram draw **two** arrows on the condenser to show where the water enters the condenser and where it leaves the condenser.

[1]

- (b) The boiling point temperature of pure methanol is 65 °C.

When an impurity is dissolved in a liquid the boiling point temperature of that liquid increases.

The boiling point temperatures of four liquids are shown in Table 4.1.

The thermometer readings are accurate.

Table 4.1

liquid	boiling point temperature / °C
P	64
Q	60
R	66
S	61

- (i) Deduce which liquid, **P**, **Q**, **R** or **S** is impure methanol.

.....

[1]

- (ii) Explain why the other three liquids cannot be impure methanol.

.....

..... [1]

[Total: 8]

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5 A student determines the focal length of a convex lens.

(a) Procedure

The student:

- sets up the apparatus as shown in Fig. 5.1

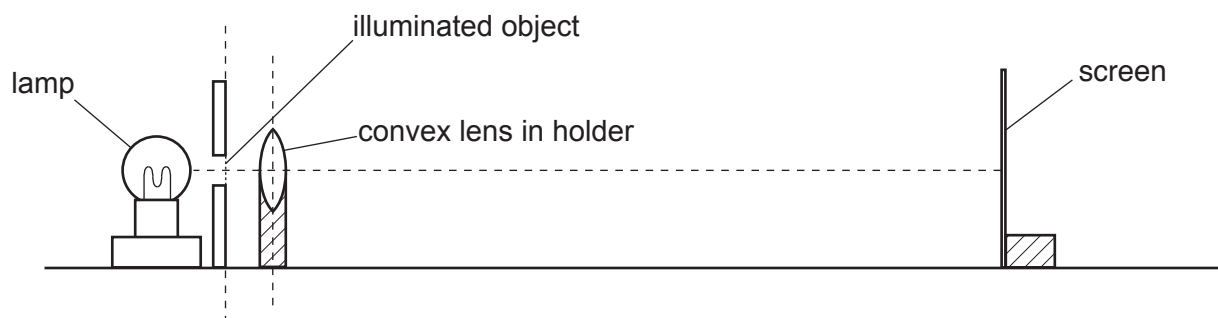


Fig. 5.1

- switches on the lamp and places the screen a distance $d = 80.0$ cm from the illuminated object. The illuminated object is shown in Fig. 5.2.

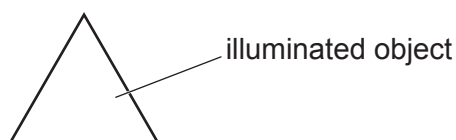


Fig. 5.2

The student:

- keeps the distance between the illuminated object and the screen constant during the experiment
- places the lens close to the illuminated object – this is shown in Fig. 5.1
- moves the lens away from the illuminated object until a sharp triangular image of the illuminated object is formed on the screen.

Fig. 5.3 shows the position of the lens when the image is sharp.



Fig. 5.3

- (i) Measure, and record in centimetres to the nearest 0.1 cm, the distance u_1 from the illuminated object to the centre of the lens in Fig. 5.3.

$u_1 = \dots\dots\dots$ cm [1]

- (ii) Use a ruler to draw a double headed arrow ($\leftrightarrow$) on Fig. 5.3 to show the object distance u_1 . [1]

- (iii) The actual distance of the object is 5 times larger than the distance you have measured.

Calculate the actual object distance U_1 from the lens.

$U_1 = \dots\dots\dots$ cm [1]

- (iv) Calculate the focal length f_A of the lens. Use the equation shown.

$$f_A = \frac{U_1 \times (80 - U_1)}{80}$$

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

Fig. 5.4 shows a full size diagram of the image on the screen.

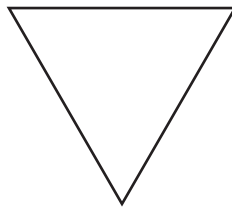


Fig. 5.4

- (v) Measure the vertical height h_1 of the image in Fig. 5.4. Record the height in millimetres.

$h_1 = \dots\dots\dots$ mm [1]

(b) The student:

- moves the lens even further away from the illuminated object until another sharp triangular image of the illuminated object is formed on the screen
- measures and records the new distance U_2 from the illuminated object to the lens.

$$U_2 = 59.2 \text{ cm}$$

(i) Calculate the focal length f_B of the lens. Use the equation shown.

$$f_B = \frac{U_2 \times (80 - U_2)}{80}$$

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

(ii) Fig. 5.5 shows a full size diagram of the image on the screen for the new position of the lens.



Fig. 5.5

Measure the vertical height h_2 of the image in Fig. 5.5. Record this height in millimetres.

$$h_2 = \dots\dots\dots \text{ mm [1]}$$

(c) Use your results from (a)(iv) and (b)(i) to calculate the average value for the focal length f of the lens.

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

(d) Use your answers to (a)(v) and (b)(ii) to calculate the ratio r of the two heights. Use the equation shown.

$$r = \frac{h_1}{h_2}.$$

$$r = \dots\dots\dots [1]$$

- (e) The teacher says that the ratio $r = \frac{h_1}{h_2}$ should be equal to 3.0.

Two values can be considered to be the same if they are within 10% of each other.

State if your result for r can be considered to be the same as the teacher's value. Justify your answer with reference to a calculation.

statement

justification

.....
 [1]

- (f) State **one** difference and **one** similarity between the images shown in Fig. 5.4 and Fig. 5.5.

difference

similarity [2]

- (g) State **one** precaution the student needs to take in this experiment to obtain accurate results.

.....
 [1]

[Total: 13]

6 Fig. 6.1 shows a pendulum.

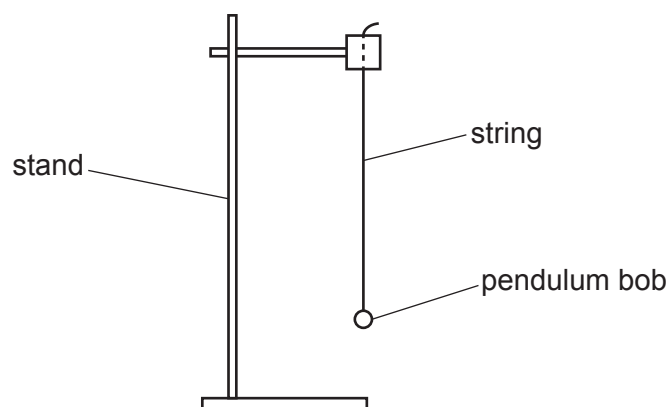


Fig. 6.1

The period of a pendulum is the time taken for one complete oscillation (swing) of the pendulum.

Fig. 6.2 shows one complete oscillation.

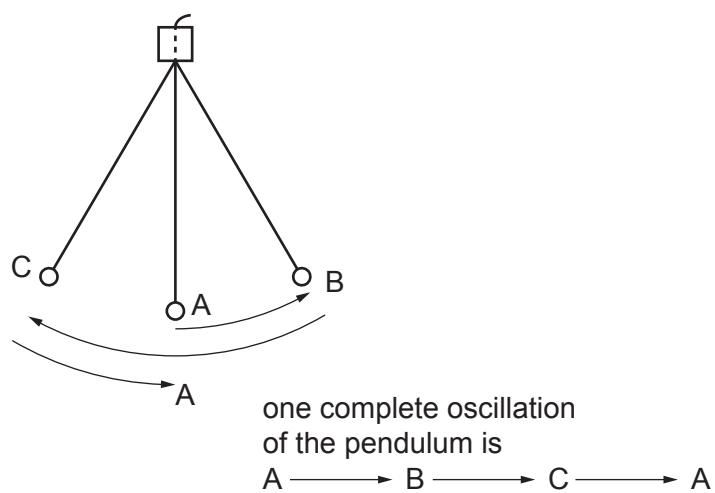


Fig. 6.2

Plan an experiment to investigate how the period of a pendulum depends upon the mass of its bob.

The apparatus available is listed. You are **not** required to do this investigation.

- boss, clamp and stand
- pendulum bobs of different masses
- a ball of string
- a pair of scissors

Include in your answer:

- any other apparatus you will need
- a brief method, including how you will ensure your results are as accurate as possible
- the variables you will control
- how you will process and use your results (you are not required to enter any readings in the table)
- how you use your results to reach a conclusion.

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..... [7]

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