CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICAL SCIENCE 0652/62

Paper 6 Alternative to Practical **October/November 2017**

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

[Turn over

1 A student investigates the temperature changes when metals **L**, **M** and **N** react with acid.

(a) • The student places $5\,cm^3$ hydrochloric acid in a test-tube.

• She measures the initial temperature of the acid in the test-tube and records in Table 1.1 this value to the nearest 0.5 °C.

• She adds a sample of metal **L** to the acid and starts the stopclock.

• She stirs the mixture for 3 minutes and records in Table 1.1 the maximum temperature during this time.

• She records in Table 1.2 her observations of the reaction.

• She repeats the above steps for metal **M** and for metal **N**.

Table 1.1

metal	temperature / °C		
	initial	maximum	change
L		28.5	
M		26.5	
N		40.0	

Table 1.2

metal and appearance	observations
L grey powder	bubbles slowly and some solid remains
M fine grey filings	bubbles very slowly and some solid remains
N grey strip (ribbon)	many bubbles immediately and ribbon disappears

(i) The initial temperature of the acid is the same for all three metals. This temperature is shown in Fig. 1.1.

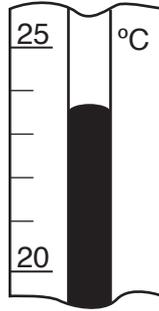Read the thermometer and record, in Table 1.1 on page 2, the initial temperature to the nearest 0.5 °C. [1]

Fig. 1.1

(ii) Complete Table 1.1 by calculating the temperature change for each metal. [1]

(b) (i) Use the results in Tables 1.1 and 1.2 to suggest an order of reactivity for the three metals.

State which observations you used to reach your conclusion.

Explain how you have used these observations to produce an order of reactivity.

most reactive ....

....

least reactive ....

observations used and explanation ....

....

....
[3]

(ii) Identify one variable which should be controlled in the experiment.

....

....[1]

(c) During the reaction of **N** with acid, the student proves that the gas produced is hydrogen.

State the test that she carries out and the observation that leads her to this conclusion.

test ....

observation ....[1]

(d) The student separates the mixture that results from the reaction of **M** with acid.

She tests the liquid part of the mixture with a reagent and obtains a green precipitate.

(i) Name the separation technique that she uses to separate the mixture.

....[1]

(ii) Suggest a reagent that produces the green precipitate.

....[1]

(iii) Identify metal **M**.

M is ....[1]

2 A student carries out reactions to identify five solutions, **D**, **E**, **F**, **G** and **H**. He is told that the five solutions are as follows but he does not know which solution is which.

> ammonia solution
> barium chloride solution
> iron(III) nitrate solution
> sodium hydroxide solution
> sulfuric acid

(a) He adds solid sodium carbonate to separate samples of all five solutions. His observations are shown in Table 2.1.

Table 2.1

solution	observations with solid sodium carbonate
D	no visible reaction
E	no visible reaction
F	no visible reaction
G	bubbles
H	no visible reaction

Identify **G** and explain how you have used the observations in Table 2.1 to make your deduction.

G is ....

explanation ....

....

....[2]

(b) The student then adds solution **D** to separate samples of the other four solutions in test-tubes. His observations are shown in Table 2.2.

Table 2.2

solution	observations with solution **D**
E	orange-brown ppt.
F	no visible reaction
G	no visible reaction
H	orange-brown ppt.

Identify **D** and state a conclusion about **E** and **H**.

D is ....

E and **H** are ....

....

....[2]

(c) He then adds solution **F** to separate samples of the other four solutions in test-tubes. His observations are shown in Table 2.3.

Table 2.3

solution	observations with solution **F**
D	no visible reaction
E	no visible reaction
G	white ppt.
H	no visible reaction

Identify **F** and explain how you have used the observations and previous deductions to make this deduction.

F is ....

explanation ....

....

....[2]

(d) When red litmus paper is added to each of the five solutions, only **E** and **H** change the litmus to a blue colour.

Plan a test to distinguish between **E** and **H** and describe the observations which will allow you to distinguish between them.

....

....

....

....

....[3]

(e) The student adds silver nitrate solution to one of the five solutions as an extra test to confirm its identity.

Circle the solution that is tested with silver nitrate and describe the observations that will confirm its identity.

ammonia solution

barium chloride solution

iron(III) nitrate solution

sodium hydroxide solution

sulfuric acid

observations ....

....[1]

3 A student investigates the cooling of two beakers of hot water, **P** and **Q**. Beaker **P** is not insulated (unlagged), and beaker **Q** is insulated (lagged).
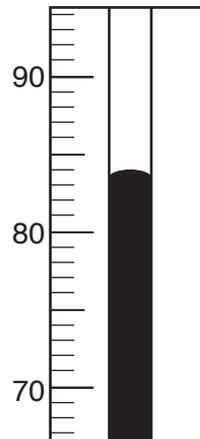
She pours 200 cm³ of hot water into beaker **P**. She places a thermometer in the hot water, as shown in Fig. 3.1.
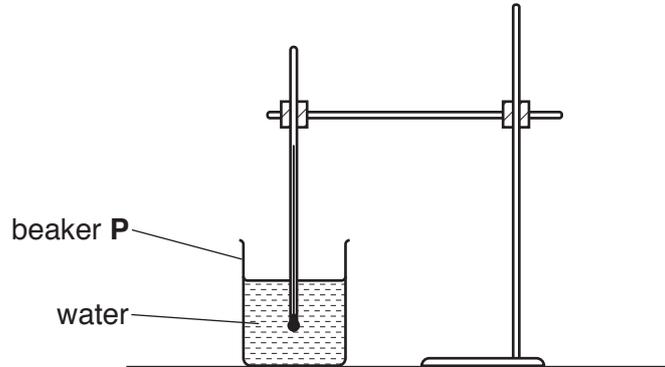
Fig. 3.1

She waits for 1 minute and starts the stopclock. She measures and records in Table 3.1 the temperature θ of the hot water at time $t = 0$.

**(a)** Complete the column headings in Table 3.1 on page 9 with the correct unit symbols. [1]

(b) Fig. 3.2 shows the thermometer at time $t = 0$.

Fig. 3.2

Read the thermometer and record the value in Table 3.1 for time $t = 0$. [1]

Table 3.1

time *t* /	beaker **P** temperature *θ* /	beaker **Q** temperature *θ* / ....
0		82
30	81	
60	78	76
90	76	74
120	74	72
150	72	71
180	71	70

She continues recording the temperature every 30 seconds for a total of 3 minutes and records her results in Table 3.1.

(c) The student then pours 200 cm^3 of hot water into beaker **Q**. She places the thermometer in the hot water, as shown in Fig. 3.3.
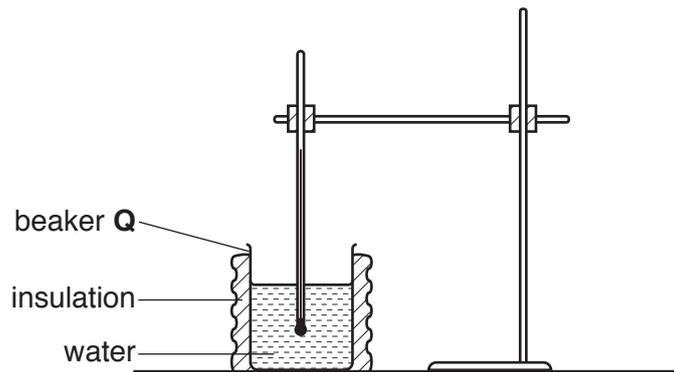
Fig. 3.3

Fig. 3.4 shows the thermometer at time t = 30 seconds.
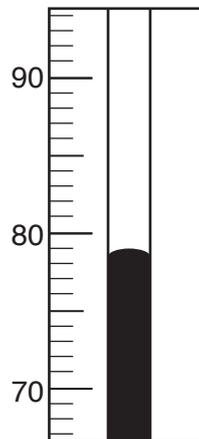
Fig. 3.4

Read the thermometer and record the value in Table 3.1 on page 9 for time t = 30. [1]

(d) Explain why the student waited for 1 minute before measuring the temperature of the hot water at time t = 0.

....

....[1]

(e) Use the results in Table 3.1 to state whether insulating the beaker **increases**, **decreases** or has **no significant effect** on the rate of cooling of the water.

Justify your answer with reference to the results.

effect on the rate of cooling ....

justification ....

....

....[2]

(f) (i) The student says that a possible cause of heat loss from the beakers is by evaporation. Suggest how she could reduce the effect of evaporation.

....

....[1]

(ii) Refer to Fig. 3.3. Suggest one other modification that could be made to the apparatus to further reduce the loss of heat.

....

....[1]

(g) Another student repeats the experiment with the same apparatus to check the results. Suggest two variables that should be kept constant.
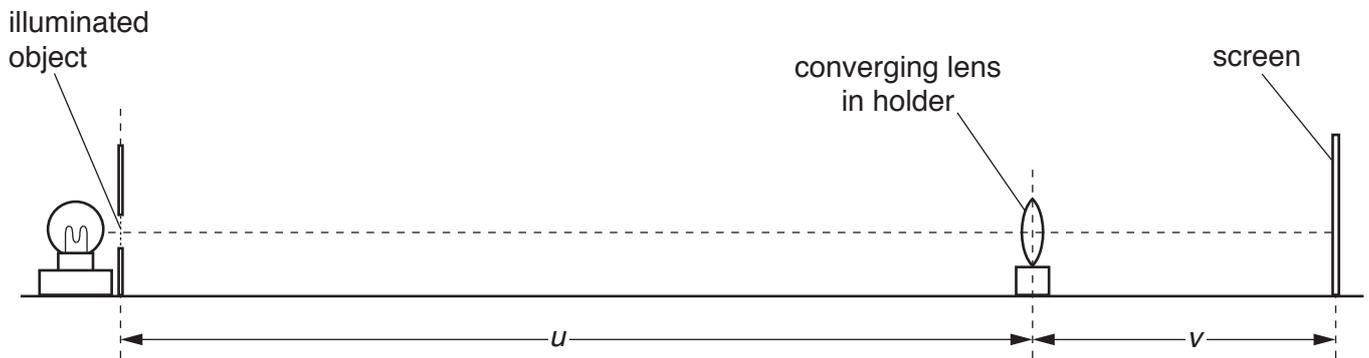
variable 1 ....

variable 2 ....[2]

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4 A student investigates the relationship between the object distance *u* and the related image distance *v* for an illuminated object placed in front of a converging lens.

The experimental set-up is shown in Fig. 4.1.

illuminated object   converging lens in holder   screen

Fig. 4.1

The student places the lens a distance *u* = 60.0 cm from the illuminated object.

He adjusts the position of the screen by moving it backwards and forwards along the bench until a sharp image of the illuminated object is formed on the screen.

(a) (i) Measure, on Fig. 4.1, to the nearest 0.1 cm, the image distance *v* from the lens to the screen.

v on Fig. 4.1 = ... cm [1]

(ii) Fig. 4.1 is drawn one-fifth full size.

Calculate and record, in Table 4.1 on page 14, the actual image distance v from the lens to the screen.

[1]

(iii) The illuminated object is in the shape of a triangle, as shown below.
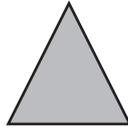
Draw, in the space below, the image that is seen on the screen.

[1]

The student repeats the procedure for values of u of 45.0 cm, 40.0 cm, 35.0 cm, 30.0 cm, 25.0 cm and 20.0 cm. His results are shown in Table 4.1.

Table 4.1

u/cm	v/cm	$(u + v)$/cm
60.0		
45.0	22.5	
40.0	24.0	
35.0	26.3	61.3
30.0	30.0	60.0
25.0	37.5	62.5
20.0	60.0	80.0

(b) (i) Complete the third column of Table 4.1 to give the missing values of $(u + v)$. [1]

(ii) State **one** precaution that the student should take while carrying out the experiment to ensure that the readings he obtains are as accurate as possible.

....

....[1]

15

(c) (i) On the grid provided, plot a graph of (*u* + *v*) (vertical axis) against *u*. Draw the best-fit curve.
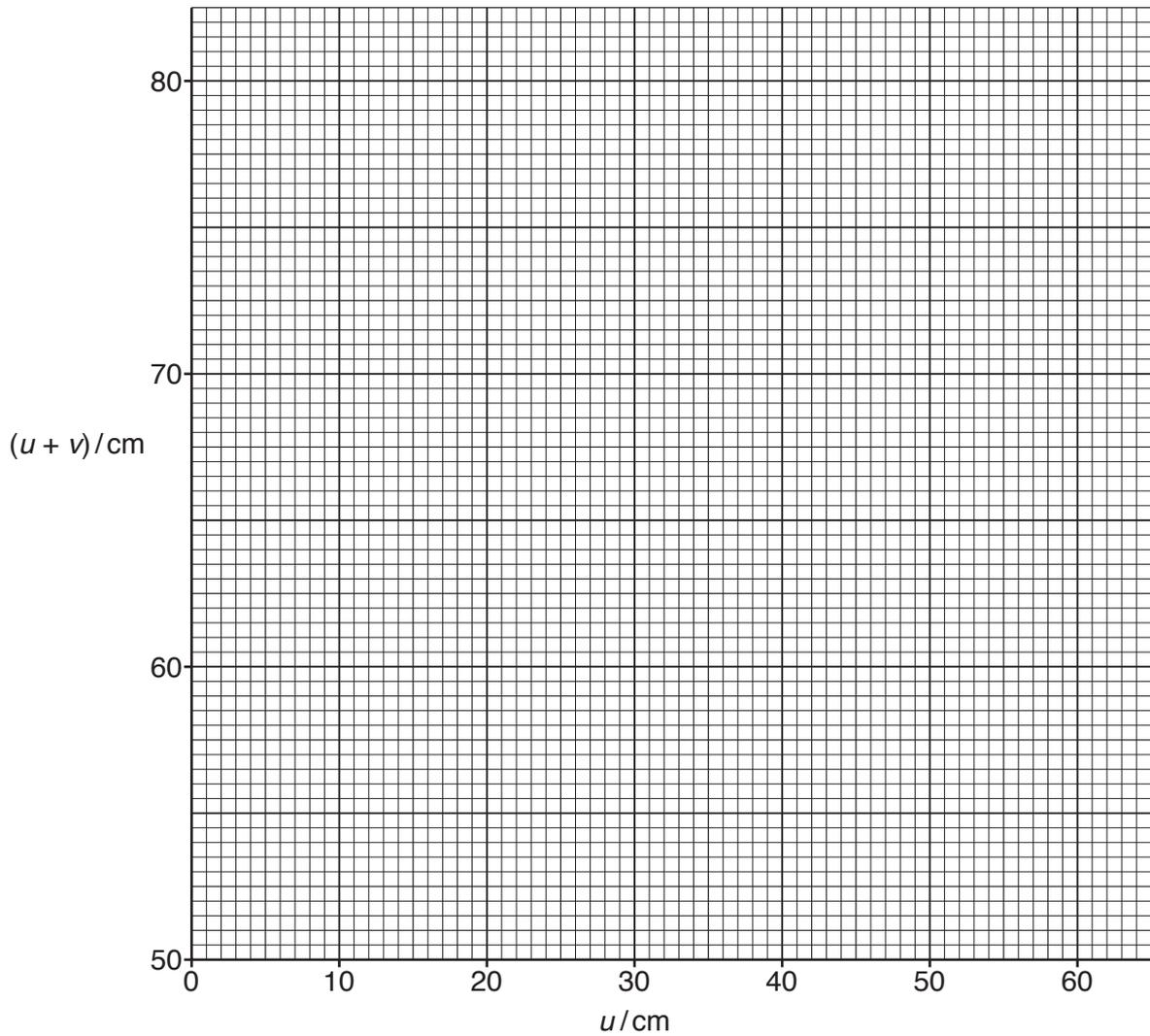
[2]

(ii) On your graph, mark the minimum value of (*u* + *v*) against *u*. Record this value below.

minimum value = ... cm [1]

(d) The minimum value of (*u* + *v*) is equal to 4*f*, where *f* is the focal length of the lens.

Write down the value of the focal length of the lens.

Give your answer to an appropriate number of significant figures.

f = ... cm [2]

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5 **(a)** A student investigates the effect of concentration on the rate of the reaction between hydrochloric acid and marble chips (calcium carbonate).

step 1

She weighs a clean and empty piece of apparatus suitable for measuring the volume of liquid.

She records the mass of this apparatus in Table 5.1 on page 18.

step 2

She adds $25\,cm^3$ hydrochloric acid to the apparatus used in **step 1**.

She weighs the apparatus containing the acid and records the new mass in Table 5.1.

step 3

She places a suitable container on a top pan balance and adds 10 marble chips.

She records the mass of the container and marble chips in Table 5.1.

step 4

She adds the $25\,cm^3$ hydrochloric acid to the marble chips and starts a stopclock.

step 5

She reads the balance every minute and records the mass in Table 5.2 on page 18.

step 6

She continues the process in **step 5** until there is no further change in the mass.

(i) Suggest a suitable piece of apparatus for use in **step 1**.

....[1]

(ii) Suggest a suitable container for use in **step 3**.

....[1]

Table 5.1

	mass / g
apparatus in step 1	40.73
apparatus + acid in step 2	65.81
mass of acid used in step 2	
mass of container + marble chips in step 3	52.12

(b) (i) Use the data in Table 5.1 to calculate the mass of acid used and enter the value in Table 5.1.

[1]

(ii) Use the answer to **(b)(i)** and the data in Table 5.1 to calculate the mass of the container with marble chips and acid.

Record your answer in Table 5.2 for time $t = 0$.

Table 5.2

time t / min	mass / g
0	
1	76.70
2	76.42
3	76.29
4	
5	76.10
6	76.10

[1]

(iii) Use the graph shown in Fig. 5.1 to complete Table 5.2 with the mass at time t = 4 min.
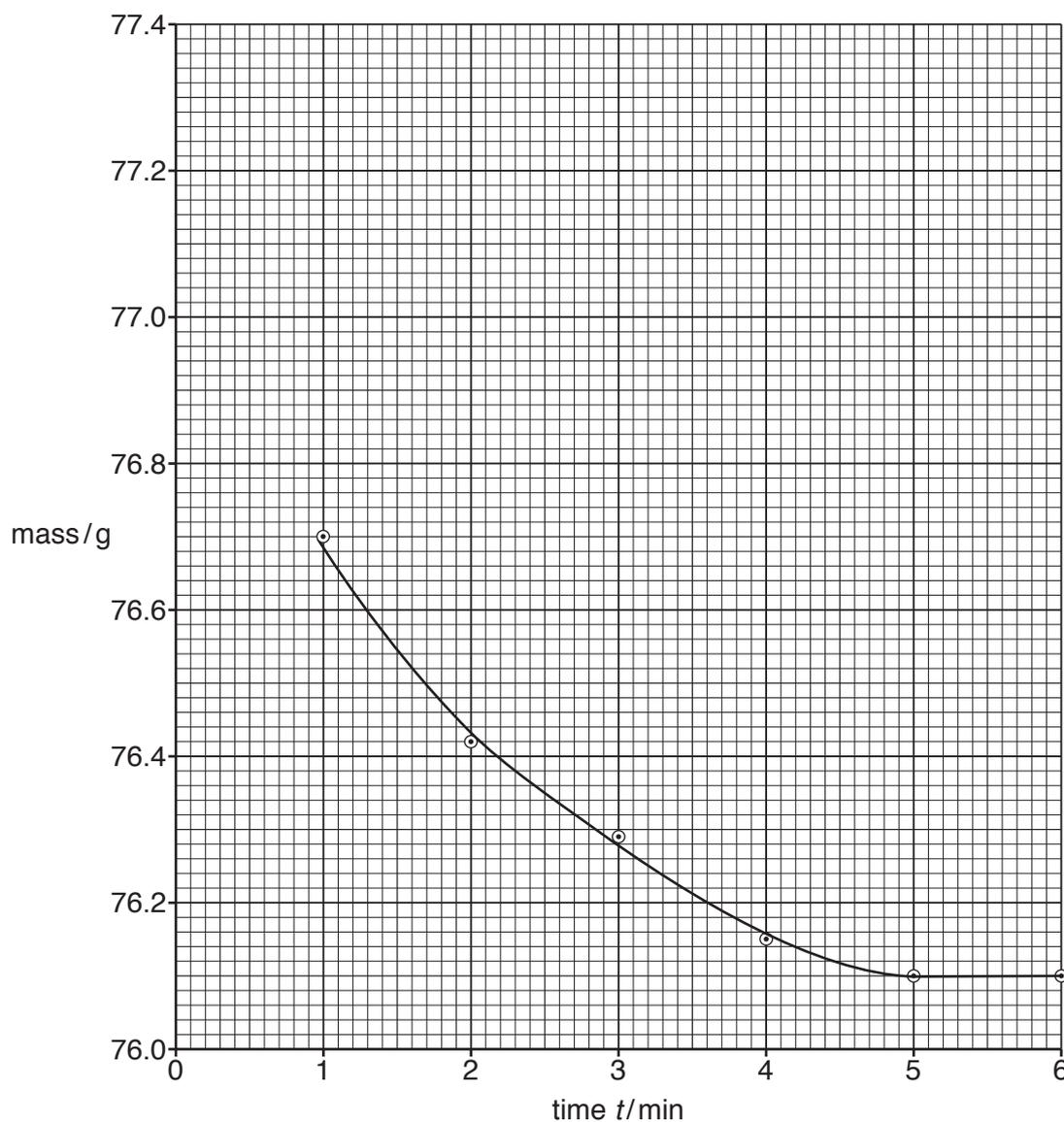
Fig. 5.1

[1]

(iv) Use the value you have calculated in **(b)(ii)** for mass at time t = 0 to plot the point for time t = 0 on the graph. Complete the curve back to the y axis. [1]

(c) The rate of the reaction at any time is represented by the gradient of the graph at that time.

    (i) The concentration of the acid changes during the reaction. State what the graph tells you about the effect of acid concentration on the rate of the reaction.

       ....

       ....

       ....[1]

    (ii) Suggest why the temperature of the acid should be measured before and after the reaction.

       ....

       ....[1]

(d) This experiment uses changes in mass to investigate the rate of reaction.

    (i) State an alternative measurement that could be used to investigate the rate of this reaction.

       ....[1]

    (ii) Draw a diagram of the apparatus you would use to make the measurement stated in **(d)(i)**.

       [1]

6 A teacher demonstrates to a class how the gamma radiation emitted by a radioactive source depends upon the distance of the detector from the source.

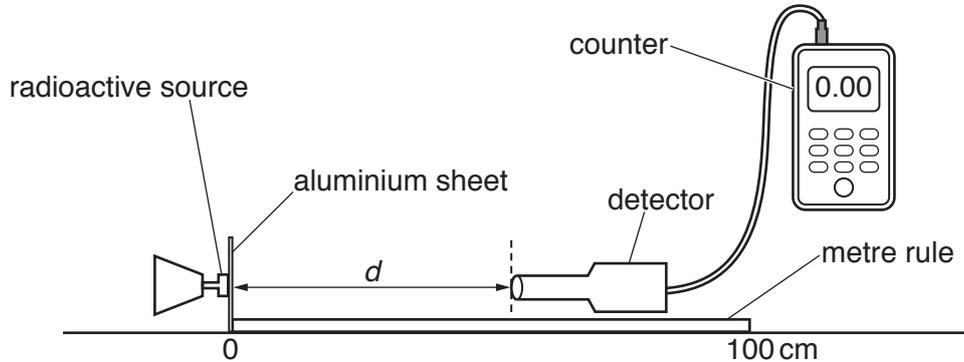He uses a detector and counter to measure the count rate from the radioactive source, as shown in Fig. 6.1.

Fig. 6.1

He sets up the detector and counter **without** the radioactive source and measures the background count in 1 minute. He repeats this twice more.

His results are shown below.

1. 10 counts/minute   2. 13 counts/minute   3. 12 counts/minute

(a) Calculate the average count rate due to background radiation. Give your answer **to the nearest whole number**.

average background count rate = ... counts / minute [1]

(b) The radioactive source used in the experiment emits alpha-particles (α-particles), beta-particles (β-particles) and gamma-rays (γ-rays).

Explain why the teacher places an aluminium sheet close to the source and between the source and the detector.

....

....

....[2]

             [Turn over

The teacher places the detector a distance d = 10.0 cm from the source.

He switches on the counter and measures the number of counts in 1 minute. He records this measured count rate in Table 6.1.

He then repeats this procedure with the detector at d = 20.0 cm, 30.0 cm, 40.0 cm, 50.0 cm and 60.0 cm from the source. The results are also shown in Table 6.1.

Table 6.1

distance d of detector from source/cm	measured count rate/counts per minute	count rate from source/counts per minute
10.0	889	
20.0	232	
30.0	109	
40.0	67	
50.0	48	
60.0	37	

(c) Use your answer to **(a)** to calculate the count rate from the source for each distance d. Use the formula

count rate from source = measured count rate from source – average background count rate.

Record your answers in Table 6.1.

[1]

(d) Plot a graph of count rate from source (vertical axis) against distance *d* from the source. Start your axes from the origin (0,0). Draw a best-fit curve.

count rate / counts
per minute

distance from source / cm
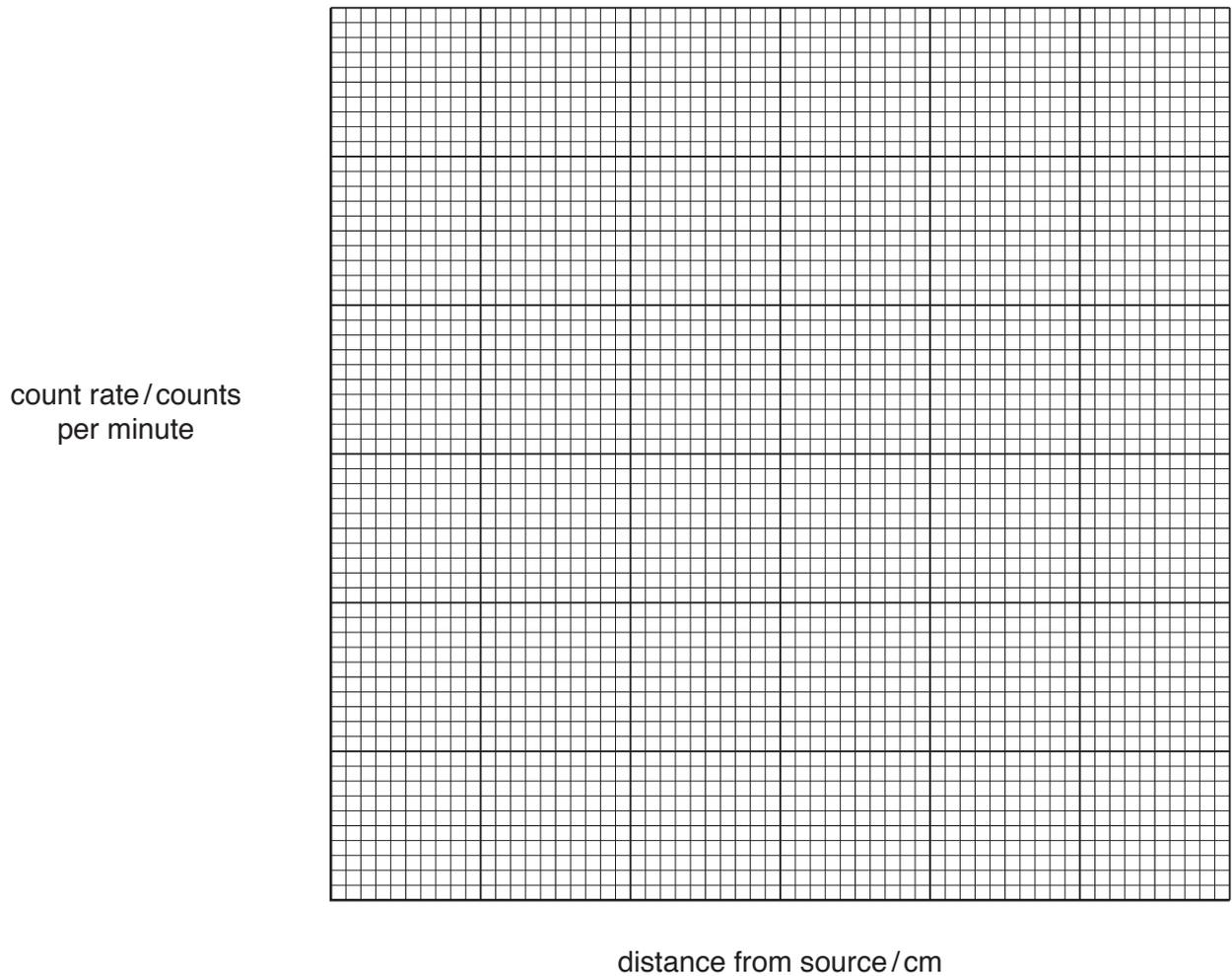
[4]

(e) (i) Use your graph to suggest one safety precaution that a person working with a source of gamma-rays should take.

....

....[1]

(ii) State one other precaution that a person working with a source of radioactive radiation should take.

....

....[1]

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