Cambridge
IGCSE

CANDIDATE
NAME

CENTRE
NUMBER

CANDIDATE
NUMBER

PHYSICAL SCIENCE 0652/61

Paper 6 Alternative to Practical **October/November 2019**

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 thermal energy produced when a neutralisation reaction occurs.

(a) •   She measures 25 cm^3 aqueous hydrochloric acid into a small beaker.

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

   •   She measures 25 cm^3 aqueous sodium hydroxide and adds this to the hydrochloric acid.

   •   She starts the stop clock and stirs the mixture.

   •   She measures the temperature of the mixture every 30 seconds for 5 minutes and records her measurements to the nearest 0.5 °C in Table 1.1.

   Fig. 1.1 shows the thermometer scales for the temperatures at 90 seconds and 240 seconds.

   Read the temperatures and record them to the nearest 0.5 °C in Table 1.1.   [2]
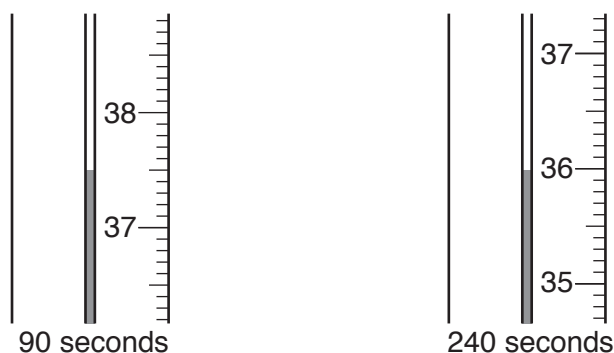
Fig. 1.1

Table 1.1

time/s	temperature/°C
0	25.0
30	37.5
60	38.0
90	
120	37.0
150	37.0
180	36.5
210	36.0
240	
270	35.5
300	34.0

(b) (i) Plot a graph of temperature (vertical axis) against time on the grid provided.
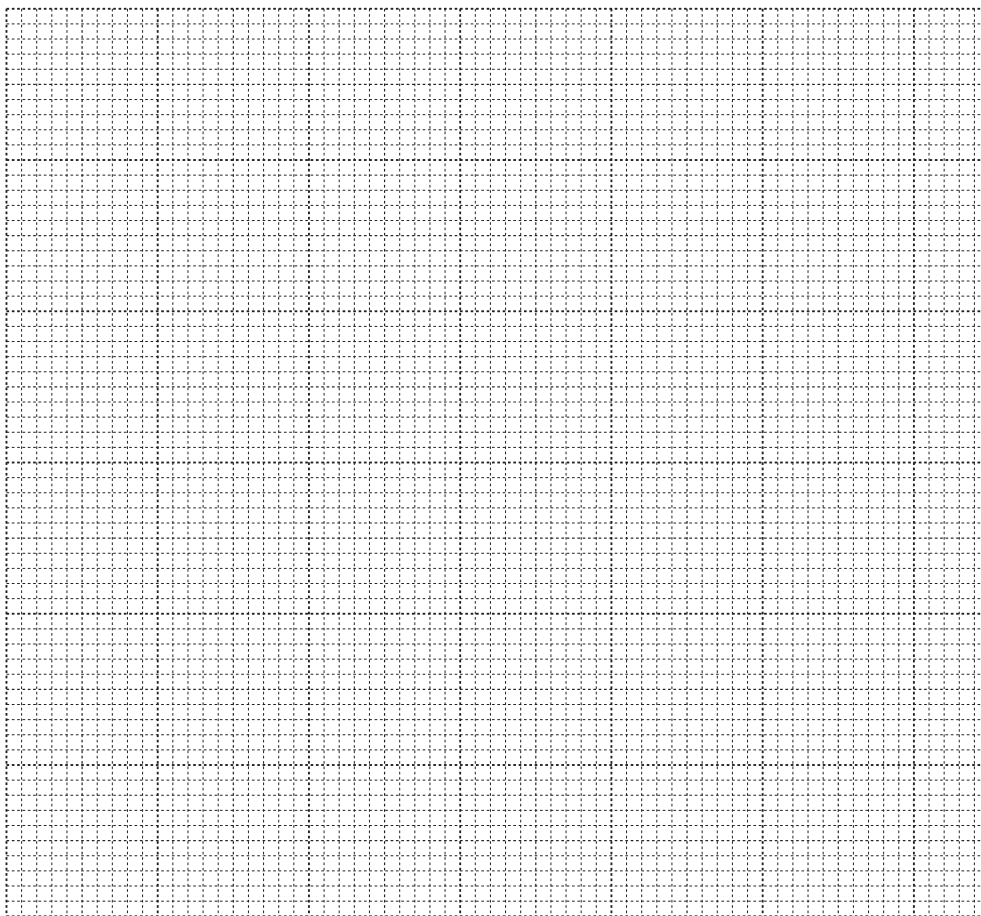
[3]

(ii) • Draw the best-fit straight line for the increasing temperatures.

 • Draw the best-fit straight line for the decreasing temperatures.

 • Extend both lines until they cross. This is the actual highest temperature reached in the reaction.

 Record this highest temperature.

 highest temperature reached = ... °C [2]

(c) The temperature rise of the reaction is the highest temperature reached minus the temperature at time 0 seconds.

 The thermal energy produced by this reaction can be calculated by the equation:

 thermal energy produced = 50 × 4.2 × temperature rise

 Calculate the thermal energy produced in this reaction.

 thermal energy produced = ... J [1]

(d) The measured amount of thermal energy produced in her experiment is much lower than the expected value.

Suggest **two** different reasons why her value for the thermal energy produced is lower than the expected value.

For each reason, suggest how the experiment can be changed to improve the accuracy. The changes must be possible using apparatus found in a school or college laboratory.

reason 1 ....

....

improvement 1 ....

....

reason 2 ....

....

improvement 2 ....

....
[2]

(e) In this experiment, the amount of sodium hydroxide exactly neutralises the amount of hydrochloric acid. Neither of the reagents is in excess.
The equation for the reaction is:

$$HCl + NaOH \longrightarrow NaCl + H_2O.$$
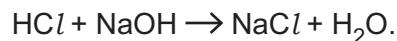
A student repeats the experiment but replaces the hydrochloric acid with $25\,cm^3$ of sulfuric acid, which has the same concentration as the hydrochloric acid.
The equation for this reaction is:

$$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O.$$
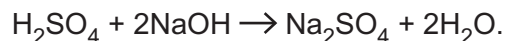
Suggest a value for the amount of thermal energy produced in this reaction, based on your result in **(c)**.

Explain your suggestion.

thermal energy produced = ... J

explanation ....

....

....
[2]

[Total: 12]

Question 2 begins over the page

2 A student is given two substances, solid compound **A** and solution **B**.

He performs a series of tests to identify **A** and **B**.

(a) He records the appearance of solid **A**.

- He adds $20\,cm^3$ distilled water to solid **A** and stirs well.

He records the appearance of the solution of **A** as shown in Fig. 2.1.

solid **A** is a white powder

solution of **A** is blue

Fig. 2.1

The student thinks that the blue solution of **A** is copper sulfate solution.

- He puts 2 cm depth of the solution of **A** into each of 4 test-tubes.

- To the first test-tube, he adds a few drops of nitric acid followed by a few drops of aqueous silver nitrate.

- To the second test-tube, he adds a few drops of nitric acid followed by a few drops of aqueous barium nitrate.

- To the third test-tube, he adds aqueous sodium hydroxide until it is in excess.

- He soaks a wooden splint in the solution in the fourth test-tube. He places the wooden splint into a blue flame.

Record the observations in Table 2.1 that confirm that compound **A** is copper sulfate.

Table 2.1

test	observation
nitric acid and aqueous silver nitrate	
nitric acid and aqueous barium nitrate	
aqueous sodium hydroxide	
immediate flame colour	

[4]

(b) The student notices a pungent smell coming from solution **B** and thinks the solution may be aqueous ammonia.

Describe a test to confirm that solution **B** is aqueous ammonia. Describe the observations for a positive result, including the observations for identifying the gas produced in the test.

test ....

....

observations ....

....

[2]

(c) The student places 2 cm depth of solution **B** into a test-tube.

He slowly adds the solution of **A** until it is in excess.

Describe the observations that would confirm that solution **A** contains copper ions and that solution **B** is aqueous ammonia.

observations ....

....

.... [2]

[Total: 8]

8

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3 A student calculates the density of soft modelling clay. She uses two different methods to find the volume.

(a) Finding the mass

- She models the clay into a disc shape approximately 5 cm in diameter.

- She places the disc on the metre rule so that its centre is at the 10.0 cm mark as shown in Fig. 3.1.

- She places a pivot under the 50.0 cm mark on the rule.

- She adjusts the position of the 50.0 g mass until the rule is balanced.
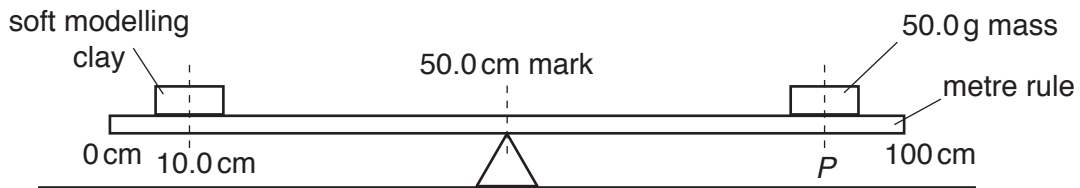
Fig. 3.1

(i) Fig. 3.2 shows the position of the 50.0 g mass on the metre rule when balanced.
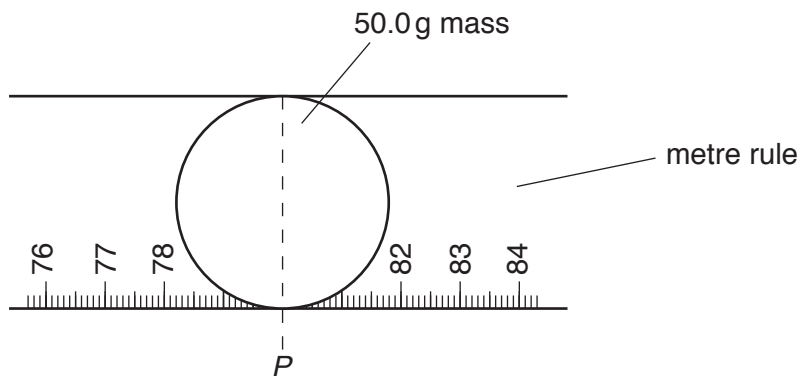
Fig. 3.2

Determine the position *P* of the centre of the 50.0 g mass as shown in Fig. 3.2.

P = ... cm [1]

(ii) Calculate the mass *m* of the soft modelling clay.

Use the equation:

$$m = 1.25(P-50.0)$$

m = ... g [1]

                                       [Turn over

(iii) It is difficult to obtain an accurate value of the mass of the modelling clay using this method.

State one difficulty in this method.

....

....

.... [1]

(b) Finding the volume – method 1

- She rolls the soft modelling clay into a ball. The ball is shown in Fig. 3.3.
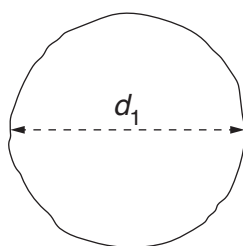
Fig. 3.3

(i) Measure and record the diameter d_1 of the ball.

d_1 = ... cm [1]

(ii) She uses wooden blocks to help her measure the diameter of the ball more accurately.

Draw a labelled diagram to show how the wooden blocks are used for this purpose.

[1]

(iii) She takes two more readings in order to calculate an average. Her measurements are shown below.

$$d_2 = 3.2\,\text{cm} \qquad d_3 = 3.1\,\text{cm}$$

Use your value of d_1 from part **(b)(i)** and the values of d_2 and d_3 to calculate d_{av}, the average of the three diameter measurements d_1, d_2 and d_3.

$d_{av} =$ .... cm [1]

(iv) Calculate the volume V_1 of the soft modelling clay.

Use the equation:

$$V_1 = 0.52 d_{av}{}^3$$

Give your answer to a suitable number of significant figures.

$V_1 =$ .... cm^3 [2]

(v) Use your values from **(a)(ii)** and **(b)(iv)** to calculate the density ρ_1 of the modelling clay.

Use the equation:

$$\rho_1 = \frac{m}{V_1}$$

$\rho_1 =$ .... g/cm^3 [1]

(c) Finding the volume – method 2

The student then performs a different procedure to work out the volume of the soft modelling clay in order to calculate the density.

- She fills a measuring cylinder with $50.0\,cm^3$ of water.

- She submerges the soft modelling clay ball into the water, as shown in Fig. 3.4.
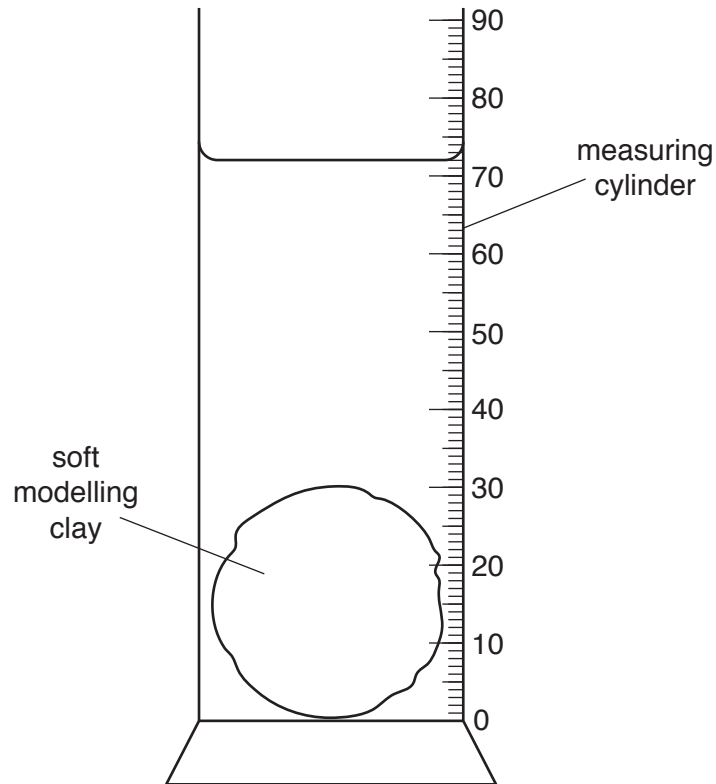
Fig. 3.4

(i) Record the new volume V_2 shown by the new water level on Fig. 3.4.

V_2 = ... cm^3 [1]

(ii) Calculate volume V_3 of the soft modelling clay.

Use the equation:

$$V_3 = V_2 - 50.0$$

V_3 = ... cm^3 [1]

(iii) Use your answers from **(a)(ii)** and **(c)(ii)** to calculate another density value ρ_2 of the soft modelling clay.

Use the equation:

$$\rho_2 = \frac{m}{V_3}$$

ρ_2 = ... g/cm^3 [1]

(d) Suggest which method of measuring the volume of the soft modelling clay is more accurate.

Explain your answer.

method ....

explanation ....

....
[1]

[Total: 13]

4   A student investigates how the length of a pendulum affects its period. The period of a pendulum is the time it takes for one complete (to and fro) oscillation as shown in Fig. 4.1.

1 complete oscillation is the time taken for the bob to swing from A to B and back to A again.

pendulum bob

A   B

1 complete oscillation
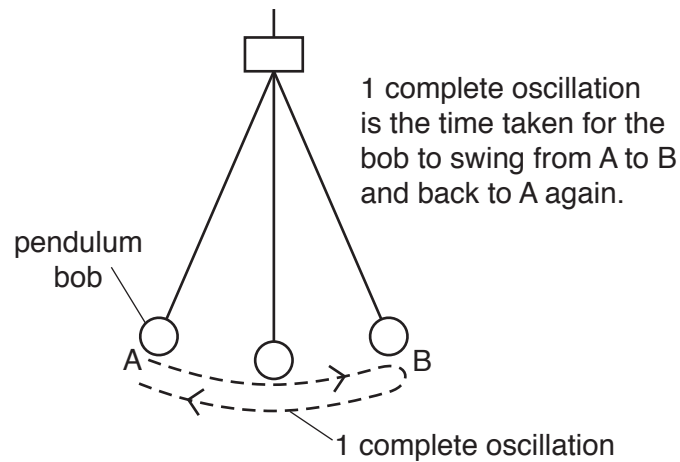
Fig. 4.1

Plan an experiment to investigate the relationship between the length *l* of a pendulum and its period *T* as shown in Fig. 4.2.

l
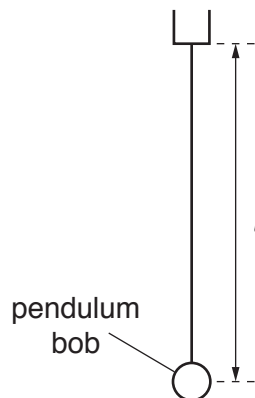
pendulum bob

Fig. 4.2

You can assume you have access to laboratory equipment.

Your plan should include:

•   any additional apparatus needed
•   a brief description of the method, including number and range of pendulum lengths to use
•   the measurements you will make
•   the variables to control
•   the precautions you will take to ensure that the results are as accurate as possible
•   the table you will draw to record your results, with column headings (you are **not** required to enter any readings into the table).

A diagram is not required but you may draw one if it helps to explain your plan.

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