# Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

**CO-ORDINATED SCIENCES** **0654/63**

Paper 6 Alternative to Practical **May/June 2020**

**1 hour 30 minutes**

You must answer on the question paper.

No additional materials are needed.

## 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 60.
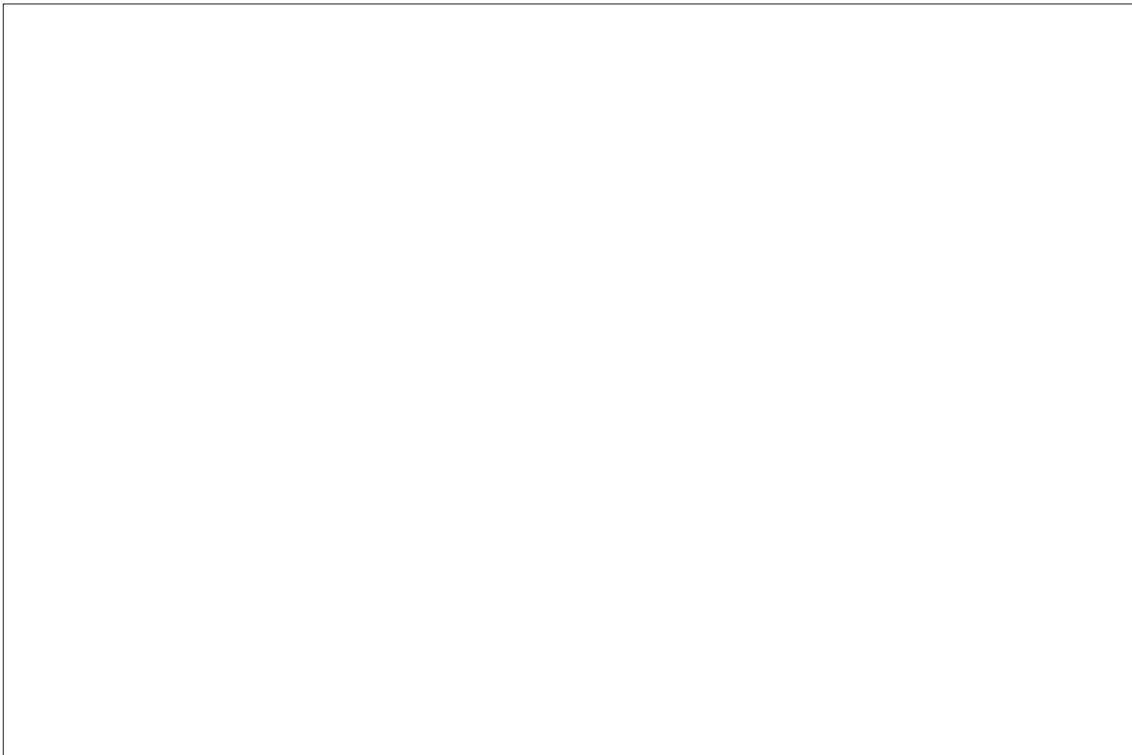- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Blank pages are indicated.

**[Turn over**

**1** Fig. 1.1 shows a shell.
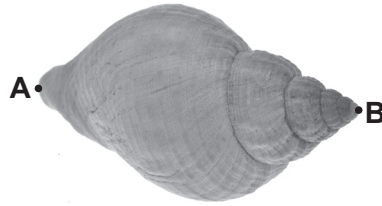


**Fig. 1.1**

(a) In the box, make an enlarged detailed pencil drawing of the shell.

[3]

(b) (i) Draw a straight line to join points **A** and **B** on Fig. 1.1.

This is the actual length of the shell.

Measure and record the length of this line **AB** in millimetres to the nearest millimetre.

actual length of line **AB** on Fig. 1.1 = ................................................ mm [1]

(ii) Mark the points **A** and **B** on your drawing in (a).

Join these points with a line.

Measure and record the length of this line **AB** in millimetres to the nearest millimetre.

length of line **AB** on drawing = ................................................ mm [1]

**(iii)** Use your measurements in **(b)(i)** and **(b)(ii)** to calculate the magnification *m* of your drawing.

Use the equation shown.

$$m = \frac{\text{length of line } \textbf{AB} \text{ on drawing}}{\text{actual length of line } \textbf{AB} \text{ on Fig. 1.1}}$$

*m* = ........................................................  [1]

[Total: 6]

**2** A teacher says that after exercise, the fitness of a person determines the time taken for their pulse rate to return to normal. A fit person's pulse returns to normal in a shorter time.

Plan an investigation to compare the fitness of two students.

Include in your answer:

- a brief description of your method
- how you would measure pulse rate
- what variables you would control
- how you would use your results to draw a conclusion
- any safety precautions you would take.

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

................................................................................................................................... [7]

[Total: 7]

**3** A student investigates the nutrient content of two food solutions, **A** and **B**, using biuret solution and iodine solution.

Solution **A** tests positive with biuret solution and solution **B** tests positive with iodine solution.

All other results are negative.

**(a)** Record in Table 3.1 the final **colours** that the student observes for solutions **A** and **B** with biuret solution and iodine solution.

**Table 3.1**

| food solution | final colour observed with biuret solution | final colour observed with iodine solution |
|---|---|---|
| **A** | | |
| **B** | | |

[3]

**(b)** Use these results to state the nutrient content of solution **A** and solution **B**.

solution **A** contains ...........................................................................................................................

solution **B** contains ...........................................................................................................................

[2]

**(c)** A student tests solution **A** for the presence of fat.

**(i)** State the two substances that are required to test for fat.

................................................................. and .................................................................

[1]

**(ii)** State the observation for a positive result.

observation for a positive result ................................................................................... [1]

[Total: 7]

4 **(a)** In this investigation a student is going to identify four solutions labelled **J**, **K**, **L** and **M**.

The names of the solutions are shown but the student does not know which of these are solutions **J**, **K**, **L** and **M**.

**aqueous barium nitrate**

**aqueous iron(II) sulfate**

**aqueous iron(III) chloride**

**aqueous sodium hydroxide**

**J** is a green solution.

**K** is a yellow solution.

**L** and **M** are colourless solutions.

The student does three experiments to identify the solutions.

The observations are shown in Table 4.1.

**Table 4.1**

| experiment | method | observation |
|---|---|---|
| 1 | To a sample of **J**, add **L** slowly until there is no further change. | green ppt. insoluble in excess |
| 2 | To a sample of **K**, add **L** slowly until there is no further change. | red-brown ppt. insoluble in excess |
| 3 | To a sample of **J**, add a small volume of **M**. | white ppt. |

**(i)** Name solution **J**.

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

**(ii)** Name solution **K**.

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

**(iii)** Name **L** and **M**.

Explain your answer.

**L** is ...............................................................

**M** is ...............................................................

explanation ...................................................................................................................

........................................................................................................................................

........................................................................................................................................
[2]

**(b)** Fig. 4.1 shows the pH chart for universal indicator.

| red | orange | yellow | green | dark green | blue | purple | colour |
|-----|--------|--------|-------|------------|------|--------|--------|
| 1 | | | 7 | | | 14 | pH |

**Fig. 4.1**

**(i)** The student adds three drops of universal indicator to the sample of aqueous iron(II) sulfate.

The pH of aqueous iron(II) sulfate is approximately 6.

State the colour of the universal indicator at this pH.

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

**(ii)** The sample of **K** has a pH of 4.

Suggest why it is difficult to determine the pH of **K** using universal indicator.

.......................................................................................................................................

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

**(c)** Solid **Q** contains one anion and one cation.

    **(i)** A student places a sample of **Q** into a test-tube.

       The student adds aqueous sodium hydroxide and warms the mixture carefully.

       The gas produced turns moist red litmus paper blue.

       Name the gas.

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

   **(ii)** State and explain **one** safety precaution the student **must** take in **(c)(i)**.

       safety precaution ..........................................................................................................

       explanation ...................................................................................................................

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

  **(iii)** The student adds dilute hydrochloric acid to a sample of **Q**.

       The mixture fizzes and produces a gas that turns limewater milky.

       Name the gas.

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

  **(iv)** Name the cation (positive ion) and the anion (negative ion) present in **Q**.

       cation ..............................................................

       anion ..............................................................

                                                                            [1]

                                                                                [Total: 10]

**BLANK PAGE**

**5** A student investigates the effect of increasing the length of magnesium ribbon on the rate of the reaction between magnesium and hydrochloric acid.

The student:

- places 25 cm³ of hydrochloric acid into a beaker
- puts a 5 mm length of magnesium ribbon into the hydrochloric acid and starts a stop-watch
- stops the stop-watch when all the magnesium has disappeared and records this reaction time in Table 5.1
- repeats the experiment using fresh 25 cm³ samples of hydrochloric acid each time but adds different lengths of magnesium ribbon as shown in Table 5.1.

**Table 5.1**

| length of magnesium ribbon /mm | reaction time /s | rate of reaction mm/s |
|---|---|---|
| 5 | 34 | 0.15 |
| 10 | 33 | 0.30 |
| 15 | 35 | 0.43 |
| 20 | | |
| 25 | | |

**(a)** Fig. 5.1 shows the stop-watch readings for the 20 mm and 25 mm lengths of magnesium ribbon.

Record these times in Table 5.1, to the nearest second.



20 mm of magnesium ribbon                 25 mm of magnesium ribbon

**Fig. 5.1**

[2]

**(b)** The rate of the reaction is calculated using the formula shown.

$$\text{rate} = \frac{\text{length of magnesium ribbon}}{\text{reaction time}}$$

Calculate the rates of reaction for both the 20 mm and 25 mm lengths of magnesium.

Record your answers in Table 5.1.

[2]

**(c)** Suggest what the student can do to have more confidence in their results.

...................................................................................................................................................

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

**(d)** Describe the relationship between the length of magnesium ribbon and the rate of reaction.

...................................................................................................................................................

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

**(e) (i)** State two variables that must be controlled in this investigation.

variable 1 ....................................................................................................................................

variable 2 ....................................................................................................................................
[2]

**(ii)** Explain why these variables should be controlled to make the test fair.

...........................................................................................................................................

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

**(f)** The student notices that the magnesium ribbon floats on the surface of the hydrochloric acid.

Suggest how this affects the reaction time.

effect on reaction time ................................................................................................................

explanation ..................................................................................................................................

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

[Total: 10]

                                       **[Turn over**

**6** A student measures the acceleration of free fall $g$.

- He places a metre rule on the ground and clamps it vertically as shown in Fig. 6.1.
- He drops a metal ball from a height of 1.000 m.
- He uses a stop-watch to measure the time $t$ it takes to reach the ground.
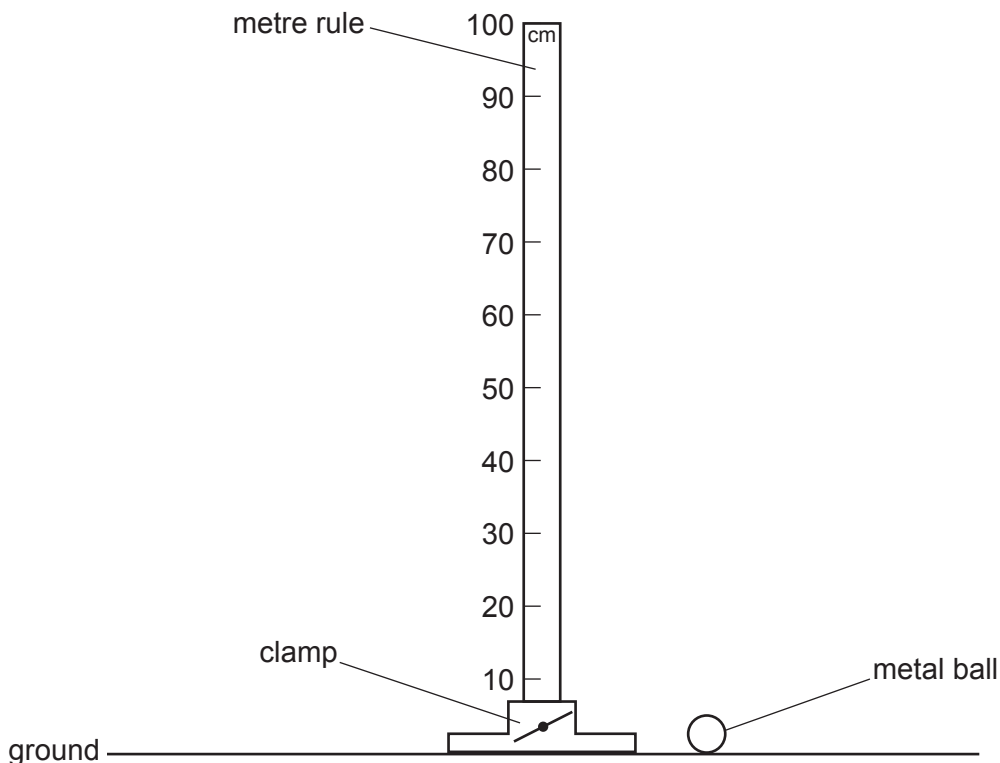


**Fig. 6.1**

**(a) (i)** On Fig. 6.1 draw the position of the ball when the student is about to release it. [1]

**(ii)** On Fig. 6.1 draw the position of the student's eye as he releases the ball, which ensures an accurate measurement of 1.000 m. [1]

**(b)** The student records the time taken for the ball to reach the ground.

He repeats the experiment two more times.

The values for $t$ are shown.

$$0.71\,s \qquad 0.78\,s \qquad 0.63\,s$$

**(i)** Calculate $t_{AV}$, the average (mean) value of $t$. Give your answer to two decimal places.

$t_{AV}$ = ...................................................... s [2]

**(ii)** State why the average value of *t* is not given to more than two decimal places.

...................................................................................................................................

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

**(c)** Calculate the acceleration due to gravity. Use the equation shown.

$$g = \frac{2}{(t_{AV})^2}$$

*g* = ................................................. m/s$^2$ [1]

**(d)** The actual value of the acceleration due to gravity near the Earth's surface is $9.8\,m/s^2$.

State whether your calculated value for *g* agrees with this, allowing for experimental error.

Justify your answer with reference to the values of *g*.

...................................................................................................................................

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

**(e)** State why a ball of the same size made from a material with a very low density, such as polystyrene, would be unsuitable for use in this experiment.

...................................................................................................................................

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

**(f)** One practical problem in this experiment is that the student takes time to react.

There is a small time delay in him seeing the metal ball hit the floor and actually stopping the stop-watch.

This time is called human reaction time.

The student's friend suggests that a better value for *g* will be obtained if the ball is released from a height of much more than 1 m.

Suggest why the student's friend is correct.

...................................................................................................................................

................................................................................................................... [2]

[Total: 10]

**7** A teacher demonstrates the absorption of beta (β)-particles by aluminium foil.
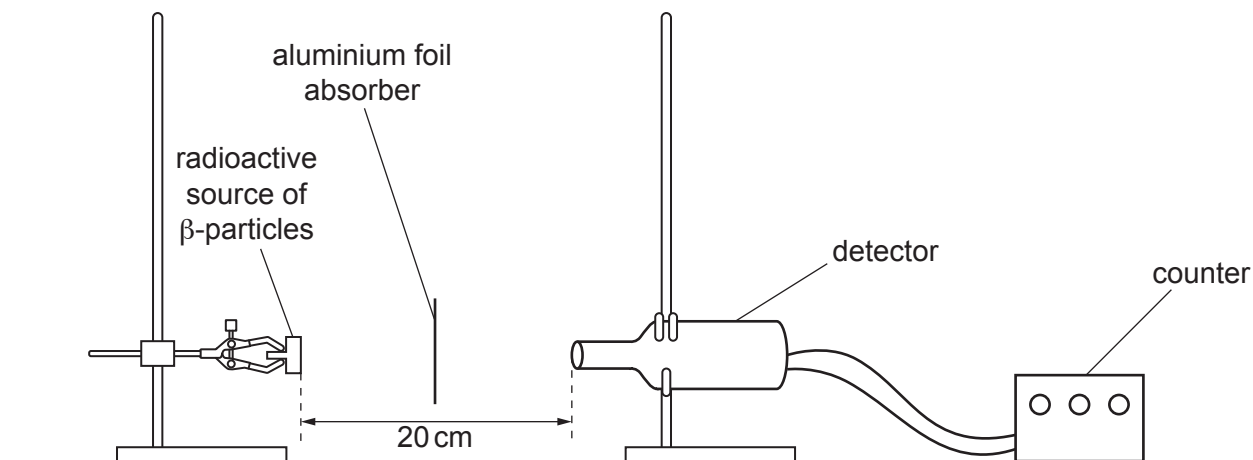
She sets up the apparatus shown in Fig. 7.1.



**Fig. 7.1**

She uses a detector connected to a counter to measure the radioactive radiation emitted by a source of β-particles.

Before the teacher starts the demonstration:

- she removes the radioactive source of β-particles
- she measures the background radiation count in 1 minute
- she repeats the background radiation count two more times
- she calculates the average background radiation count to be 32 counts per minute.

**(a)** Explain why the background radiation count is measured three times.

.............................................................................................................................................

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

**(b) Procedure**
- The teacher places the detector 20 cm away from the radioactive source of β-particles.
- She switches on the counter, measures the initial count rate and records it in Table 7.1.
- She places a sheet of very thin aluminium foil between the detector and the source.
- She measures the new count rate and records it in Table 7.1.
- She adds a second sheet of aluminium foil.
- She measures and records the count rate in Table 7.1.
- She repeats this procedure until 6 sheets of foil are added.

**Table 7.1**

| number of sheets of foil added (N) | measured count rate counts/minute | actual count rate from source counts/minute |
|---|---|---|
| 0 | 632 | 600 |
| 1 | 456 | 424 |
| 2 | 384 | |
| 3 | 322 | 290 |
| 4 | 272 | 240 |
| 5 | 227 | |
| 6 | 190 | 158 |

The actual count rate from the source can be found by using the equation shown.

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

Record, in Table 7.1, the missing values of the actual count rate from the source. [1]

**(c) (i)** Plot a graph of actual count rate from source (vertical axis) against N.

Start your graph at the origin (0, 0).
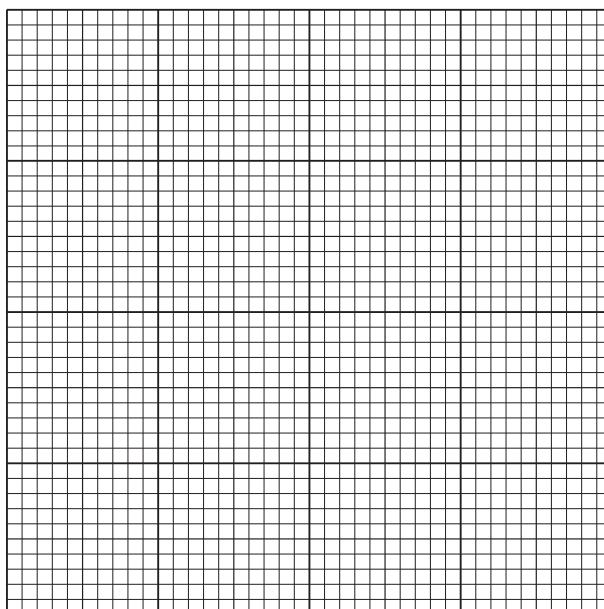
[3]

**(ii)** Draw the best-fit curve. [1]

**(d)** Use your graph to determine the minimum number of sheets of aluminium foil needed to halve the actual count rate from the source.
Show on your graph how you obtained your answer.

number of sheets of foil needed = ........................................................... [2]

**(e) (i)** Suggest why the distance between the radioactive source and the detector must remain constant during this experiment.

.................................................................................................................................

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

**(ii)** The teacher replaces the radioactive source of β-particles with a radioactive source of alpha (α)-particles. The rest of the apparatus is kept the same.

Suggest why the count rate detected decreases to the background count rate.

.................................................................................................................................

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

[Total: 10]