Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

COMBINED SCIENCE **0653/62**

Paper 6 Alternative to Practical **October/November 2023**

1 hour

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 40.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

DC (EF/SG) 319391/3

[Turn over

1 **(a)** A student investigates the effect of exercise on the heart rate of a fit and healthy person.

The heart rate is the number of heart beats per minute.

The student uses an electrocardiogram (ECG) to record the heart beats of the person.

Fig. 1.1 shows an ECG for one heart beat.

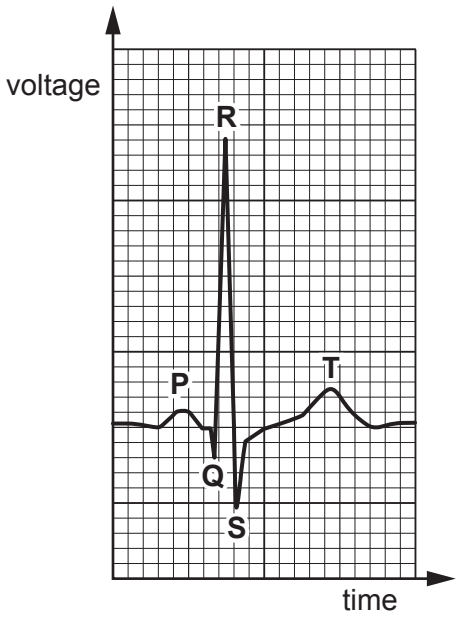

Fig. 1.1

The letters **P**, **Q**, **R**, **S** and **T** represent different stages of the heart beat.

Procedure

The student:

- records the number of heart beats in 5 seconds of the person at rest
- asks the person to run at a constant speed for a running time of 5 minutes
- records the number of heart beats in 5 seconds of the person at the end of this running time
- repeats the procedure for running times of 10, 15, 20 and 25 minutes.

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(i) The ECG results for running times of 5 and 10 minutes are shown in Fig. 1.2.

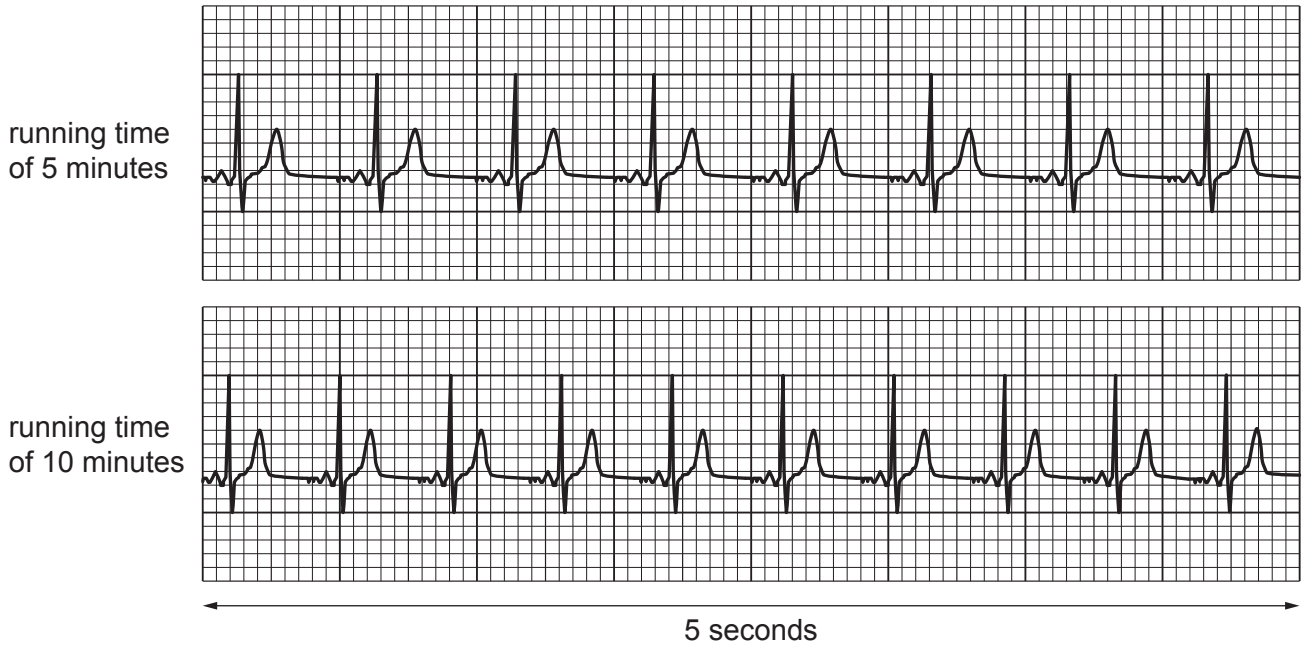


Fig. 1.2

Use Fig. 1.2 to count the number of heart beats in 5 seconds of the person at the end of running times of 5 minutes and 10 minutes.

Record these values in Table 1.1.

Table 1.1

running time / minutes	number of heart beats in 5 seconds	heart rate / bpm
0	5	60
5		
10		
15	12	144
20	12	144
25	12	144

[2]

(ii) The heart rate is calculated as beats per minute (bpm).

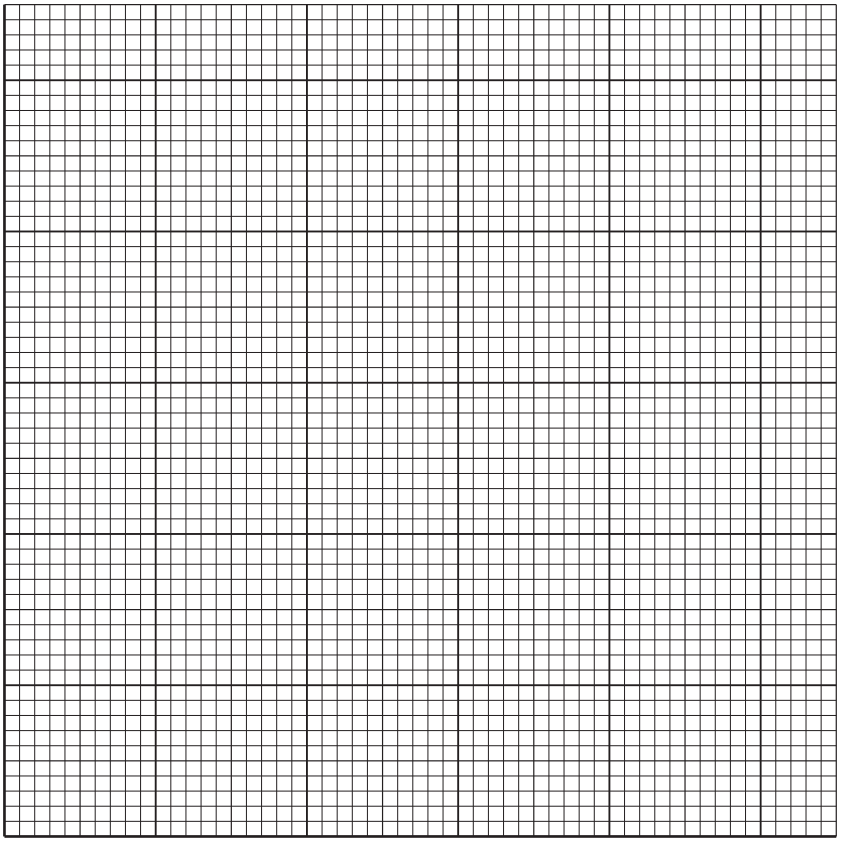
Complete Table 1.1 by calculating the heart rate of the person at the end of running times of 5 minutes and 10 minutes.

Use the equation shown.

heart rate = number of heart beats in 5 seconds × 12

[1]

(iii) On the grid, plot a graph of heart rate (vertical axis) against running time.



[3]

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

(v) Describe the relationship between running time and heart rate.

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.....

..... [1]

(vi) The person is asked to run at a constant speed during the investigation.

Explain why this makes it a fair test.

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..... [1]

(b) The ECG in Fig. 1.3 shows two heart beats.

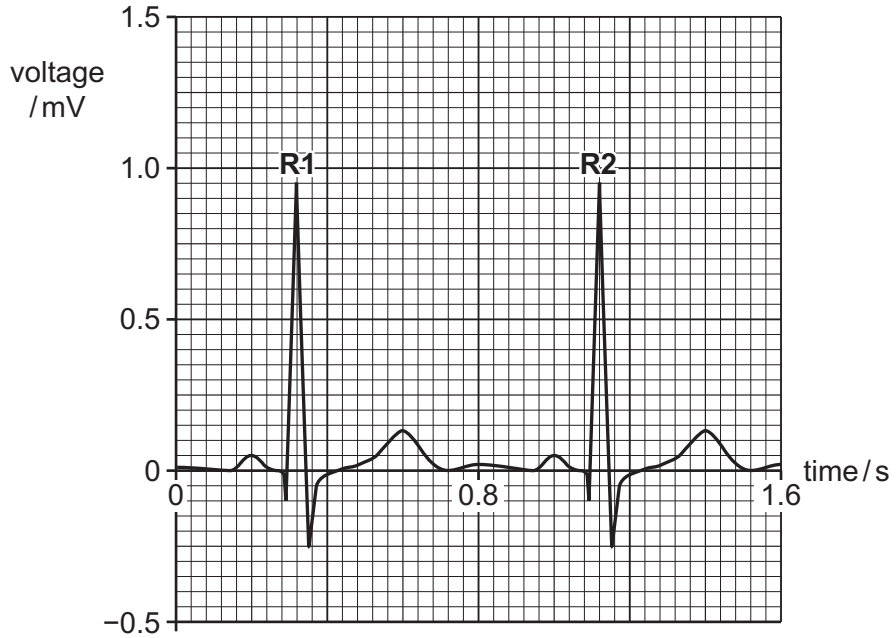

Fig. 1.3

Use Fig. 1.3 to determine the voltage at **R1** and the time between **R1** and **R2**.

voltage at **R1** = ... mV

time between **R1** and **R2** = ... s
[2]

(c) ECGs are used to diagnose heart problems.

Fig. 1.4 shows an ECG for a healthy person and an ECG for a person with a heart problem.

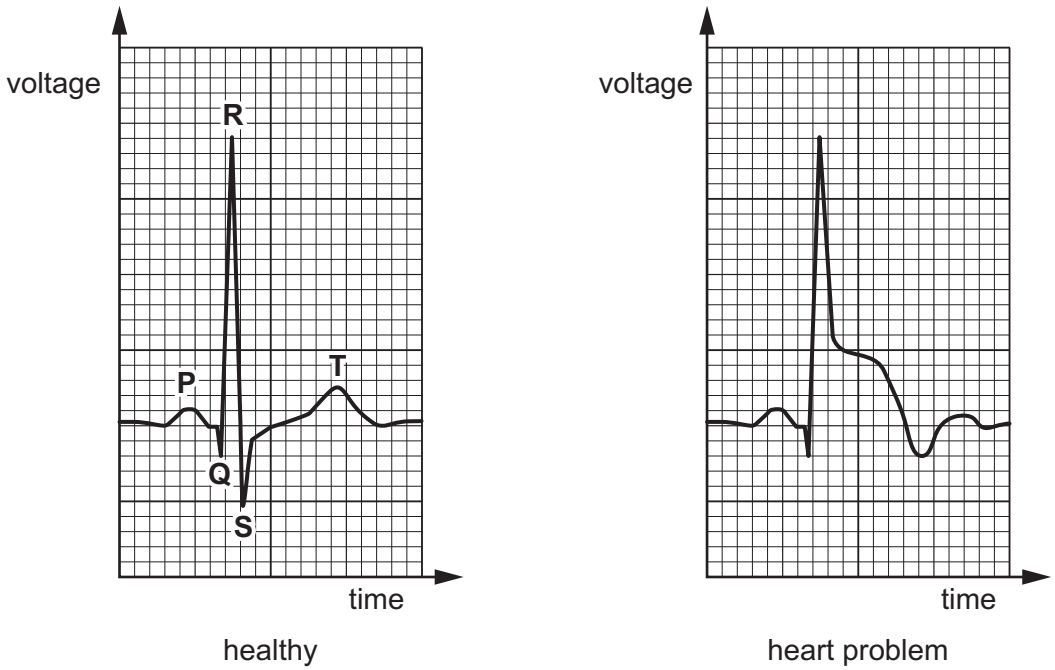

Fig. 1.4

Describe **one** similarity and **one** difference between the ECG for the healthy person and the ECG for the person with a heart problem.

similarity .....

.....

difference .....

.....

[2]

[Total: 13]

2 A student investigates the reaction between iron and a dilute acid.

At room temperature, this reaction is quite slow.

Procedure

The student:

- uses a measuring cylinder to add some dilute acid to a boiling tube
- adds excess iron powder to the dilute acid
- stirs the reaction mixture with a glass rod
- tests the gas produced with a lighted splint.

(a) Fig. 2.1 shows the reading on the balance when the student measures the mass of iron powder.

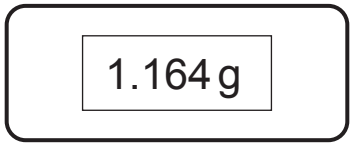

Fig. 2.1

Record the mass to **one** decimal place.

mass = ... g [1]

(b) Suggest why the student mixes the reactants together by stirring during the procedure.

.....

..... [1]

(c) When the student tests the gas with a lighted splint, there is a squeaky pop.

Identify the gas produced in the reaction.

..... [1]

(d) The reaction also produces a green solution. The student separates the green solution from the excess iron in the reaction mixture.

Draw a labelled diagram of the assembled apparatus that the student uses.

Label the residue and the filtrate.

[2]

(e) The student tests the green solution to identify the ions it contains.

The tests and observations are shown in Table 2.1.

Table 2.1

test	observation
add dilute nitric acid and aqueous barium nitrate	white precipitate
add excess aqueous sodium hydroxide	green precipitate, insoluble in excess

(i) State the name of the anion (negative ion) in the filtrate.

..... [1]

(ii) State the name of the cation (positive ion) in the filtrate.

..... [1]

[Total: 7]

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3 Citric acid reacts with aqueous sodium hydroxide as shown in the word equation.

citric acid	+	sodium hydroxide	→	sodium citrate	+	water

In the reaction, aqueous sodium hydroxide is neutralised by solid citric acid.

Sodium hydroxide is an alkali. When citric acid is added to aqueous sodium hydroxide, the pH decreases as the neutralisation reaction happens.

Plan an investigation to determine the relationship between the mass of citric acid added to aqueous sodium hydroxide and the pH of the solution obtained.

You are provided with:

- solid citric acid
- aqueous sodium hydroxide
- universal indicator and a pH colour chart.

You may use any common laboratory apparatus in your plan.

In your plan, include:

- the apparatus you will use
- a brief description of the method and an explanation of any safety precautions you will take
- what you will measure
- which variables you will keep constant
- how you will process your results to draw a conclusion.

You may include a labelled diagram if you wish.

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

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..... [7]

4 A student compares the conducting properties of metal and glass.

The apparatus is shown in Fig. 4.1.

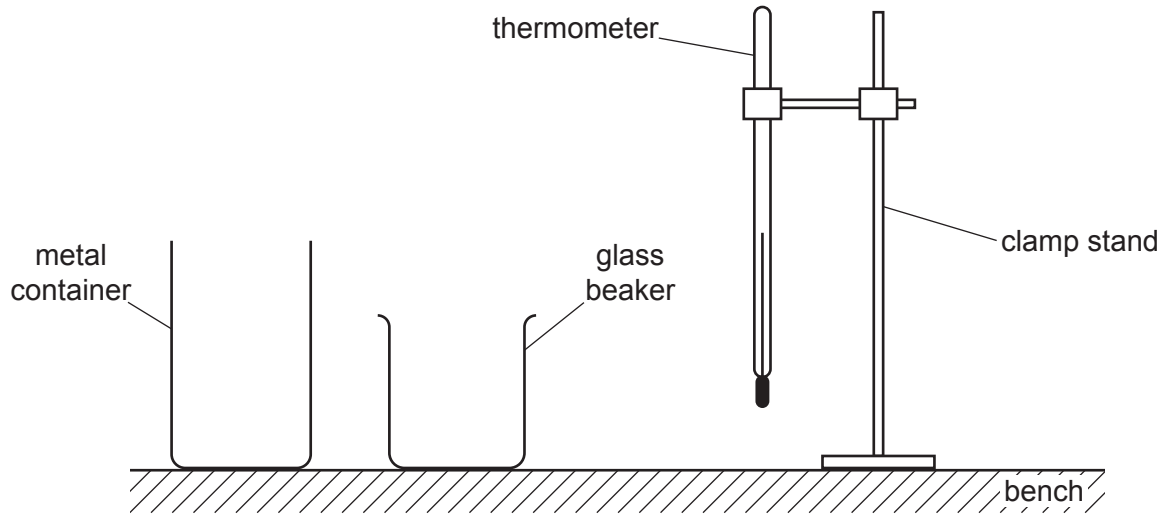

Fig. 4.1

Procedure

The student:

step 1 measures the volume of some hot water using a measuring cylinder

step 2 pours the hot water into the metal container

step 3 places the thermometer into the hot water

step 4 waits for half a minute

step 5 records in Table 4.1 the temperature θ_M of the water in the metal container and at the same time starts a stop-watch

step 6 records in Table 4.1 the temperature θ_M of the water in the metal container every minute for 6.0 minutes.

The student repeats the procedure using the glass beaker instead of the metal container and measures the temperature θ_G of the water in the glass beaker.

(a) (i) Fig. 4.2 shows the hot water in the measuring cylinder.

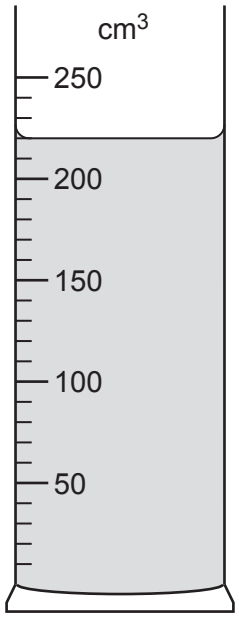

Fig. 4.2

Record the volume of hot water in the measuring cylinder.

volume = ... cm^3 [1]

(ii) Describe how the student avoids a parallax error (line of sight error) when measuring the volume of hot water.

.....

..... [1]

(b) (i) Fig. 4.3 shows the readings on the thermometers after one minute for the metal container and the glass beaker.

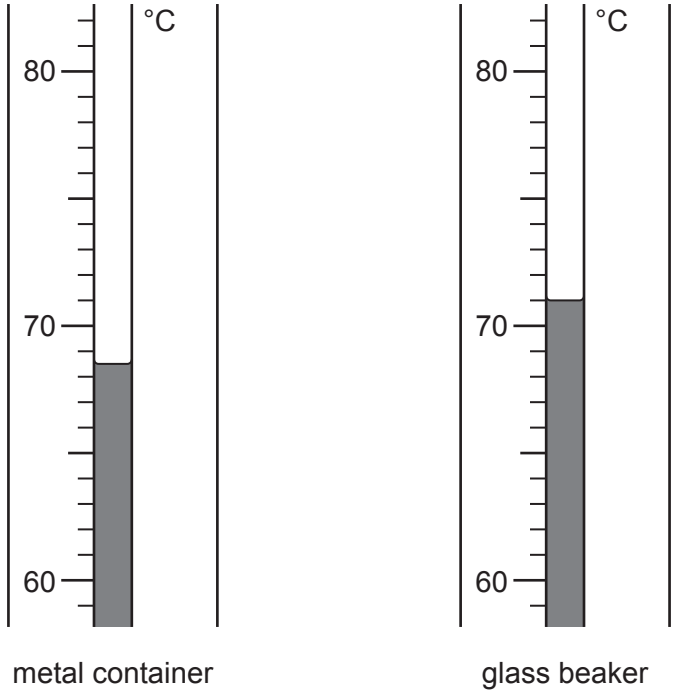

Fig. 4.3

Record in Table 4.1 the two temperature readings against time t = 1.0 min.

Table 4.1

t / min	θ_M / °C	θ_G / °C
0.0	71.5	73.5
1.0		
2.0	66.0	69.0
3.0	64.0	67.5
4.0	62.5	66.0
5.0	61.0	65.0
6.0	60.0	64.0

[2]

(ii) Calculate the change in temperature $\Delta\theta_M$ for the metal container and $\Delta\theta_G$ for the glass beaker between $t = 0.0$ and $t = 6.0$ min.

$\Delta\theta_M$ = ... °C

$\Delta\theta_G$ = ... °C
[1]

(iii) Calculate the average rate of cooling R_M for the water in the metal container and R_G for the water in the glass beaker.

Use the equations:

$$R_M = \frac{\Delta\theta_M}{\Delta t} \qquad R_G = \frac{\Delta\theta_G}{\Delta t}$$

where $\Delta t = 6.0$ min.

Record your answers to **two** significant figures.

Give the unit for the rate of cooling.

R_M = ...

R_G = ...

unit .....
[3]

(iv) Two quantities are considered equal within the limits of experimental accuracy if the values are within 10% of each other.

Explain whether the rate of cooling in the metal container is equal to the rate of cooling in the glass beaker within the limits of experimental accuracy.

Include a calculation in your answer.

explanation .....

.....
[2]

(c) (i) Explain why in **step 4** the student waits half a minute after adding the hot water before taking the first temperature reading.

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..... [1]

(ii) Suggest **two** improvements to the procedure to improve the accuracy of the results.

1 .....

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2 .....

.....

[2]

[Total: 13]

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