

Please write clearly in block capitals.

Centre number

--	--	--	--	--

Candidate number

--	--	--	--

Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL GCSE COMBINED SCIENCE

Paper 3 Physics Extension

E

Friday 31 May 2024

07:00 GMT

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a pencil and a ruler
- a protractor
- a scientific calculator
- the Physics Equations Sheet (enclosed).



Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.
- You are expected to use a scientific calculator where appropriate.
- The Physics Equations Sheet is provided as a loose insert.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	



Answer **all** questions in the spaces provided.

0 1

An electric kettle is connected to the mains electricity supply.

0 1

. 1

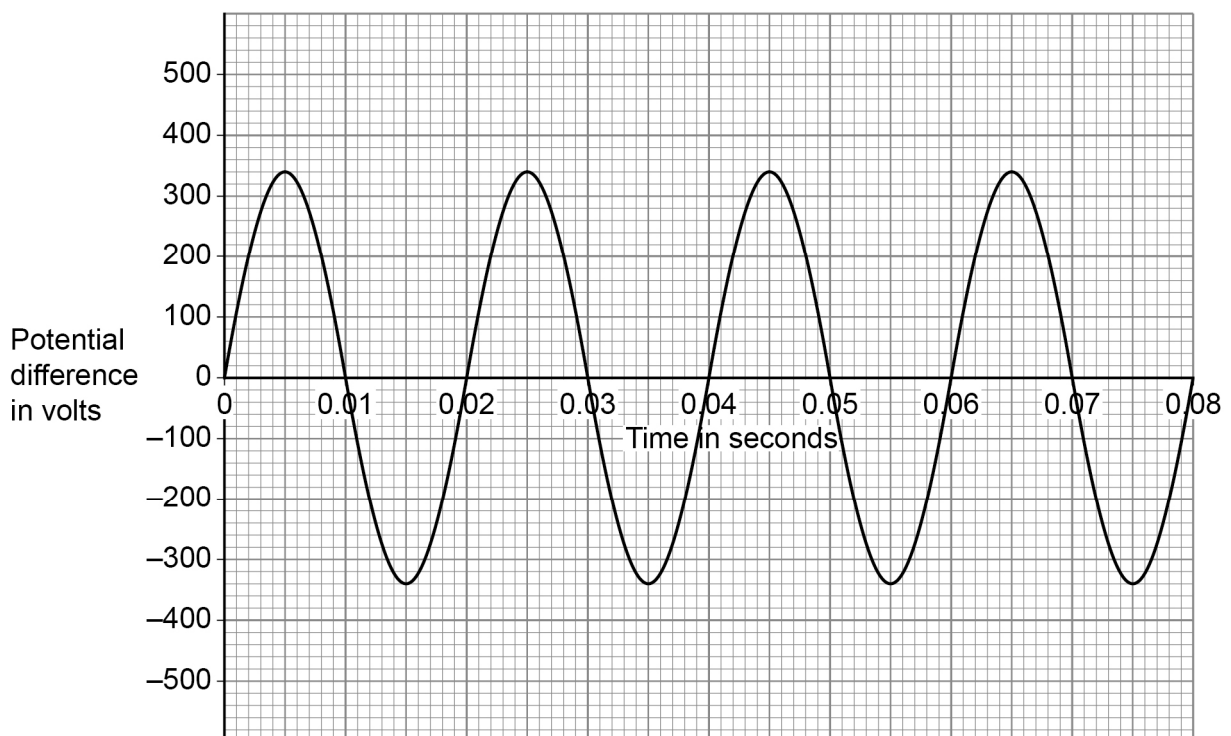
The mains electricity supply is an alternating current (ac) supply.

What does 'alternating current' mean?

[1 mark]

Figure 1 shows how the potential difference of the mains electricity supply varies with time.

Figure 1



0 1 . 2

What is the peak potential difference of the mains electricity supply shown in **Figure 1**?

[1 mark]

Peak potential difference = _____ V

0 1 . 3

Determine the frequency of the mains electricity supply.

Use **Figure 1** and the equation:

$$\text{frequency} = \frac{1}{\text{period}}$$

You must show your working.

[3 marks]

Frequency = _____ Hz

Question 1 continues on the next page

Turn over ►



Figure 2 shows an electric kettle.

Figure 2



The kettle is connected to the mains electricity supply by a cable that contains three different wires.

A fault can cause the metal case to become live.

0 1 . 4 Give **one** risk of the metal case becoming live.

[1 mark]

0 1 . 5 Name the wire that safely conducts the current away if the metal case becomes live.

[1 mark]

0 1 . 6 The plug that connects appliances to the mains electricity supply contains a fuse.

Name the wire that the fuse is connected to.

[1 mark]

Fuses contain a thin piece of metal wire that melts if the current is larger than a specific value.

The specific value is called the fuse rating.

A manufacturer of plugs tests a fuse to check the fuse rating is accurate.

0 1 . 7

The current in the fuse is slowly increased until the thin piece of metal wire melts.

The current at which the wire melts is recorded.

Complete the circuit diagram for a circuit the manufacturer could use.

The symbol for a fuse has been drawn for you.

[2 marks]

Circuit diagram



0 1 . 8

The manufacturer of plugs has 10 000 fuses.

Explain how the manufacturer can make sure the fuse rating of the fuses to be fitted in the plugs is accurate.

[2 marks]



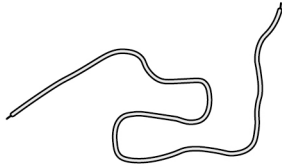
*Do not write
outside the
box*

0	2
---	---

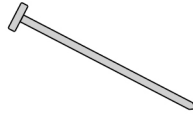
A student investigated one factor that affected the strength of an electromagnet.

Figure 3 shows some of the equipment used.

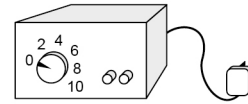
Figure 3



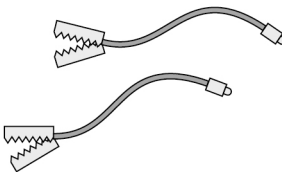
Insulated wire



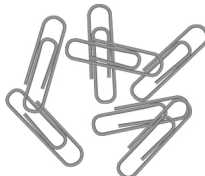
Iron nail



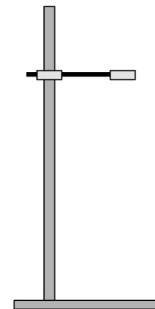
Power supply



Connecting leads



Steel paperclips



Wooden clamp
and stand

0	2	.	1
---	---	---	---

Describe a method the student could use.

[6 marks]

[illegible]

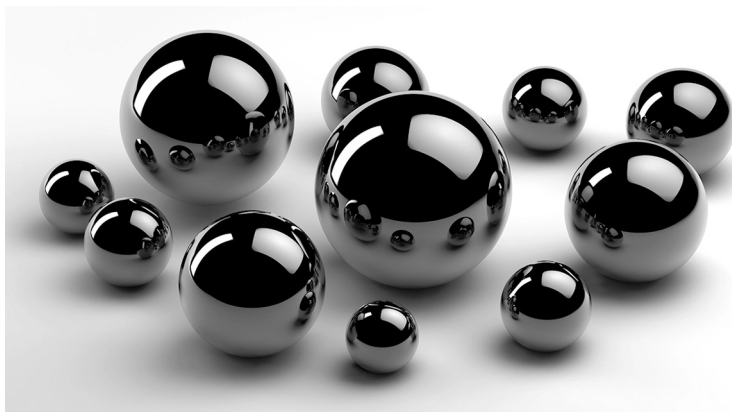
Question 2 continues on the next page

Turn over ►



Figure 4 shows steel balls with different diameters.

Figure 4



The steel balls have been magnetised.

A student investigated how the diameter of a steel ball affected the strength of the magnetic field at the surface of the ball.

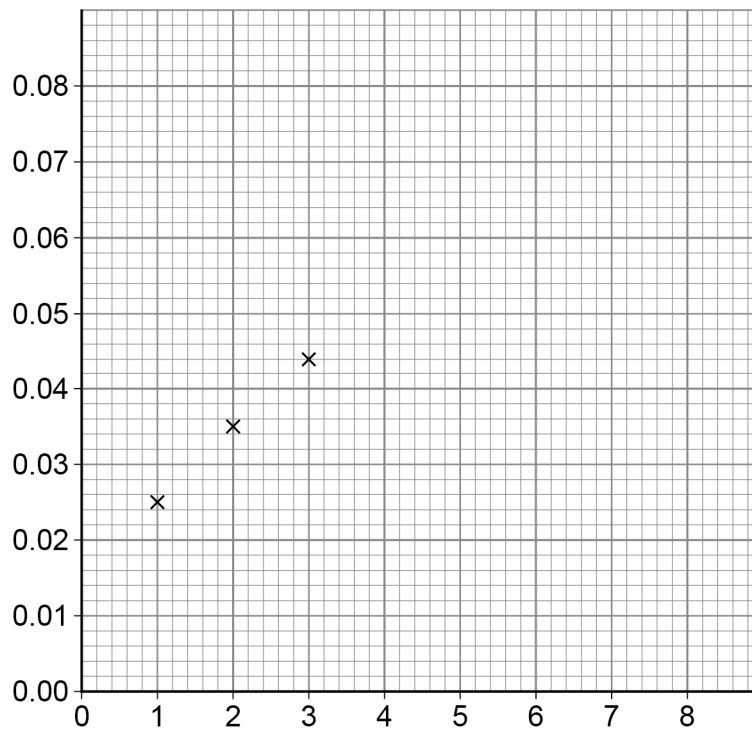
Table 1 shows the results.

Table 1

Diameter in millimetres	Strength of magnetic field in arbitrary units
1.00	0.025
2.00	0.035
3.00	0.044
4.00	0.050
5.00	0.056
6.00	0.061
7.00	0.066
8.00	0.071

Figure 5 is a graph of the results.

Figure 5



0 2 . 2

Complete **Figure 5**.

You should:

- label both axes
- plot the remaining data from **Table 1**
- draw a line of best fit.

[4 marks]

Question 2 continues on the next page

Turn over ►



0 2 . 3 The first row of **Table 1** is repeated below.

Diameter in millimetres	Strength of magnetic field in arbitrary units
1.00	0.025

What was the resolution of the instrument the student used to measure the diameter of the steel balls?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

0.001 millimetres

☐

0.01 millimetres

☐

0.1 millimetres

☐

1.0 millimetres

☐

11



Turn over for the next question

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Turn over ►



0 3

A house contains many devices that are connected to the mains electricity supply.

0 3 . 1

One device in the house transfers 0.450 kWh of energy in 3.0 hours.

Calculate the power of the device.

Give your answer in kW.

[3 marks]

Power = _____ kW

0 3 . 2

The owner of the house has a budget of \$5.00 per day for the energy transferred by all the devices.

The cost per kWh is \$0.40.

Calculate the maximum energy transferred if the owner does not go over budget.

Give your answer in kWh.

[2 marks]

Energy transferred = _____ kWh



0 3 . 3

Suggest why the total power used by all the devices varies during one day.

[1 mark]

0 3 . 4

The owner of the house identifies that some of the energy transferred by the devices is wasted.

Suggest **two** ways that the energy wasted could be reduced.

[2 marks]

1

2

8

Turn over for the next question

Turn over ►



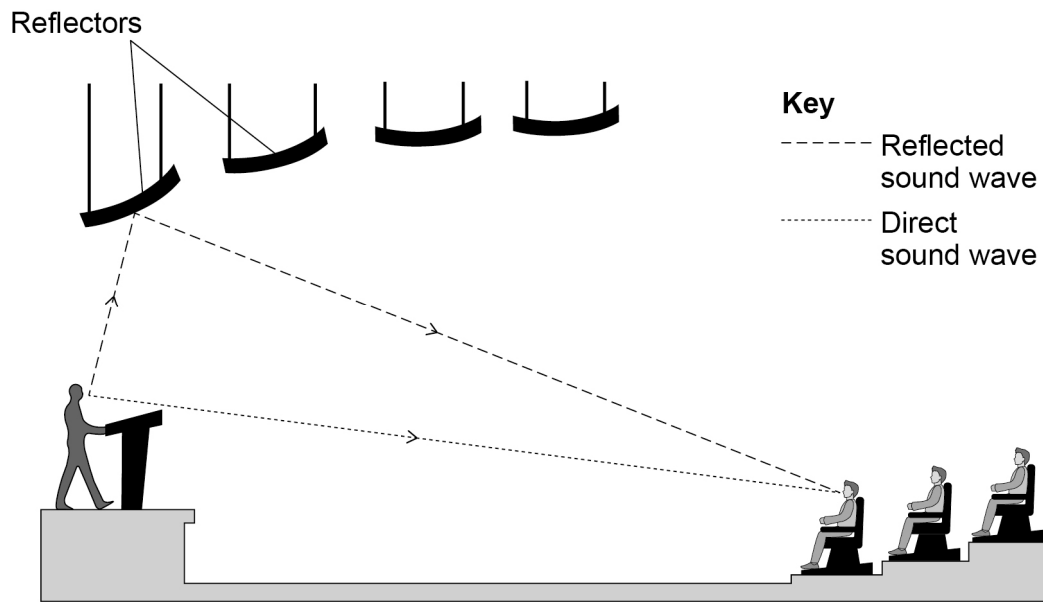
0 4

A teacher gives a talk in a large school theatre.

The theatre has curved reflectors hanging from the ceiling. The reflectors make the sounds received by the students clearer.

Figure 6 shows the sound waves produced by the teacher reaching a student sat in the first row.

Figure 6



0 4 . 1

What are reflected sound waves called?

[1 mark]

0 4 . 2

Complete the sentence about sound waves.

[1 mark]

When waves are reflected, the angle of _____ is equal to the angle of _____.



0 4 . 3

The lines in **Figure 6** that represent the direct sound wave and the reflected sound wave are drawn to the same scale.

The direct wave from the teacher travels a distance of 20.0 metres to the student.

speed of sound in air = 330 m/s

Determine the time between the direct sound wave and the reflected sound wave reaching the student.

You should take measurements from **Figure 6**.

[5 marks]

Time = _____ s

0 4 . 4

Suggest a problem caused by a large time difference between the two sound waves reaching the student.

[1 mark]

8

Turn over ►



0	5
---	---

Nuclear fusion in stars releases energy.

0	5	.	1
---	---	---	---

Describe how a star is formed.

[2 marks]

0	5	.	2
---	---	---	---

Nuclear fusion takes place in the core of a star.

Describe the conditions in the core of a star.

[2 marks]



Figure 7 shows one of the nuclear fusion reactions in the core of a star. The star is on the main sequence.

Figure 7

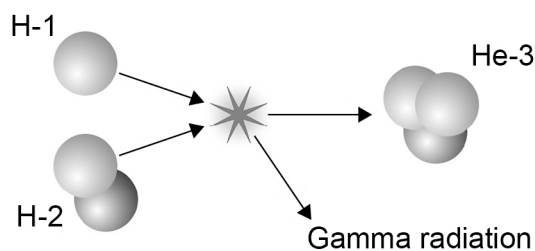


Table 2 shows some information about the isotopes involved in the reaction.

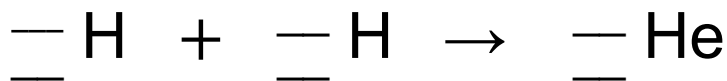
Table 2

Isotope	Particles in the nucleus
Hydrogen-1 (H-1)	1 proton
Hydrogen-2 (H-2)	1 proton, 1 neutron
Helium-3 (He-3)	2 protons, 1 neutron

0 5 . 3 Complete the nuclear equation for the reaction in **Figure 7**.

Use information from **Table 2**.

[2 marks]



0 5 . 4 Energy is released in the nuclear reaction in the form of gamma radiation.

What is gamma radiation?

[1 mark]

Turn over ►



[illegible]

12



Turn over for the next question

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

Turn over ►



0 6

A filament lamp emits light when there is a current in the filament.

0 6 . 1

Why does the brightness of the lamp increase as the current in the filament increases?

[1 mark]

Tick (✓) **one** box.

The mass of the filament increases.

☐

The resistance of the filament increases.

☐

The temperature of the filament increases.

☐

The volume of the filament increases.

☐**0 6 . 2**

When the potential difference across the filament is 2.40 V the current in the filament is 640 mA.

Calculate the resistance of the filament.

[4 marks]

Resistance = _____ Ω



0	6	.	3
---	---	---	---

The filament is made of a material that is a good conductor of electricity.

Describe the movement **and** arrangement of the particles in the filament when there is a current in the filament.

[4 marks]

9

Turn over for the next question

Turn over ►



0 7

Figure 8 shows a person playing a sport called badminton.

Figure 8



Shuttlecock

Racket

The player hits the shuttlecock with the racket.

The racket exerts a force on the shuttlecock and the shuttlecock exerts a force on the racket.

0 7

. 1

Give one **similarity** and one **difference** between the force exerted on the shuttlecock and the force exerted on the racket.

[2 marks]

Similarity _____

Difference _____



0 7 . 2

The shuttlecock leaves the racket with a speed of 80 m/s.

The kinetic energy of the shuttlecock as it leaves the racket is 16 J.

Calculate the mass of the shuttlecock.

Give your answer in grams.

[4 marks]

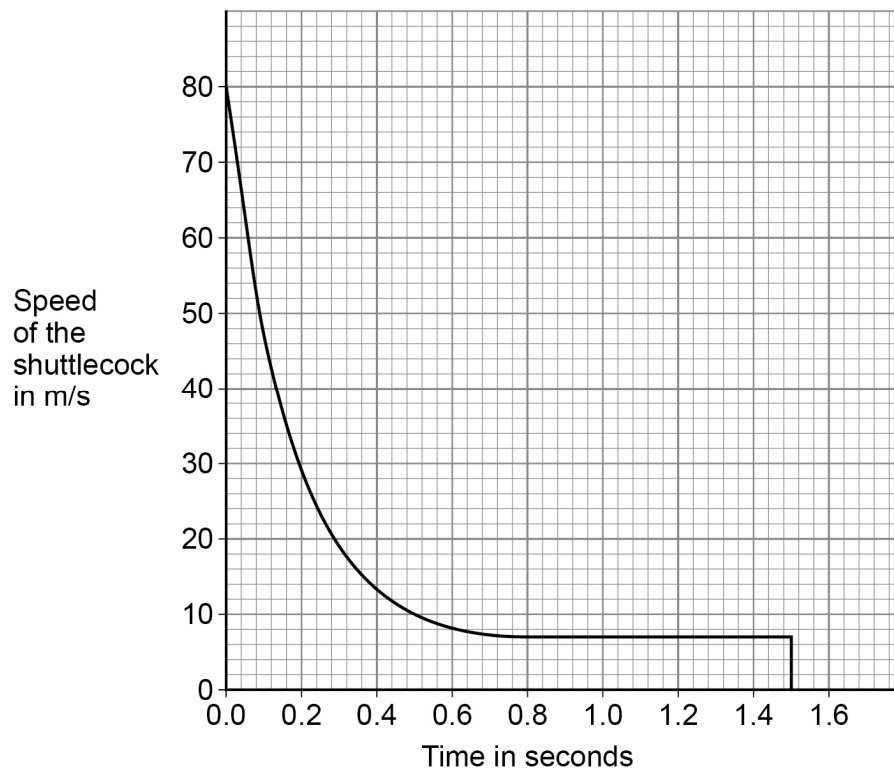
Mass = _____ g

Question 7 continues on the next page

Turn over ►

Figure 9 is a speed–time graph for the shuttlecock after it leaves the racket.

Figure 9



0 7 . 3 After leaving the racket the shuttlecock decelerates.

Explain why the deceleration decreases.

[4 marks]

0 7 . 4

After 1.0 seconds the shuttlecock fell vertically at a constant velocity and hit the ground at a speed of 7.0 m/s.

Determine the height of the shuttlecock at 1.0 seconds.

Use **Figure 9**.

[2 marks]

Height = _____ m

12

Turn over for the next question

Turn over ►



0 8

Electromagnetic waves are transverse waves.

0 8 . 1

What is meant by 'transverse waves'?

[1 mark]

0 8 . 2

Radio waves and microwaves are used in communications.

How do the properties of radio waves and microwaves compare to the properties of **other** types of electromagnetic waves?**[3 marks]**

Frequency _____

Wavelength _____

Speed in a vacuum _____

0 8 . 3

Mobile phones use microwaves.

Give one **other** use of microwaves.**[1 mark]**



0	8	.	4
---	---	---	---

The microwaves used by a mobile phone have a frequency of 1800 MHz.

Calculate the wavelength of the microwaves.

speed of electromagnetic waves = 3.00×10^8 m/s

Give your answer to 3 significant figures.

[5 marks]

Wavelength (3 significant figures) = _____ m

Question 8 continues on the next page

Turn over ►



0 8 . 5

Satellite phones are used in remote areas where ordinary mobile phones would not work.

Figure 10 shows a person using a satellite phone.

Figure 10



The satellite phone transmits signals to satellites in orbit around the Earth.

The satellites are either in a geostationary orbit or a low polar orbit.

Explain the advantages **and** disadvantages of using satellites in different orbits to communicate with a satellite phone.

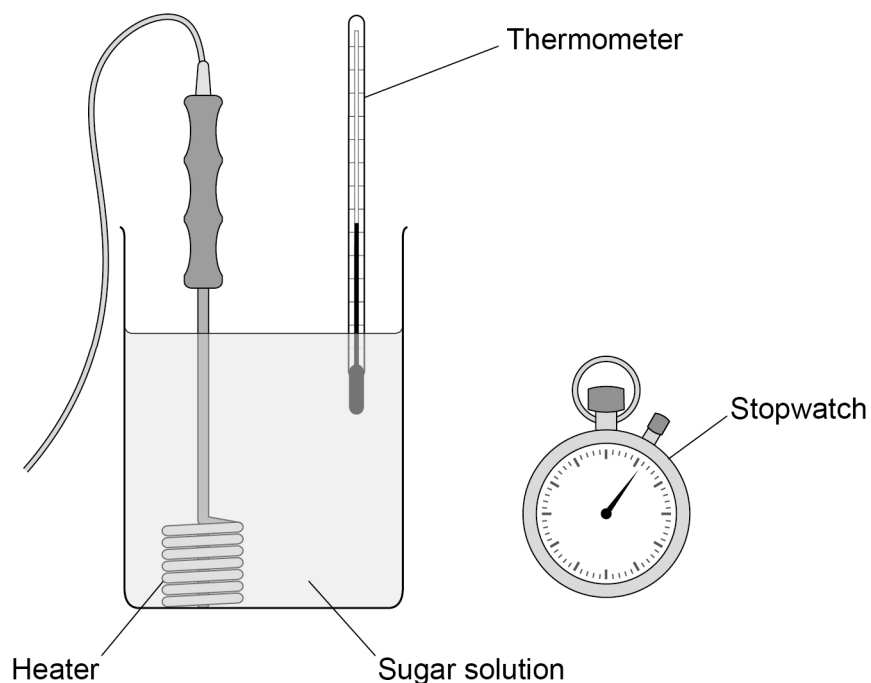
[4 marks]

0 9

A student investigated how the concentration of a sugar solution affected the time taken for the solution to reach boiling point.

Figure 11 shows a sugar solution being heated by an electric heater.

Figure 11

**0 9 . 1**

The power of the electric heater was kept constant during the investigation.

Name two **other** variables that should be kept constant.

[2 marks]

1 _____

2 _____

Question 9 continues on the next page

Turn over ►



The concentration of the sugar solution affects both the specific heat capacity and the boiling point.

Figure 12 shows how the concentration of the sugar solution affects the **specific heat capacity** of the sugar solution.

Figure 12

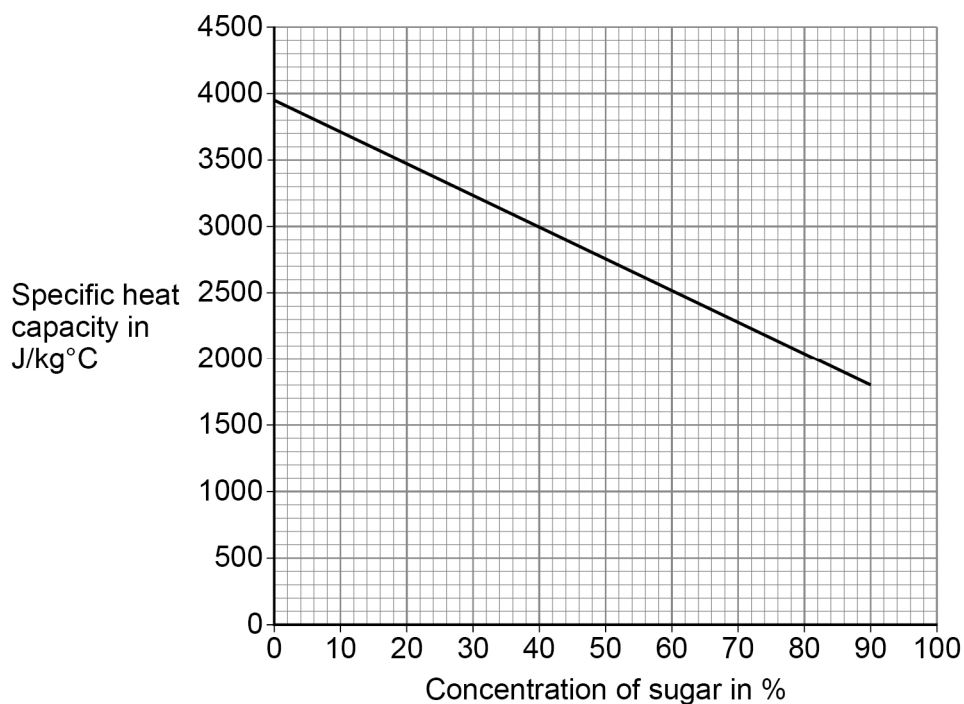
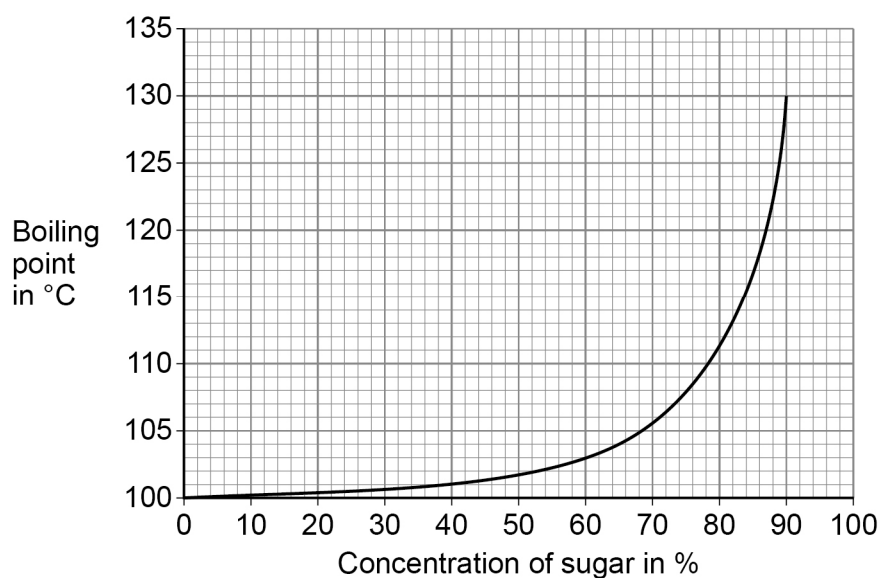


Figure 13 shows how the concentration of the sugar solution affects the **boiling point** of the sugar solution.

Figure 13



[6 marks]

[illegible]

Time = s

Question 9 continues on the next page

Turn over ►



Figure 12 and Figure 13 are repeated below.

Figure 12

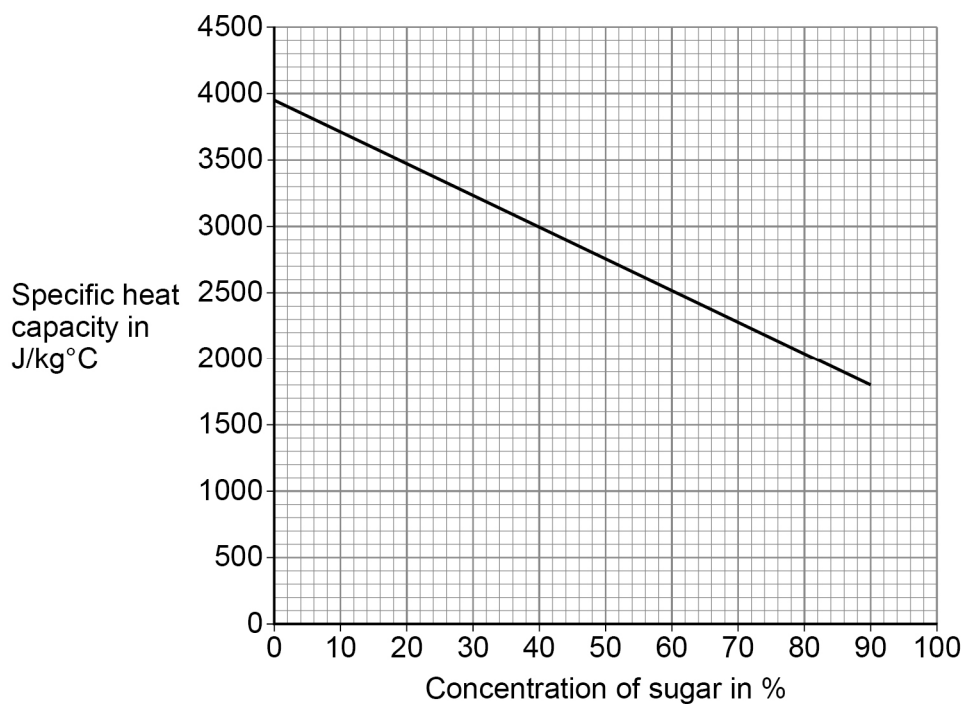
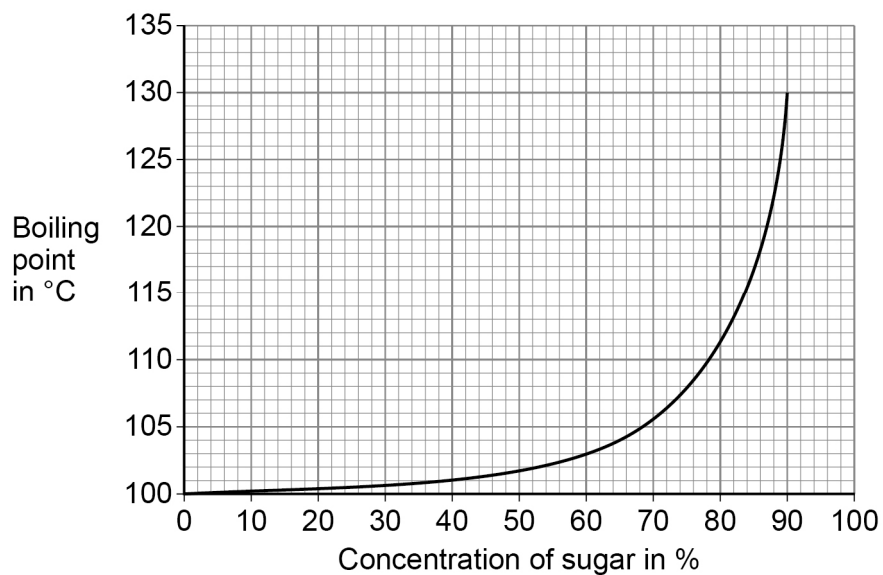


Figure 13



Explain how the concentration of the sugar solution affects the time taken for the solution to reach boiling point.

[6 marks]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

14

END OF QUESTIONS



There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



*Do not write
outside the
box*

[illegible]

[illegible]