

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL GCSE COMBINED SCIENCE

Paper 3 Physics Extension

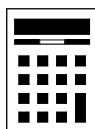
E

Tuesday 5 November 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	
TOTAL	



N 0 V 2 4 9 2 0 4 P E 0 1

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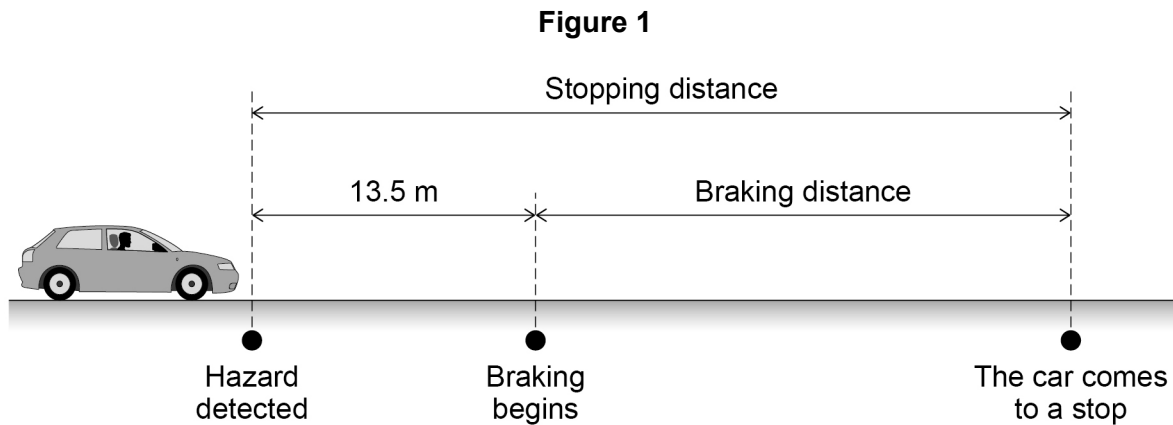
9204/PE

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

0 1

A car is being driven along a road. The driver sees a hazard in the road and applies the brakes.

Figure 1 shows the stopping distance of the car.



0 1 . 1

Which of the following describes the thinking distance?

[1 mark]

Tick (✓) **one** box.

The distance travelled between the brakes being applied and the car stopping

☐

The distance travelled between the hazard being detected and the brakes being applied

☐

The distance travelled between the hazard being detected and the car stopping

☐

0 1 . 2

Speed affects the thinking distance.

Give **two** other factors that affect the thinking distance.

[2 marks]

1 _____

2 _____



0 1 . 3

When the brakes were applied, a constant force acted on the car until the car stopped.

The force was 7500 N.

The work done by the brakes was 162 000 J.

Calculate the braking distance.

Use the Physics Equations Sheet.

[3 marks]

Braking distance = _____ m

0 1 . 4

Determine the stopping distance of the car.

Use **Figure 1** and your answer to Question **01.3**.

[2 marks]

Stopping distance = _____ m

8

Turn over ►



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ANSWER IN THE SPACES PROVIDED**



0 2

Most of the water on Earth is liquid water.

Some of the water on Earth is solid ice.

0 2 . 1

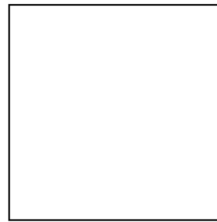
Complete **Figure 2** by drawing particles in the boxes to show the arrangement of particles in liquid water and in solid ice.

You should draw particles the same size as the example in **Figure 2**.

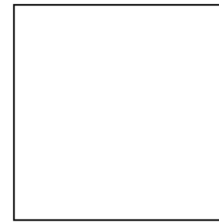
[2 marks]

Figure 2

Particle



Liquid water



Solid ice

0 2 . 2

Name **one** change of state that can happen to liquid water and **one** change of state that can happen to solid ice.

[2 marks]

Liquid water _____

Solid ice _____

Question 2 continues on the next page

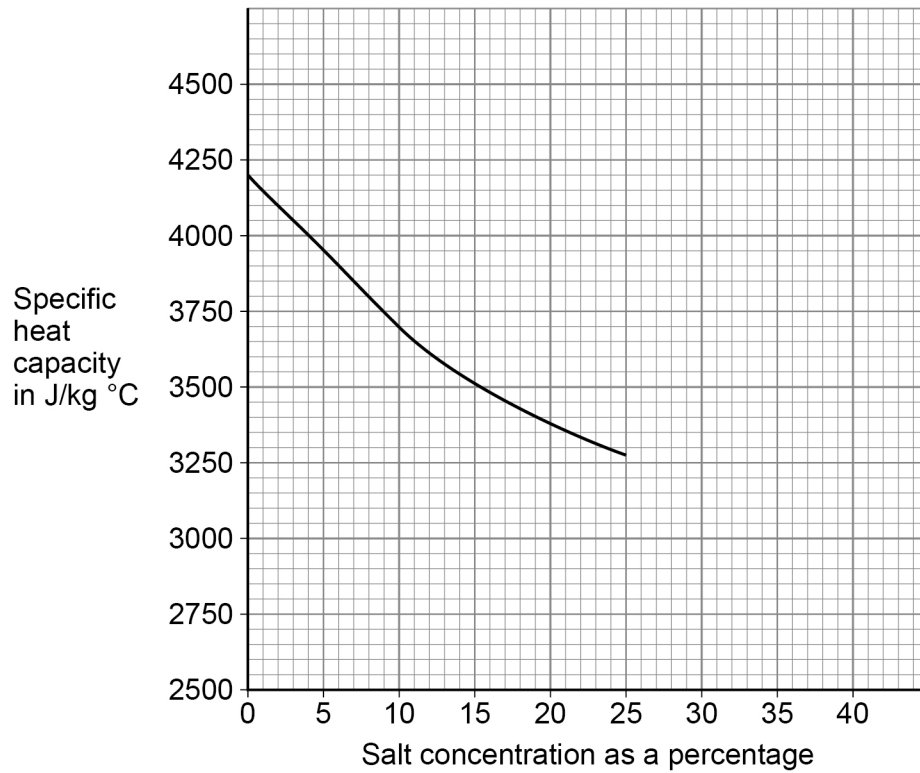
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Most of the water on Earth is in oceans and seas that contain salt.

Figure 3 shows how salt concentration affects the specific heat capacity of water.

Figure 3



The average salt concentration of the oceans and seas on Earth is 3.5%.

0 2 . 3 What is the specific heat capacity of water with a salt concentration of 3.5%?

Use **Figure 3**.

[1 mark]

Specific heat capacity = _____ J/kg °C

0 2 . 4

The Dead Sea has a salt concentration that is 10 times the average.

Determine the specific heat capacity of the water in the Dead Sea.

Use **Figure 3**.

[2 marks]

Specific heat capacity = _____ J/kg °C

0 2 . 5

The temperature of the Dead Sea varies from 20 °C in the winter to 32 °C in the summer.

Determine the energy needed to increase the temperature of 25 kg of Dead Sea water from 20 °C to 32 °C.

Use your answer from Question **02.4** and the Physics Equations Sheet.

[3 marks]

Energy = _____ J

10

Turn over for the next question

Turn over ►



0 3

A student investigated how the force applied to a spring affected the extension of the spring.

Table 1 shows the results.

Table 1

Weight in newtons	Length of spring in millimetres	Extension of spring in millimetres
0	28	0
0.5	44	16
1.0	60	32
1.5	75	47
2.0	90	62
2.5	102	74

0 3 . 1

Describe a method the student could use to obtain the results in **Table 1**.

You should include a diagram.

[6 marks]



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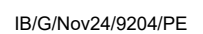


Table 1 is repeated below.

Table 1

Weight in newtons	Length of spring in millimetres	Extension of spring in millimetres
0	28	0
0.5	44	16
1.0	60	32
1.5	75	47
2.0	90	62
2.5	102	74

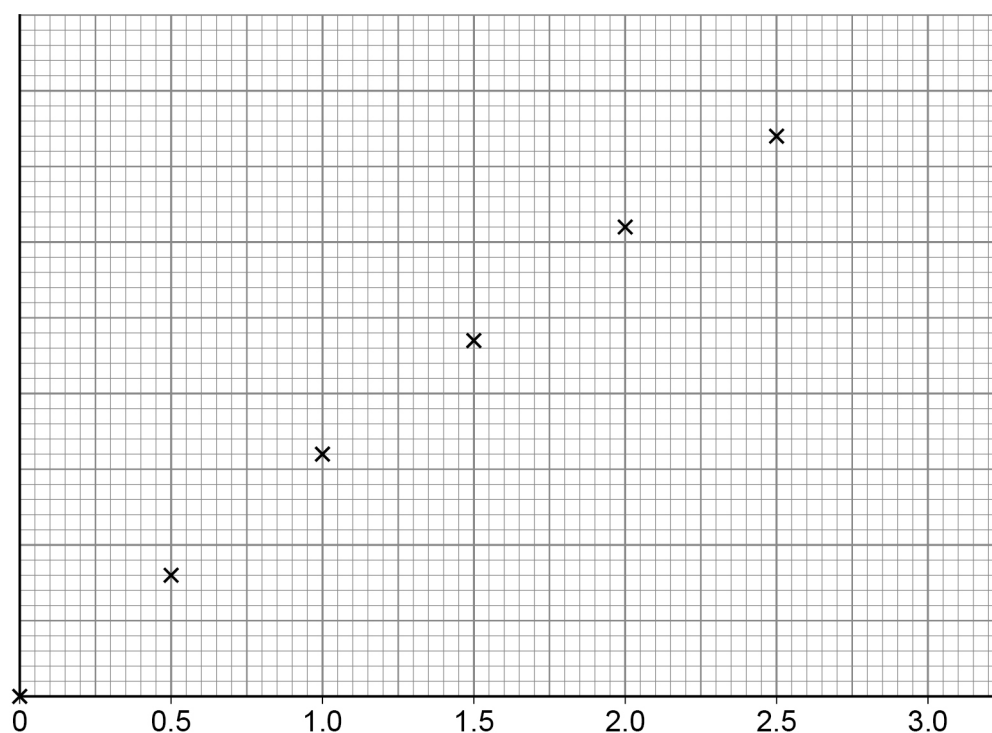
0 3 . 2 Complete **Figure 4**.

You should:

- label both axes
- add the scale to the y-axis
- draw the line of best fit.

[3 marks]

Figure 4



0 3 . 3

Describe the relationship between force and extension shown in **Figure 4**.**[2 marks]**

0 3 . 4

What was the original length of the spring?

Use **Table 1**.**[1 mark]**

Original length = _____ mm

0 3 . 5

What was the resolution of the instrument used to measure the length of the spring?

Use **Table 1**.**[1 mark]**

Resolution = _____ mm

13

Turn over for the next question**Turn over ►**

0 4

Naturally occurring uranium consists of two isotopes, uranium-235 and uranium-238.

0 4 . 1

Give **one** similarity and **one** difference between a nucleus of uranium-235 and a nucleus of uranium-238.

[2 marks]

Similarity _____

Difference _____

0 4 . 2

Uranium-235 is radioactive and decays into thorium (Th) by emitting an alpha particle.

Complete the equation for the decay of uranium-235.

[2 marks]



0 4 . 3

A nucleus of uranium-235 can also undergo nuclear fission if it absorbs a neutron.

Describe the process of nuclear fission.

[3 marks]



0 4 . 4

The percentage by mass of the two isotopes found in naturally occurring uranium are:

- uranium-235 = 0.7%
- uranium-238 = 99.3%

Before naturally occurring uranium can be used in nuclear power stations it is processed.

In processed uranium, the percentage of uranium-235 is five times greater than in naturally occurring uranium.

A nuclear power station uses 1.8×10^5 kg of processed uranium.

Calculate the mass of uranium-235 contained in the processed uranium.

[3 marks]

Mass = _____ kg

0 4 . 5

The processed uranium is used to make fuel rods for the nuclear power station.

The fuel rods are made from uranium oxide and not pure uranium.

The melting points of uranium oxide and uranium are:

- uranium oxide = 2900 °C
- uranium = 1100 °C

Uranium oxide must be used rather than uranium because of the nuclear fission reactions that occur in the fuel rods.

Explain why.

[2 marks]

Turn over ►



0 4 . 6

Some countries are planning to increase the percentage of electricity that is generated by nuclear power.

Explain **one** advantage and **one** disadvantage of **increasing** the percentage of electricity that is generated by nuclear power.

[4 marks]

Advantage _____

Disadvantage _____

16



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1 5

0 5

Sound and light transfer energy as waves.

0 5 . 1

Waves cause oscillations.

Describe the difference between the oscillations of sound waves and the oscillations of light waves.

You should refer to the types of waves in your answer.

[4 marks]

0 5 . 2

The human eye can detect light waves.

The shortest wavelength of light that the human eye can detect is 400 nm.

Which of the following is the same as 400 nm?

[1 mark]

Tick (✓) **one** box.

 $400 \times 10^{-12} \text{ m}$ ☐ $400 \times 10^{-9} \text{ m}$ ☐ $400 \times 10^{-6} \text{ m}$ ☐ $400 \times 10^{-3} \text{ m}$ ☐

0 5 . 3

Calculate the frequency of a light wave with a wavelength of 400 nm.

speed of light = 3.0×10^8 m/sUse your answer to Question **05.2** and the Physics Equations Sheet.

Give your answer in standard form.

[3 marks]

Frequency (in standard form) = _____ Hz

0 5 . 4

The human ear can detect sound waves.

Describe how different frequencies and amplitudes of sound waves are interpreted by humans.

[2 marks]

Different frequencies _____

Different amplitudes _____

10**Turn over for the next question****Turn over ►**

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0 6

One of the fastest trains in the world is in Shanghai, China.

The train connects Shanghai airport to a train station near the city centre.

0 6 . 1

The average speed of the train is 64 m/s.

The journey from the airport to the train station takes 7 minutes and 45 seconds.

Calculate the distance from the airport to the train station.

Give your answer to the nearest km.

[4 marks]

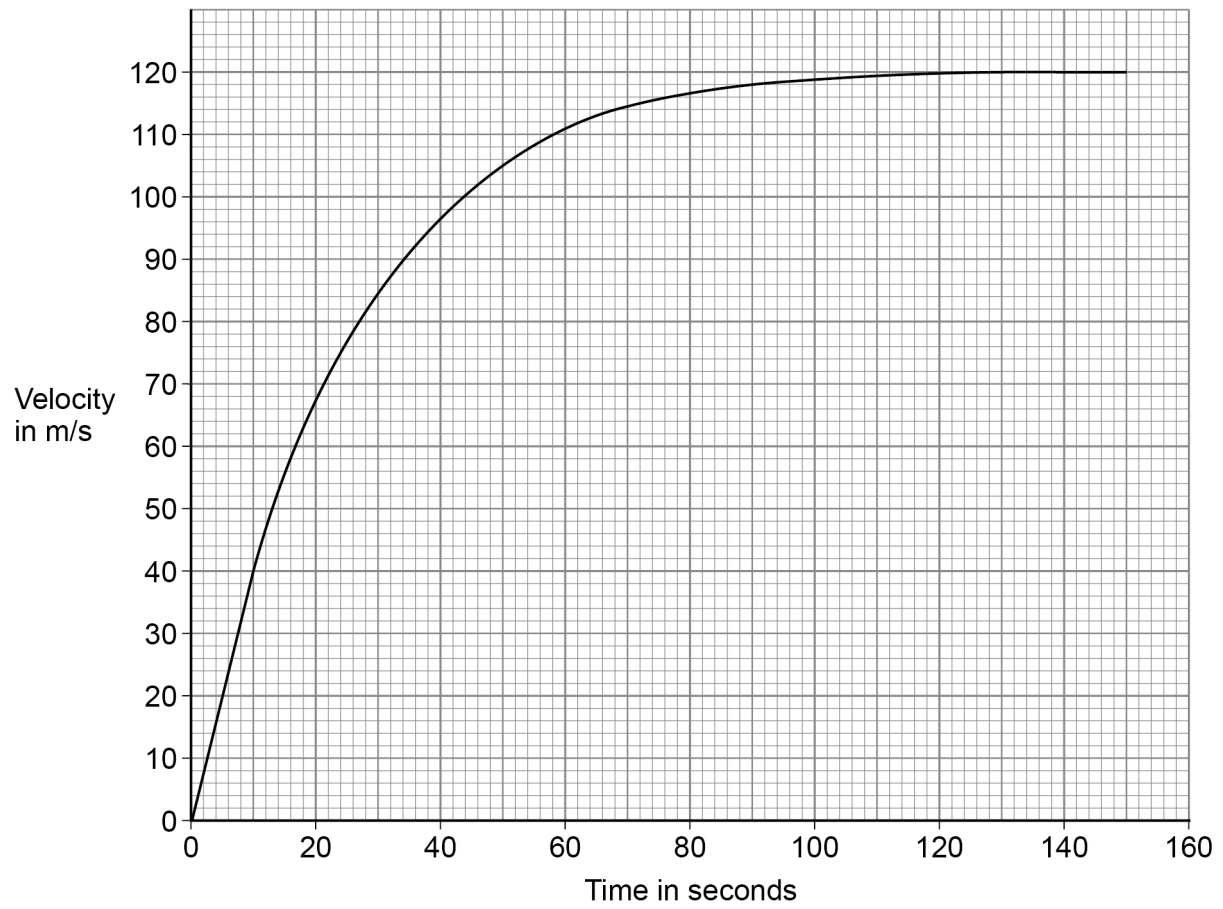
Distance = _____ km

Question 6 continues on the next page

Turn over ►

Figure 5 shows a velocity–time graph for the first 150 seconds of the journey.

Figure 5



0 6 . 2

The acceleration of the train is constant for the first 10 seconds of the journey.

Determine the acceleration of the train for the first 10 seconds.

Give the unit.

[3 marks]

Acceleration = _____ Unit _____

0 6 . 3

The forward force on the train is constant.

Explain why the acceleration of the train shown in **Figure 5** becomes zero.

[3 marks]

Question 6 continues on the next page

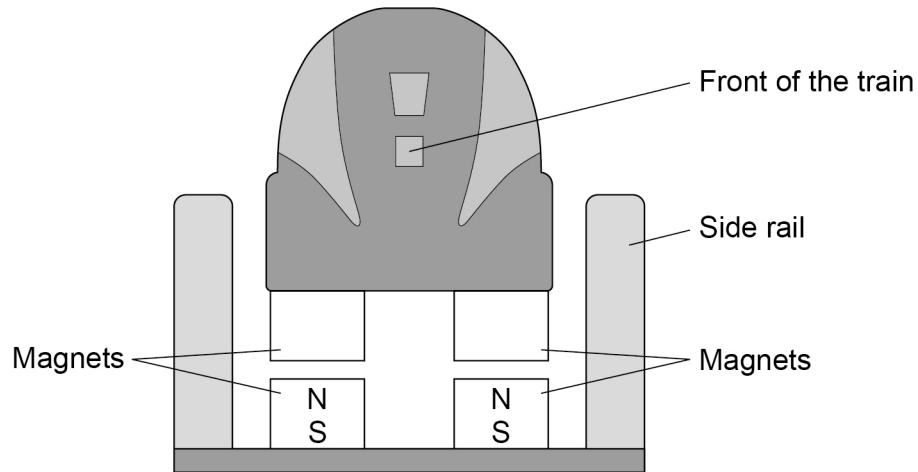
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The train is a special type called a Maglev train.

Figure 6 shows a Maglev train.

Figure 6



The magnets create a force that means the train does not touch the ground.

0 6 . 4

Two of the four magnets on **Figure 6** do not have their poles labelled.

Complete **Figure 6** by labelling the poles of the magnets on the train.

[1 mark]

0 6 . 5

Most trains have wheels that move on a track.

Maglev trains do not have wheels.

Explain the advantage of the Maglev train compared to a train with wheels that move on a track.

[3 marks]



0	6	.	6
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When the train is stationary, the magnets create an upwards force on the train of 392 kN.

gravitational field strength = 9.8 N/kg

Calculate the mass of the train.

[4 marks]

Mass = _____ kg

Question 6 continues on the next page

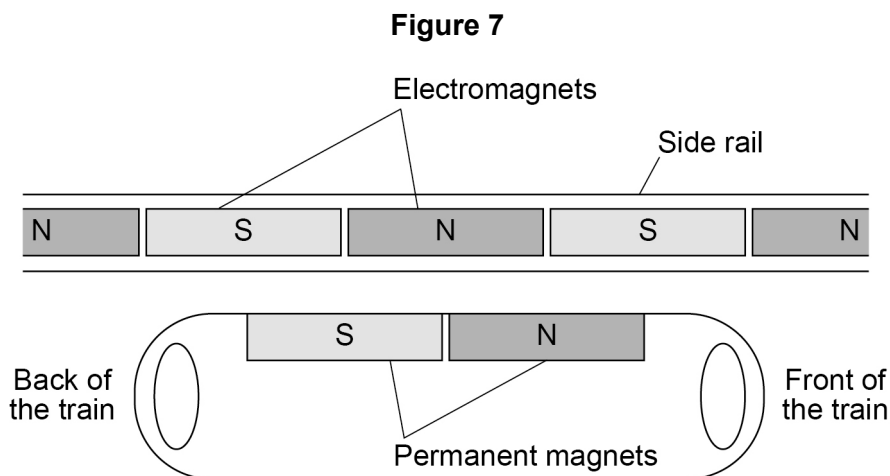
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0 6 . 7

The train is propelled forward by electromagnets in the side rail.

Figure 7 shows the train and side rail as viewed from above the train.



As the train moves forward, the current in each electromagnet in the side rail changes direction.

Explain why the current needs to change direction.

[3 marks]

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2 5

07

The resistance of some electrical components can change.

07.1

Complete the sentences.

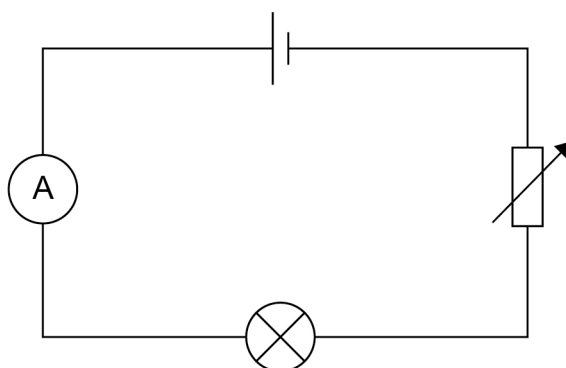
[2 marks]

An electrical component with a resistance that decreases when the **light intensity** increases is called a _____.

An electrical component with a resistance that decreases when the **temperature** increases is called a _____.

Figure 8 shows a circuit diagram for a circuit a student built.

Figure 8



07.2

When the resistance of the variable resistor decreases, the resistance of the filament lamp increases.

Explain why.

[4 marks]



0	7	.	3
---	---	---	---

The lamp has a power of 12 W when the current in the lamp is 50 mA.

Calculate the energy transferred by the lamp when a charge of 3500 C is transferred.

[5 marks]

Energy transferred = _____ J

11

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0 8

The Sun is a star.

Different stars have different masses.

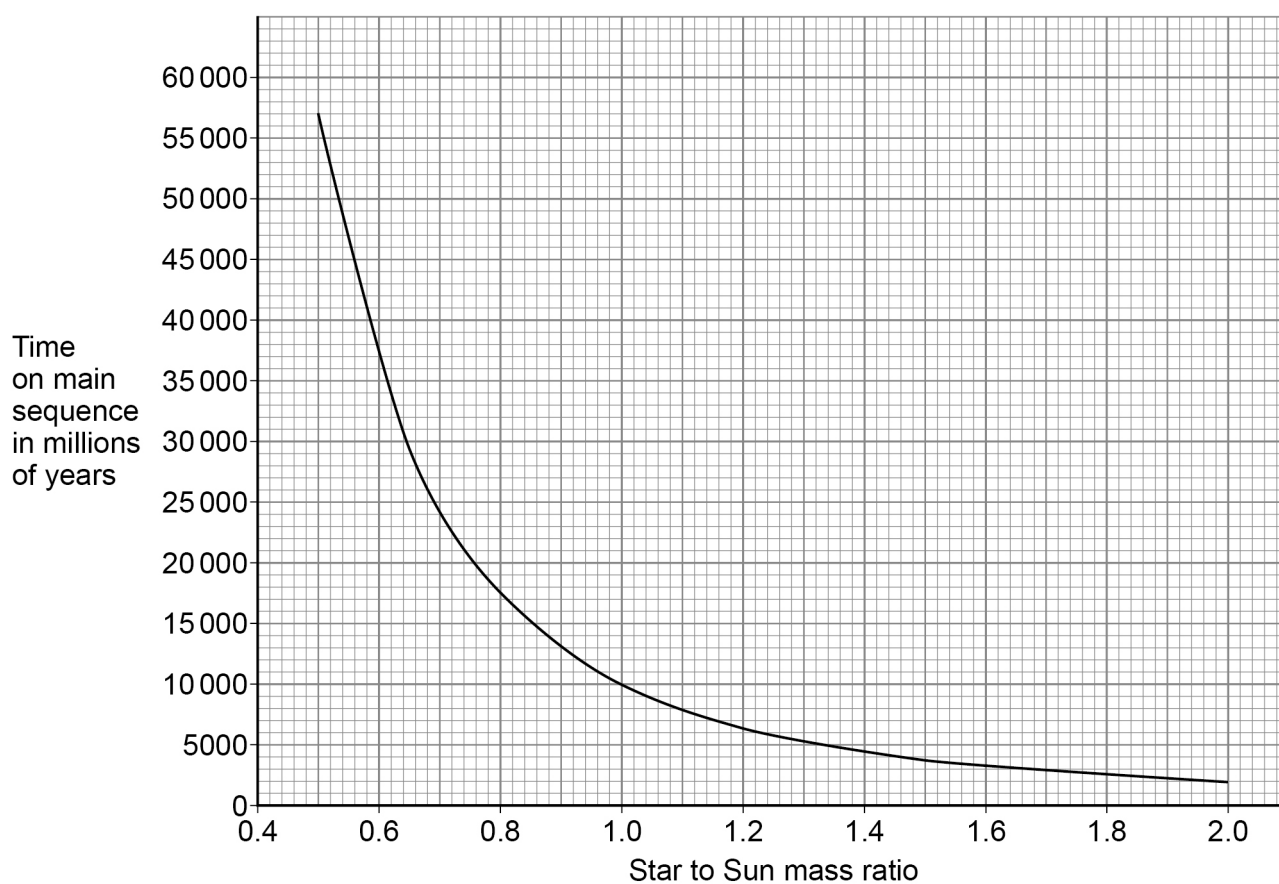
Scientists study different stars by comparing their masses.

Scientists calculate the 'star to Sun mass ratio' using the equation:

$$\text{star to Sun mass ratio} = \frac{\text{mass of star}}{\text{mass of Sun}}$$

Figure 9 shows how the 'star to Sun mass ratio' affects the time a star is a main sequence star.

Figure 9



0	8	.	1
---	---	---	---

The 'star to Sun mass ratio' for the Sun is 1.0

The Sun is 4500 million years old.

Determine how much **more** time the Sun will spend as a main sequence star.

Use **Figure 9**.

Give your answer in standard form.

[3 marks]

Time (in standard form) = _____ years

Question 8 continues on the next page

Turn over ►



One of the largest stars ever discovered by scientists is called Eta Carinae.

Eta Carinae has a 'star to Sun mass ratio' of 250

0 8 . 2 Calculate the mass of Eta Carinae.

mass of Sun = 2.0×10^{30} kg

[2 marks]

Mass = _____ kg



Describe the similarities and the differences between the life cycle of the Sun and the life cycle of Eta Carinae.

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11

END OF QUESTIONS



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