

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

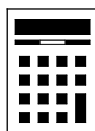
# E

Tuesday 8 November 2022 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                  |      |
| <b>TOTAL</b>       |      |



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

IB/G/Nov22/E7

9204/PE

**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**



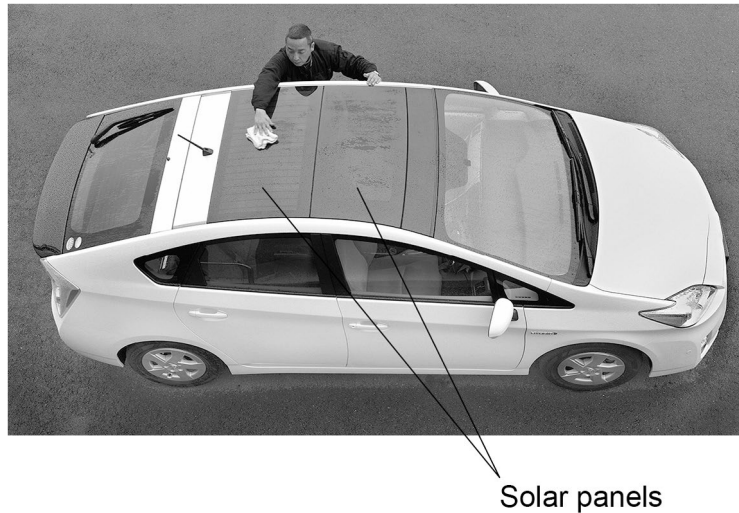
Answer **all** questions in the spaces provided.

**0 1**

**Figure 1** shows a car fitted with solar panels.

A person is cleaning the solar panels.

**Figure 1**



The car can be powered in two ways:

- by an engine that runs on fuel
- by an electric motor that is connected to a battery.

The battery is charged by the solar panels.

**0 1 . 1**

Solar power is a renewable energy source.

What is meant by 'renewable energy source'?

**[1 mark]**

---



---

**0 1 . 2**

Dirt on the car roof decreases the useful power output of the solar panels.

Suggest the reason why.

**[1 mark]**

---



---

**Turn over ►**



**0 1 . 3**

When the roof is clean, the useful power output from the solar panels is not constant.

Explain why.

**[2 marks]**

---

---

---

---

**0 1 . 4**

On one day, the solar panels received sunlight for 5 hours.

The average power received by the solar panels was 1200 W.

Calculate the total energy received by the solar panels.

Use the Physics Equations Sheet.

**[4 marks]**

---

---

---

---

---

---

---

---

Total energy = \_\_\_\_\_ J



**0 1 . 5** The efficiency of the solar panels is 0.20

Calculate the useful power out when the total power in is 1200 W.

Use the Physics Equations Sheet.

**[3 marks]**

---

---

---

---

---

Useful power out = \_\_\_\_\_ W

**0 1 . 6** **Table 1** gives information about two different types of solar panel.

**Table 1**

| Solar Panel   | Efficiency | Cost     |
|---------------|------------|----------|
| Type <b>A</b> | 0.20       | \$1500   |
| Type <b>B</b> | 0.30       | \$12 000 |

Explain why Type **A** solar panels rather than Type **B** solar panels are used on the roof of a car.

You **must** include calculations from the data in **Table 1** in your answer.

**[3 marks]**

---

---

---

---

---

---

---



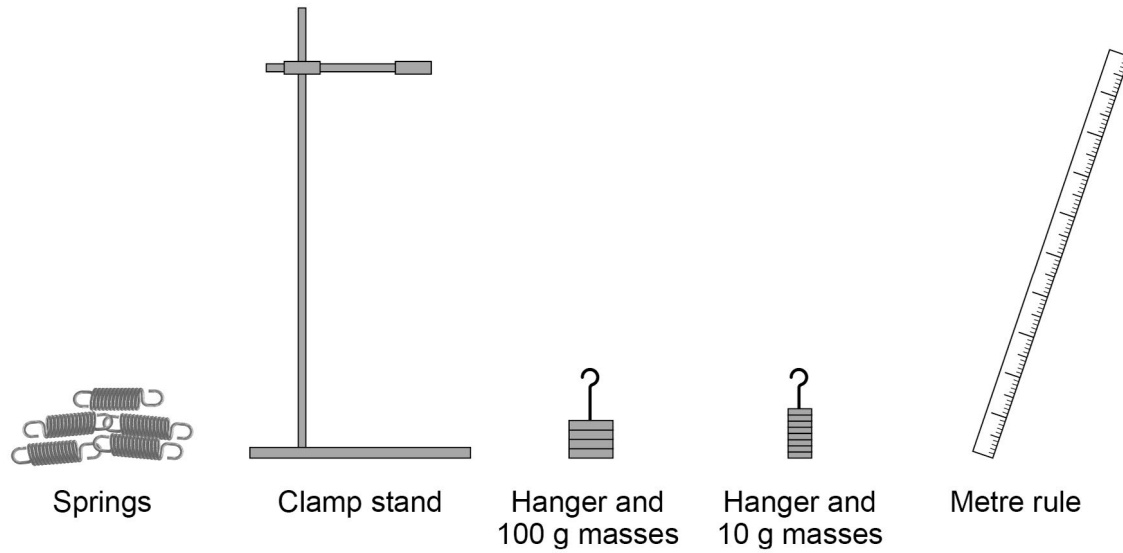
0 2

A student tested some springs to find the limit of proportionality of the springs.

The student had several identical springs.

**Figure 2** shows the equipment used.

**Figure 2**



0 2 . 1

Plan an investigation to determine an accurate value for the limit of proportionality of the springs.

**[6 marks]**

---



---



---



---



---

---

---

---

---

---

---

---

---

---

---

---

---

---

---

**Question 2 continues on the next page**

**Turn over ►**



The student then investigated the spring constant of a spring.

**Table 2** shows the results.

**Table 2**

| Force in newtons | Extension in millimetres |        |        |      |
|------------------|--------------------------|--------|--------|------|
|                  | Test 1                   | Test 2 | Test 3 | Mean |
| 1.0              | 21                       | 20     | 22     | 21   |
| 2.0              | 48                       | 50     | 52     | 50   |
| 3.0              | 78                       | 78     | 81     | 79   |
| 4.0              | 110                      | 115    | X      | 113  |
| 5.0              | 135                      | 134    | 139    | 136  |
| 6.0              | 176                      | 175    | 171    | 174  |

**0 2 . 2** Determine value **X** in **Table 2**.

**[2 marks]**

---



---

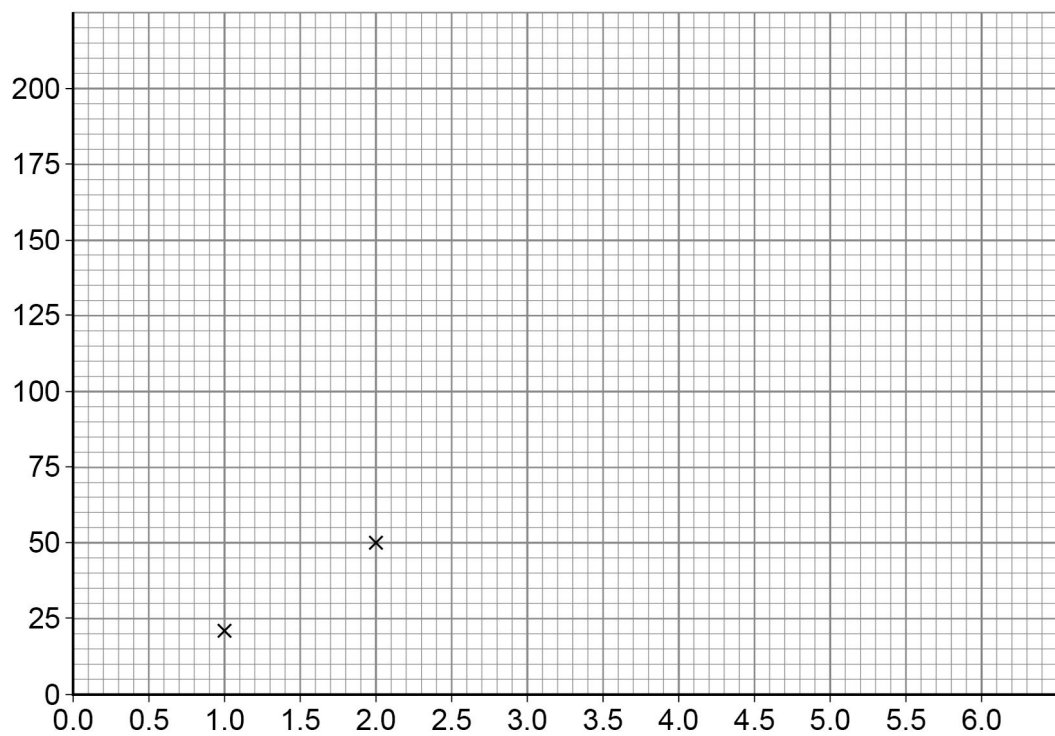


---

Value **X** = \_\_\_\_\_ mm



0 2 . 3

**Figure 3** is an incomplete graph for the data in **Table 2**.**Figure 3**Complete **Figure 3**.

You should:

- label both axes
- plot the data from **Table 2**
- draw the line of best fit for this data.

**[5 marks]****Question 2 continues on the next page****Turn over ►**

|   |   |   |   |
|---|---|---|---|
| 0 | 2 | . | 4 |
|---|---|---|---|

A different spring has an extension of 0.15 m when a force of 120 N is applied to the spring.

Calculate the spring constant of this spring.

Use the Physics Equations Sheet.

**[3 marks]**

---

---

---

---

---

Spring constant = \_\_\_\_\_ N/m

|    |
|----|
| 16 |
|----|



**0 3****Figure 4** shows circuit breakers in a house.**Figure 4**

The house is connected to the mains electricity supply.

**0 3****1**

Mains electricity is an alternating current supply.

What is meant by 'alternating current'?

**[1 mark]**

---

---

**Question 3 continues on the next page**

**Turn over ►**

**0 3 . 2**

The maximum power that the mains can supply to the house is 30 kW.

The maximum current is 125 A.

Calculate the potential difference of the mains supply.

Use the Physics Equations Sheet.

**[3 marks]**

---

---

---

---

---

Potential difference = \_\_\_\_\_ V

**0 3 . 3**

Explain how a circuit breaker acts as a safety device in electrical circuits.

**[2 marks]**

---

---

---

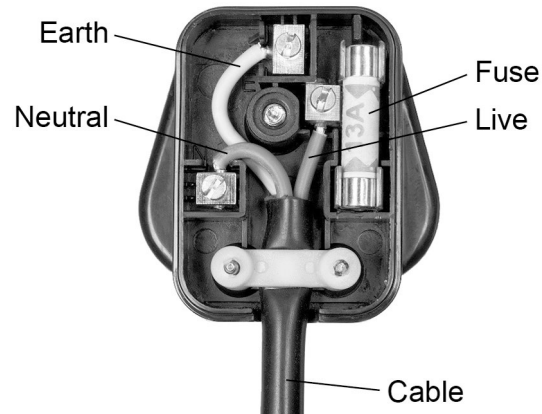
---



**Figure 5** shows how a cable is connected to the inside of a plug.

The plug and cable connect a device to the mains supply.

**Figure 5**



**0 3 . 4** The plug contains a fuse.

What is inside the fuse?

[1 mark]

---



---

**0 3 . 5** What feature in the wiring of the plug in **Figure 5** indicates that the device is **not** double insulated?

[1 mark]

---



---

8

**Turn over for the next question**

**Turn over ►**



|   |   |
|---|---|
| 0 | 4 |
|---|---|

Nuclear power stations use fuel rods.

|   |   |   |   |
|---|---|---|---|
| 0 | 4 | . | 1 |
|---|---|---|---|

The fuel rods contain two isotopes of uranium (U).

**Figure 6** shows how the two isotopes can be represented.

**Figure 6**



Compare the numbers of each type of particle in a nucleus of uranium-235 and a nucleus of uranium-238.

**[2 marks]**

---

---

---

---

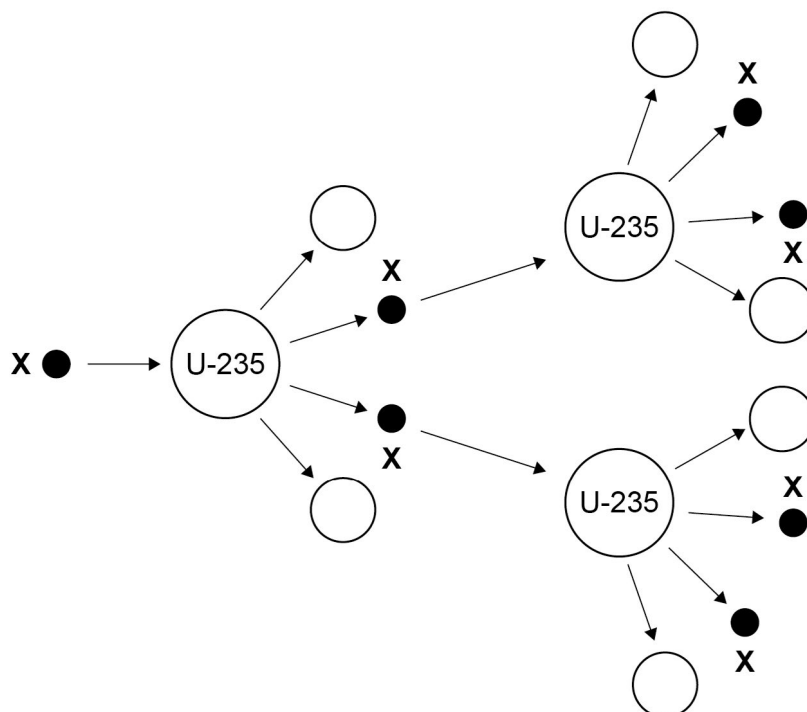


0 4 . 2

The nuclei of uranium-235 in the fuel rod can undergo a chain reaction.

**Figure 7** represents the chain reaction.

**Figure 7**



Describe the chain reaction shown in **Figure 7**.

**[4 marks]**

---

---

---

---

---

---

---

---

**Question 4 continues on the next page**

**Turn over ►**



0 4 . 3

Uranium-238 is radioactive.

When a nucleus of uranium-238 decays it changes into thorium (Th) and releases an alpha particle.

Complete the nuclear decay equation.

[2 marks]



0 4 . 4

The waste material from the nuclear fuel rods is stored underwater for several years.

**Figure 8** shows the waste material stored underwater in a large tank.

**Figure 8**



The waste is very radioactive and some nuclear fission will still happen.

Explain why storing the waste underwater makes it safer.

[3 marks]

---

---

---

---

---

---

---

**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 5**

A student investigated the cooling of some cooking oil.

The cooking oil is a solid at room temperature.

The student heated the oil until it became a liquid.

The student continued to heat the oil to a temperature of 62 °C.

The oil was left to cool.

**0 5****. 1**

Energy was transferred from the liquid oil as it cooled.

The mass of the oil was 150 g.

The initial temperature of the oil was 62 °C.

specific heat capacity of the oil = 1800 J/(kg °C)

Calculate the temperature of the oil when 5400 J of energy had been transferred.

**[4 marks]**


---

---

---

---

---

---

---

Temperature = \_\_\_\_\_ °C

**0 5****. 2**

Describe **one** similarity and **one** difference in the movement of the particles in the hot liquid oil and the cooler liquid oil.

**[2 marks]**

Similarity \_\_\_\_\_

---

Difference \_\_\_\_\_

---

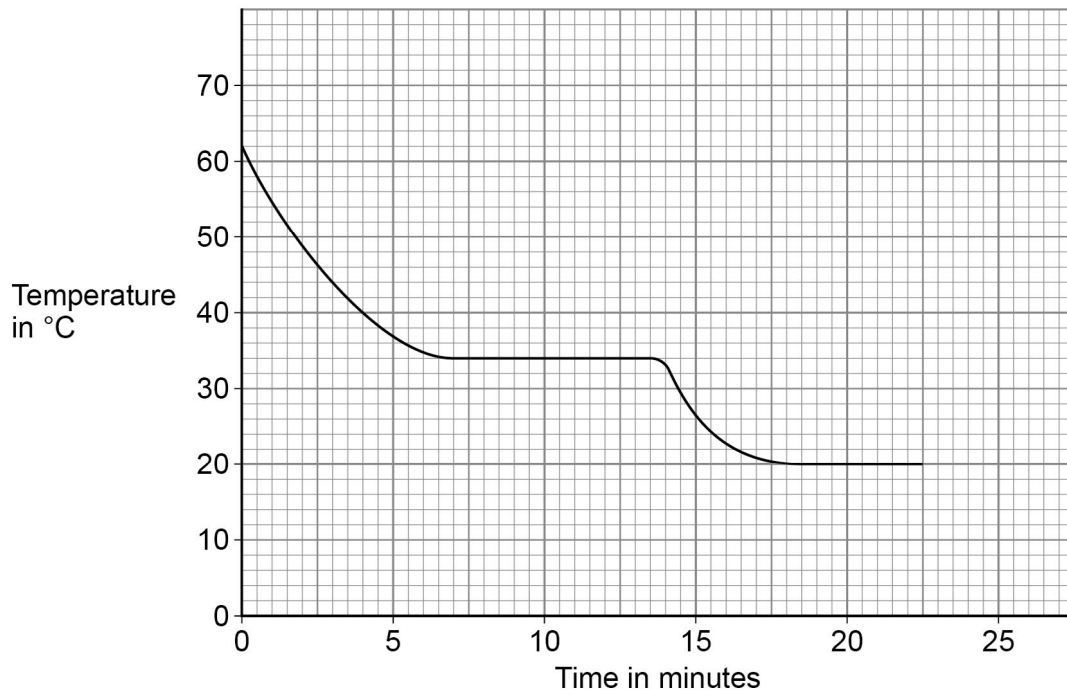


0 5 . 3

The student continued to measure the temperature of the oil as more energy was transferred from it.

**Figure 9** shows the results.

**Figure 9**



Explain the shape of the graph.

**[4 marks]**

---

---

---

---

---

---

---

---

---

10

**Turn over for the next question**

**Turn over ►**



|   |   |
|---|---|
| 0 | 6 |
|---|---|

A student investigated some electrical components.

|   |   |   |   |
|---|---|---|---|
| 0 | 6 | . | 1 |
|---|---|---|---|

Give the names of the devices used to measure current and potential difference.

**[2 marks]**

Current \_\_\_\_\_

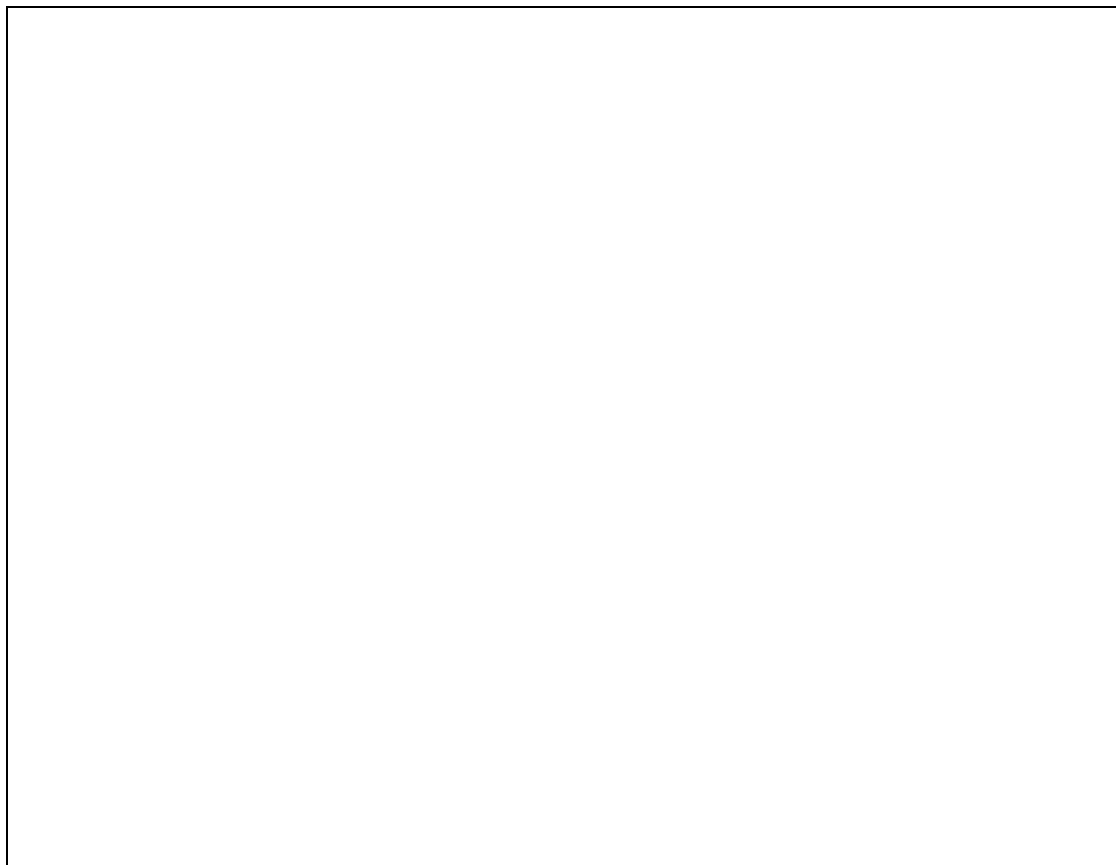
Potential difference \_\_\_\_\_

|   |   |   |   |
|---|---|---|---|
| 0 | 6 | . | 2 |
|---|---|---|---|

The student investigated how current varies with potential difference for a fixed resistor.

Draw a circuit diagram for the circuit that could be used.

**[3 marks]**



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

When the potential difference across the fixed resistor was 3.6 V, the current in the fixed resistor was 0.16 A.

Calculate the resistance of the fixed resistor.

Use the Physics Equations Sheet.

**[3 marks]**

---

---

---

---

---

Resistance = \_\_\_\_\_  $\Omega$

**Question 6 continues on the next page**

**Turn over ►**

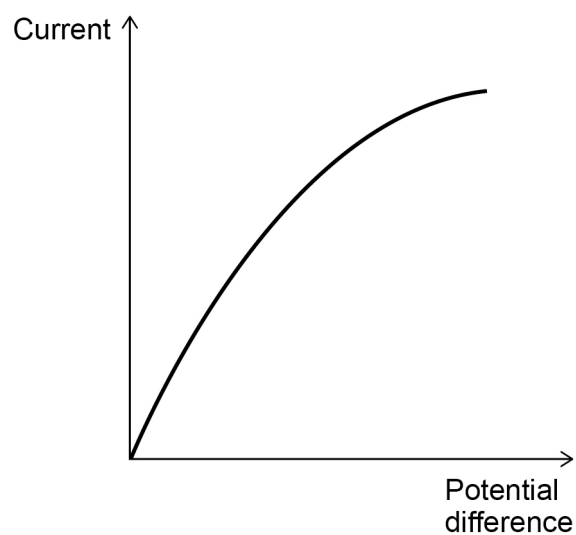


The student then investigated how current varies with potential difference for a filament lamp.

0 6 . 4

**Figure 10** shows the relationship for a filament lamp.

**Figure 10**



Explain the shape of the graph.

**[4 marks]**

---

---

---

---

---

---

---

---

---

|   |   |   |   |
|---|---|---|---|
| 0 | 6 | . | 5 |
|---|---|---|---|

There is a current of 230 mA in the lamp.

Calculate the charge flow in the lamp in a time of 3 minutes.

Give the unit.

Use the Physics Equations Sheet.

**[5 marks]**

---

---

---

---

---

---

---

---

Charge = \_\_\_\_\_ Unit \_\_\_\_\_

|    |
|----|
| 17 |
|----|

**Turn over for the next question**

**Turn over ►**



**0 7**

The Earth orbits the Sun.

**0 7 . 1**

Comets also orbit the Sun.

Which of the following sentences describes a difference between the orbit of a comet and the orbit of the Earth?

**[1 mark]**Tick (✓) **one** box.

The distance travelled by a comet in one orbit is much less.

☐

The force exerted by the Sun on the comet is constant.

☐

The radius of the orbit of a comet varies less.

☐

The speed of a comet varies more in one orbit.

☐**0 7 . 2**

Explain how an object in a circular orbit is accelerating whilst moving at a constant speed.

**[3 marks]**

---

---

---

---

---

---



**0 7 . 3**

The Earth does not orbit the Sun in a perfect circle.

The distance between the Earth and the Sun changes during the orbit.

The maximum distance between the Earth and the Sun is  $1.52 \times 10^{11}$  metres.

The minimum distance between the Earth and the Sun is  $1.47 \times 10^{11}$  metres.

speed of light =  $3.00 \times 10^8$  m/s

Calculate the maximum time taken for light to travel from the Sun to the Earth.

Give your answer to 3 significant figures.

**[4 marks]**

---

---

---

---

---

---

---

Maximum time (3 significant figures) = \_\_\_\_\_ s

**0 7 . 4**

The Sun is a main sequence star.

When the Sun uses up most of its fuel it will expand as far as the Earth.

What type of star will the Sun be at this stage of its life cycle?

**[1 mark]**

---

**Question 7 continues on the next page**

**Turn over ►**

Explain what will happen to this star after leaving the main sequence until the end of its life.

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.

15



**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 | 8 |
|---|---|

**Figure 11** shows a rhinoceros running.

**Figure 11**



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

The initial kinetic energy of the rhinoceros is 72 000 J.

The rhinoceros accelerates for a time of 4.0 s and the kinetic energy increases to 392 000 J.

The rhinoceros has a mass of 4000 kg.

Calculate the acceleration of the rhinoceros.

**[5 marks]**

---

---

---

---

---

---

---

---

---

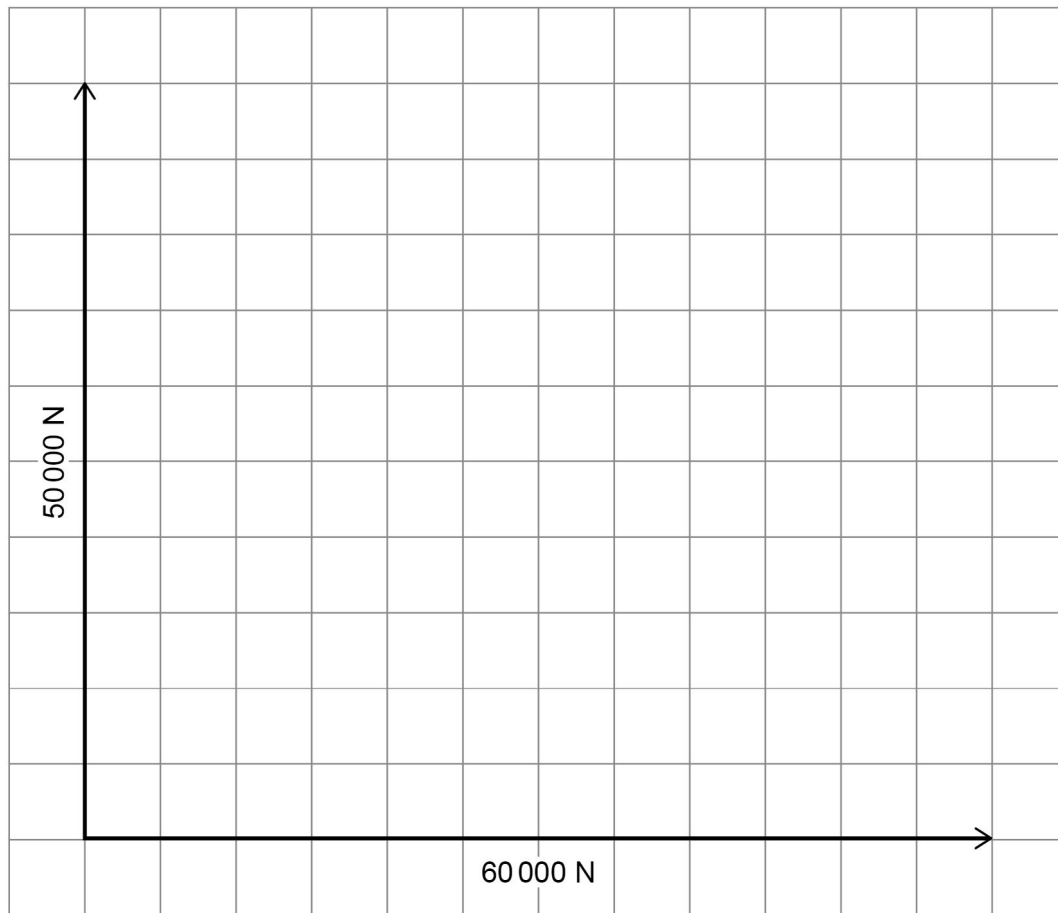
---

Acceleration = \_\_\_\_\_ m/s<sup>2</sup>

0 8 . 2

Figure 12 shows two of the forces acting on the rhinoceros as it started moving.

Figure 12



Determine the resultant of these two forces.

To gain full marks, you must draw an arrow on **Figure 12** to show the resultant force.**[4 marks]**


---



---



---



---



---



---



---



---

Magnitude of force = \_\_\_\_\_ N      Angle (to the horizontal) = \_\_\_\_\_

**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]

