AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
PHYSICS

F

Foundation Tier Paper 1

Wednesday 23 May 2018 Afternoon Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the box at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
TOTAL	

Do not write outside the box

0 1 **Figure 1** shows a cyclist riding along a flat road.

Energy can't be created or destroyed.

Figure 1

0 1 . 1 Complete the sentence.

Choose answers from the box.

stretching or compressing

need vertical displacement

[2 marks]

chemical	elastic potential	gravitational potential	kinetic

As the cyclist accelerates, the chemical energy store in the cyclist's body decreases and the kinetic energy of the cyclist increases.

0 1 . 2 The mass of the cyclist is 80 kg. The speed of the cyclist is 12 m/s.

Calculate the kinetic energy of the cyclist.

Use the equation:

kinetic energy = 0.5 × mass × (speed)^2

[2 marks]

$KE = 0.5 \times 80 \times 12^2 = 5760$

Kinetic energy = 5760 J

Do not write outside the box

0 1 . 3 When the cyclist uses the brakes, the bicycle slows down.

This causes the temperature of the brake pads to increase by 50 °C.
The mass of the brake pads is 0.040 kg.
The specific heat capacity of the material of the brake pads is 480 J/kg °C.

Calculate the change in thermal energy of the brake pads.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

$E = 0.040 \times 480 \times 50 = 960$

Change in thermal energy = 960 J

0 1 . 4 How is the internal energy of the particles in the brake pads affected by the increase in temperature?

Tick **one** box.

increase in thermal energy

[1 mark]

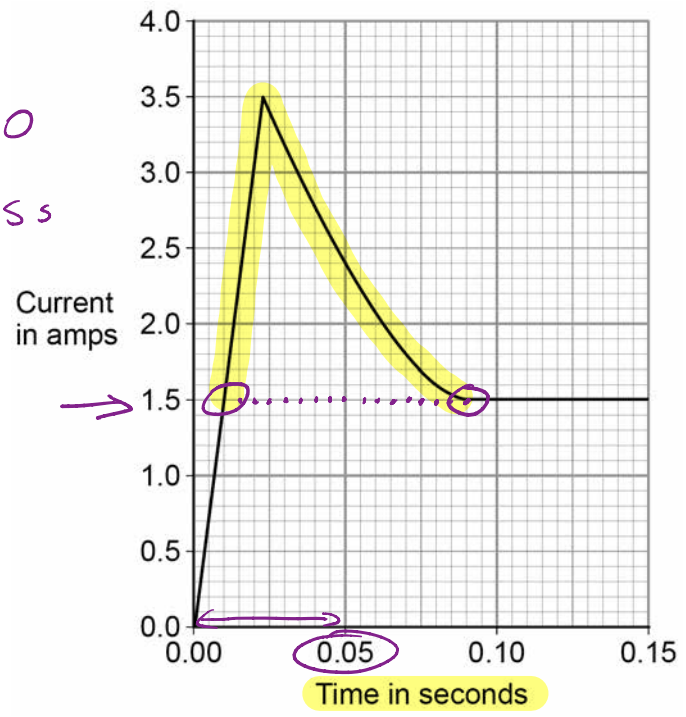
- Decreased ☐
- Increased ☑
- Not affected ☐

7

Do not write outside the box

0 2 **Figure 2** shows how the current through a filament lamp changes after the lamp is switched on.

Figure 2



1 little square = 0.05 ÷ 10 = 0.005 s

16 × 0.005 s = 0.08 s

0 2 . 1 The normal current through the filament lamp is 1.5 A.

For how many seconds is the current through the filament lamp greater than 1.5 A?

Tick **one** box.

[1 mark]

- 0.01 s ☐
- 0.08 s ☑
- 0.09 s ☐
- 0.14 s ☐

Do not write outside the box

0 2 . 2 Why might the filament inside a lamp melt when the lamp is first switched on?

[1 mark]

The current goes above 1.5A.

0 2 . 3 The lamp is connected to a 24 V power supply. The current through the lamp is 1.5 A.

Calculate the power of the lamp.

Use the equation:

power = potential difference × current

[2 marks]

$P = 24 \times 1.5 = 36$

Power = 36 W

0 2 . 4 LED lamps are much more efficient than filament lamps.

What does this statement mean?

Tick **one** box.

[1 mark]

LED lamps have a similar power output to filament lamps. ☐

→ LED lamps waste a smaller proportion of the input energy than filament lamps. ☑

LED lamps have a higher power input than filament lamps. ☐

LED lamps waste a larger proportion of the input energy than filament lamps. ☐

5

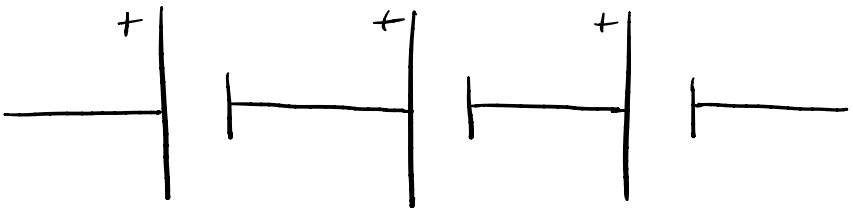
$$\text{Efficiency} = \frac{\text{useful output power}}{\text{total input power}}$$

Do not write outside the box

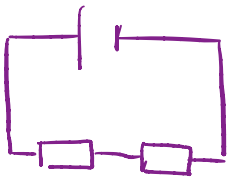
0 3 . 1 Draw a diagram to show how 1.5 V cells should be connected together to give a potential difference of 4.5 V.

Use the correct circuit symbol for a cell.

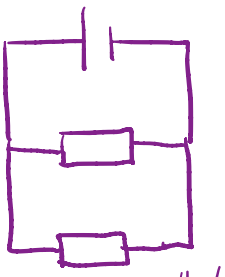
[2 marks]



1.5Ω + 1.5Ω + 1.5Ω = 4.5Ω



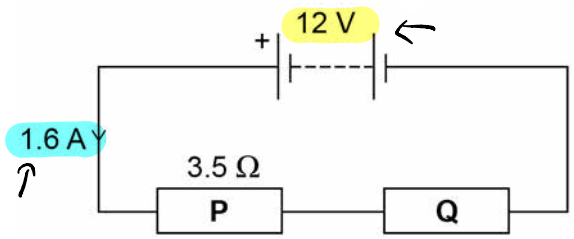
series



parallel

A student built the circuit shown in **Figure 3**.

Figure 3



0 3 . 2 Calculate the total resistance of the circuit in **Figure 3**.

Use the equation:

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

[2 marks]

$R = 12 \div 1.6 = 7.5$

Total resistance = 7.5 Ω

Do not write outside the box

0 3 . 3 The resistance of **P** is 3.5 Ω.

Calculate the resistance of **Q**. ← 2 s.f

[1 mark]

Total R = 7.5 Ω 7.5 − 3.5 = 4.0 Ω

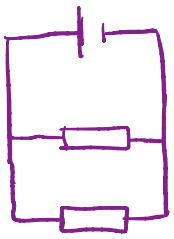
Resistance of **Q** = 4.0 Ω

0 3 . 4 The student connects the two resistors in **Figure 3** in parallel.

What happens to the total resistance of the circuit?

Tick **one** box.

[1 mark]



- It decreases ☑
- It increases ☐
- It does not change ☐

In series

$R_T = R_1 + R_2 + R_3 + \ldots$

In parallel

$R_T < R_{\text{lowest resistor}}$

Give a reason for your answer.

[1 mark]

Total resistance in parallel < resistance of the smallest resistor

7

Turn over for the next question

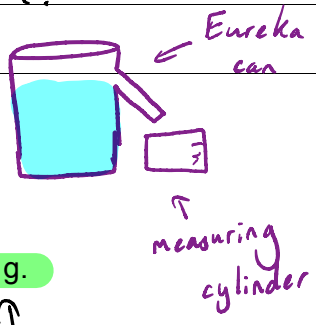
Do not write outside the box

0 4 A student wanted to determine the density of a small piece of rock.

0 4 . 1 Describe how the student could measure the volume of the piece of rock.

[4 marks]

Take a Eureka can and a measuring cylinder. Fill the Eureka can with water to the level of the spout. Gently place the rock in the water. The water level rises and is collected in the measuring cylinder from the spout. The volume of the displaced water (measured with the scale on the measuring cylinder) is equal to the volume of the rock.



0 4 . 2 The volume of the piece of rock was 18.0 cm^3.

The student measured the mass of the piece of rock as 48.6 g.

Calculate the density of the rock in g/cm^3.

3 sf

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

[2 marks]

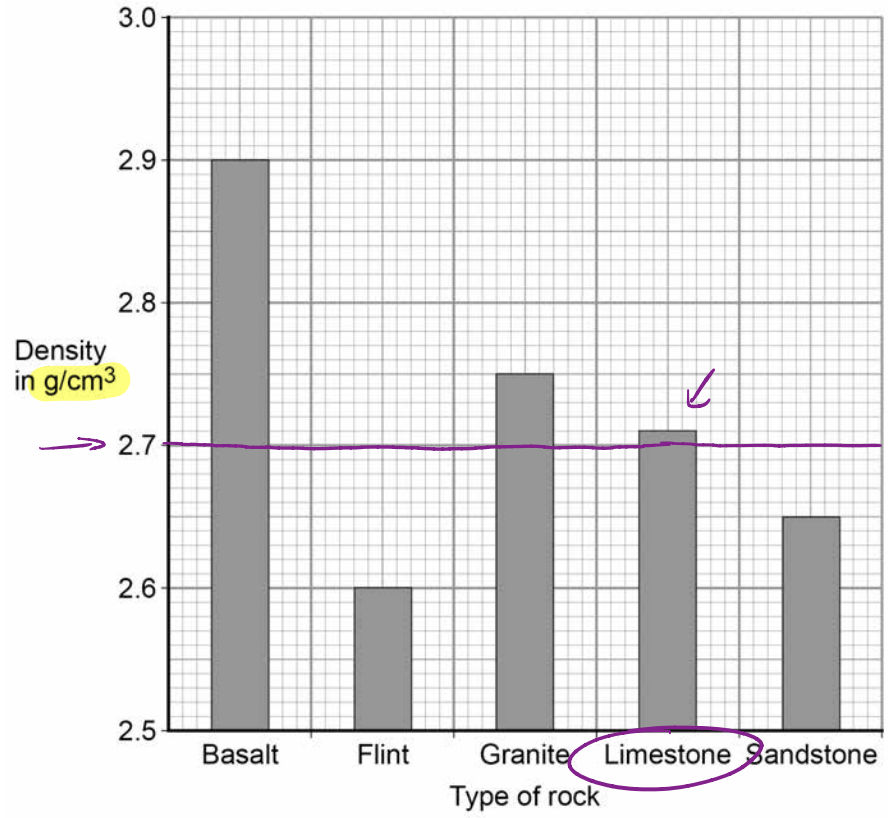
Density = 48.6 ÷ 18.0 = 2.70

Density = 2.70 g/cm^3

Do not write outside the box

Figure 4 shows the densities of different types of rock.

Figure 4



0 4 . 3 What is the most likely type of rock that the student had?

Tick **one** box.

[1 mark]

- Basalt ☐
- Flint ☐
- Granite ☐
- Limestone ☑
- Sandstone ☐

Turn over ►

Do not write outside the box

0 4 . 4 Give **one** source of error that may have occurred when the student measured the volume of the rock.

[1 mark]

Not all the displaced water is collected in the measuring cylinder.

OTHER ANSWERS: • Eye wasn't aligned with scale when measuring.
• Water wasn't level with spout to begin with.

0 4 . 5 How would the error you described in the above part affect the measured volume of the rock?

[1 mark]

Volume would be lower.

Your answer may change based on your previous answer.

9

Same element (same atomic number) but different no. of neutrons (different mass no.)

Do not write outside the box

0 5 Americium-241 ($^{241}_{95}Am$) is an isotope of americium.

0 5 . 1 Which of the isotopes given in **Table 1** is **not** an isotope of americium?

[2 marks]

no. of protons + no. of neutrons

Table 1

no. of protons

Isotope	Mass number	Atomic number
A	243	95
B	243	94
C	242	95

Isotope B

Give a reason for your answer.

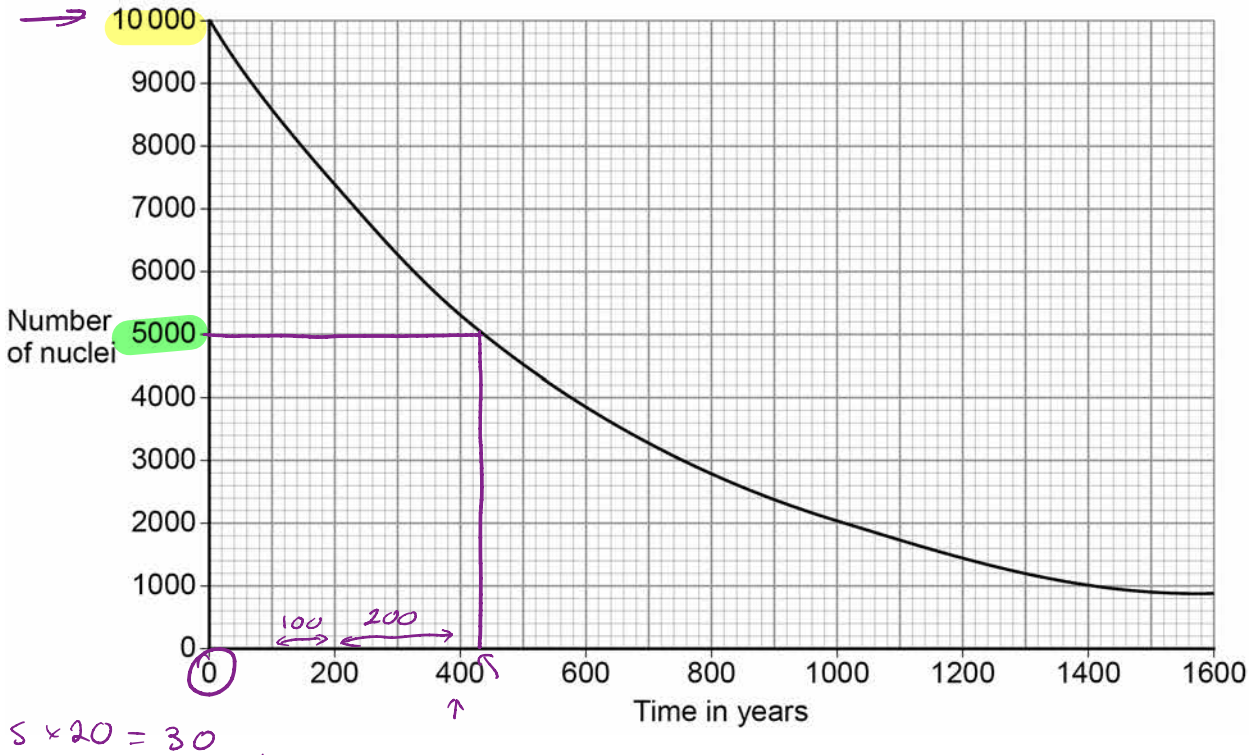
Americium has an atomic number of 95
OR B has an atomic number of 94.
OR B does not have the same atomic number as americium.

Question 5 continues on the next page

Do not write outside the box

Figure 5 shows how the number of americium-241 nuclei in a sample changes with time.

Figure 5



1·5 × 20 = 30

400 + 30 = 430

0 5 . 2 How many years does it take for the number of americium-241 nuclei to decrease from 10 000 to 5000?

[1 mark]

Time = 430 years

0 5 . 3 What is the half-life of americium-241?

[1 mark]

Half-life = 430 years

4

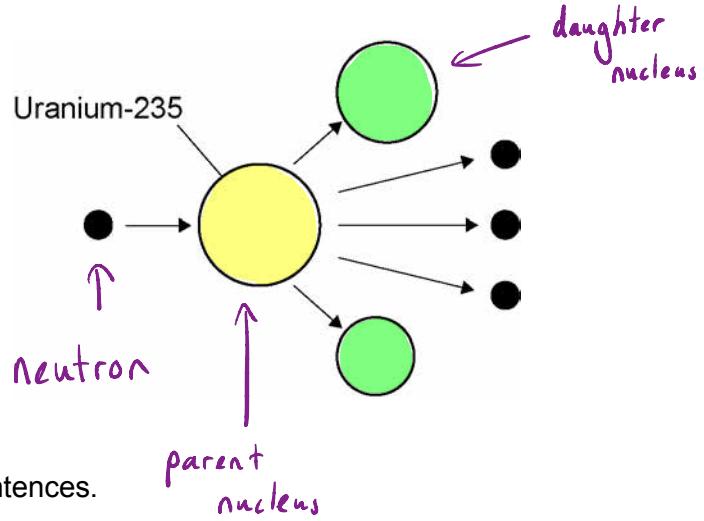
5000 = $\frac{1}{2}$ × 10000

Do not write outside the box

0 6 Nuclear power can be used to generate electricity through nuclear fission.

Figure 6 shows the process of nuclear fission.

Figure 6



0 6 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

gamma rays	light rays	proton	neutron	nucleus	X-rays

During the process of nuclear fission a uranium nucleus

absorbs a neutron .

Electromagnetic radiation is released in the form of gamma rays .

0 6 . 2 The UK needs at least 25 000 000 kW of electrical power at any time.

A nuclear power station has an electrical power output of 2 400 000 kW

Calculate how many nuclear power stations are needed to provide 25 000 000 kW of electrical power.

[2 marks]

$\frac{25000000}{2400000} = \frac{125}{12} = 10.416$

↳ can't have 0.416 power stations so round up

11

Number of nuclear power stations = 11

Turn over ►

Do not write outside the box

0 6 . 3 State **two** environmental issues caused by generating electricity using nuclear power stations.

[2 marks]

1 Waste is radioactive.

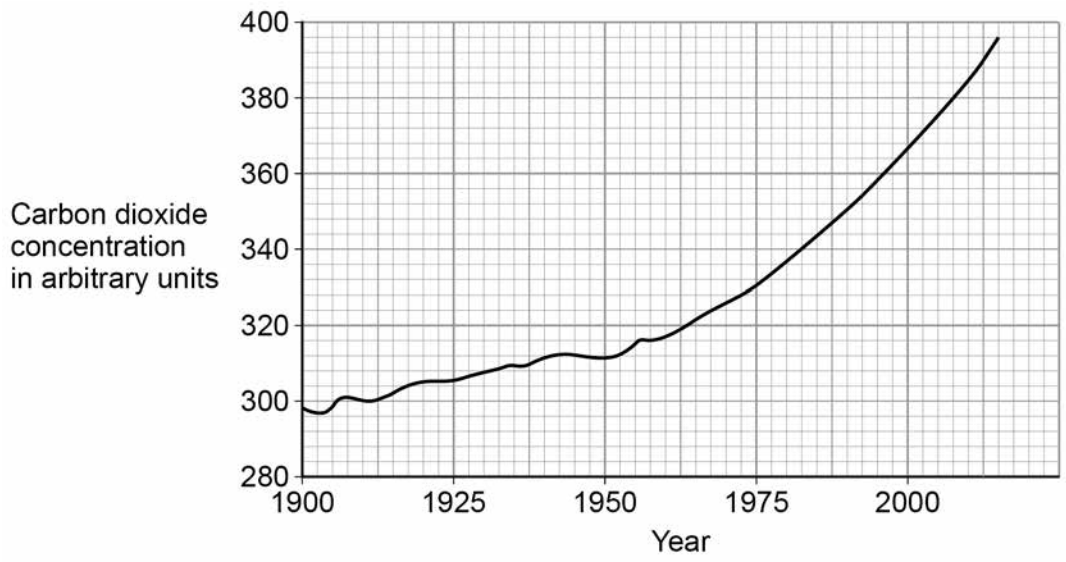
2 Fuel is non-renewable.

OTHER ANSWERS: • waste has a long half-life • risk of catastrophic accidents.
• waste is toxic
• waste must be buried

0 6 . 4 The UK currently generates a lot of electricity by burning natural gas. This proces releases carbon dioxide into the atmosphere.

Figure 7 shows how the concentration of carbon dioxide in the atmosphere ha changed over the past 115 years.

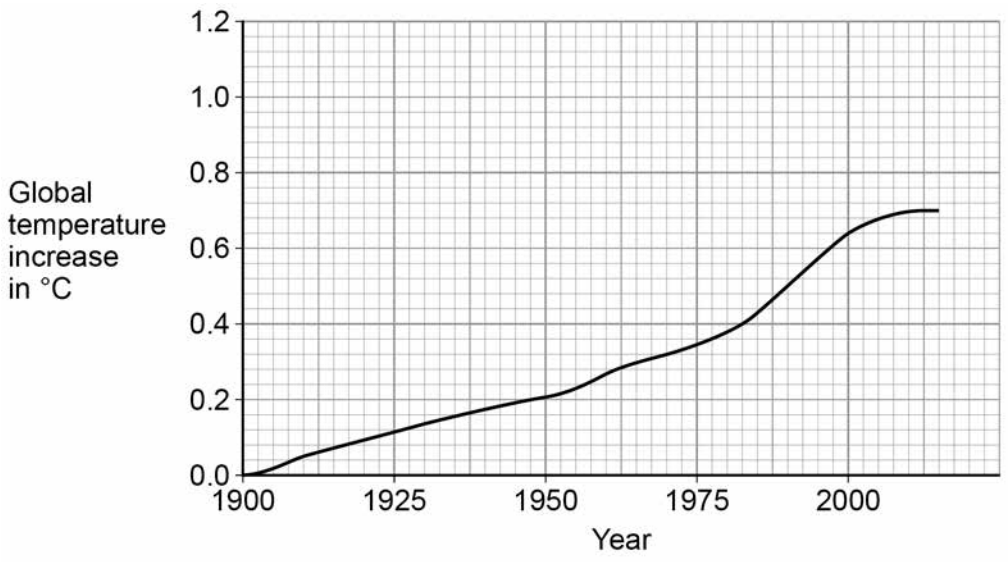
Figure 7



Do not write outside the box

Figure 8 shows how the global temperature has changed over the past 115 years.

Figure 8



Give **one** similarity and **one** difference between the data in **Figure 7** and **Figure 8**.

[2 marks]

Similarity both show a positive correlation.

Difference carbon dioxide concentration continues to increase, whereas temperature increase levels off.

9

Turn over for the next question

Do not write outside the box

0 7 The plug of an electrical appliance contains a fuse.

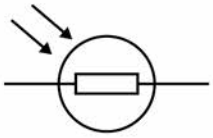
0 7 . 1 What is the correct circuit symbol for a fuse?

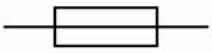
Tick **one** box.

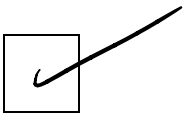
[1 mark]

Safety feature of a circuit designed to 'blow' (break) above a given current.

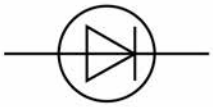
LDR



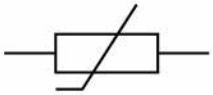




Diode



thermistor



0 7 . 2 The appliance is connected to the mains electrical supply. The mains potential difference is 230 V.

Calculate the energy transferred when 13 C of charge flows through the appliance.

Use the equation:

energy transferred = charge flow × potential difference

[2 marks]

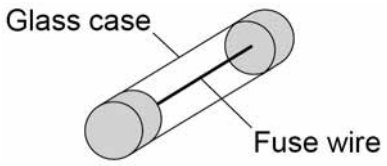
$E = 13 \times 230 = 2990$

Energy transferred = 2990 J

Do not write outside the box

Figure 9 shows the structure of a fuse.

Figure 9



0 7 . 3 Write down the equation that links charge flow, current and time.

[1 mark]

charge flow = current × time

$Q = It$

0 7 . 4 The fuse wire melts when 1.52 coulombs of charge flows through the fuse in 0.40 seconds.

Calculate the current at which the fuse wire melts.

[3 marks]

÷ time ↓ charge flow = current × time ↓ ÷ time

$\frac{\text{charge flow}}{\text{time}} = \text{current}$

$\frac{1.52}{0.40} = 3.8$

Current = 3.8 A

0 7 . 5 The mass of the fuse wire is 0.00175 kg. The specific latent heat of fusion of the fuse wire is 205 000 J/kg.

3 sf

Calculate the energy needed to melt the fuse wire.

Use the Physics Equations Sheet.

↳ energy required to change the state of 1kg of the material without changing the temperature.

[2 marks]

thermal energy for a change of state = mass × specific latent heat

$E = mL = 0.00175 \times 205000 = 358.75$

≈ 359

Energy = 359 J

solid to liquid or ↙ liquid to solid

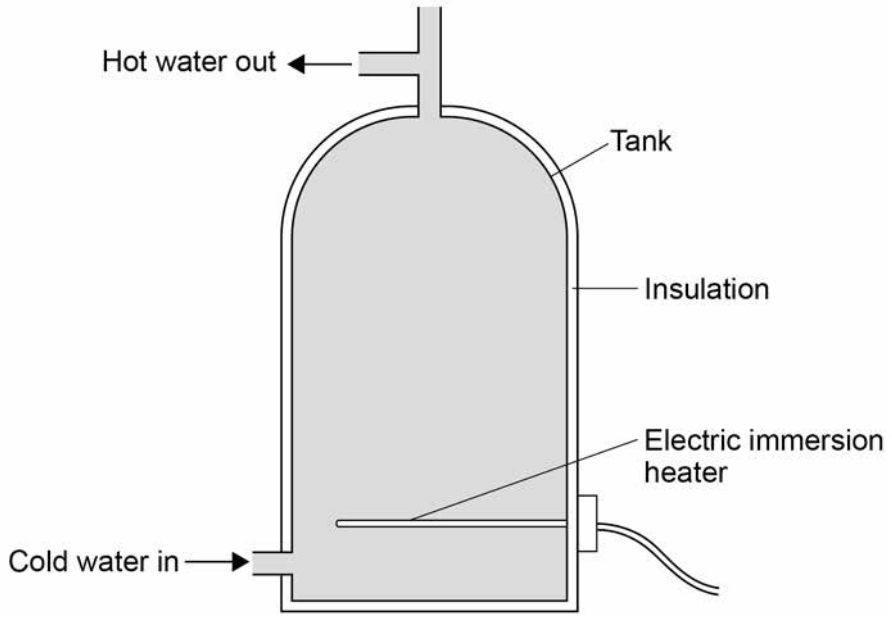
9

Turn over ►

Do not write outside the box

0 8 **Figure 10** shows a hot water tank made of copper.

Figure 10



0 8 . 1 Copper has a higher thermal conductivity than most metals.

How does the rate of energy transfer through copper compare with the rate of energy transfer through most metals?

Tick **one** box.

conducts more energy per second

[1 mark]

- Higher ✓
- Lower
- The same

low thermal conductivity

Do not write outside the box

0 8 . 2 The tank is insulated. When the water is hot, the immersion heater switches off.

Complete the sentences.

[2 marks]

Compared to a tank with no insulation, the rate of energy transfer from the water in an insulated tank is lower .

This means that the water in the insulated tank stays hotter for longer.

Do not write outside the box

Figure 11 shows how temperature varies with time for water in a tank heated with an immersion heater.

Figure 12 shows how temperature varies with time for water in a tank heated with a solar panel.

Figure 11

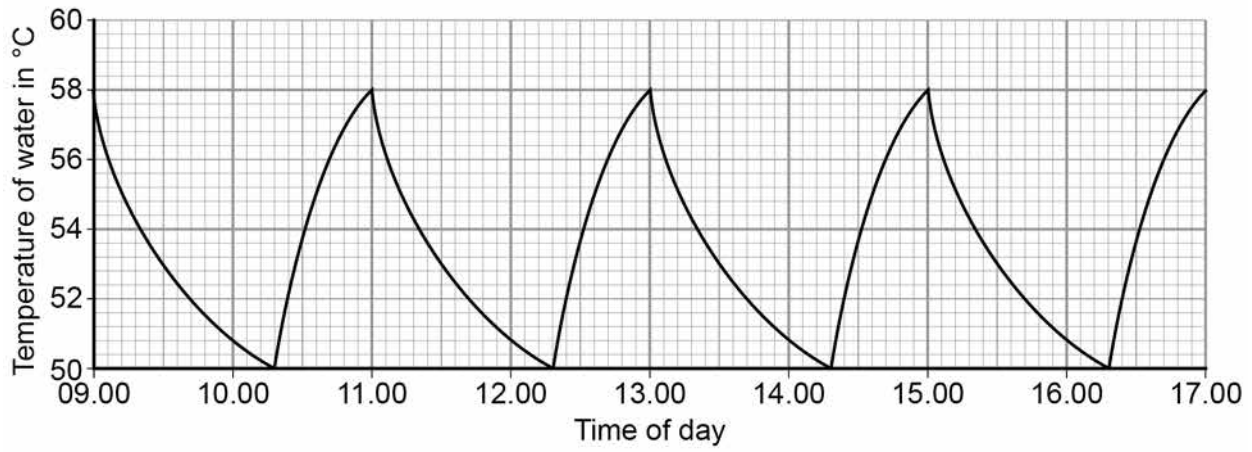
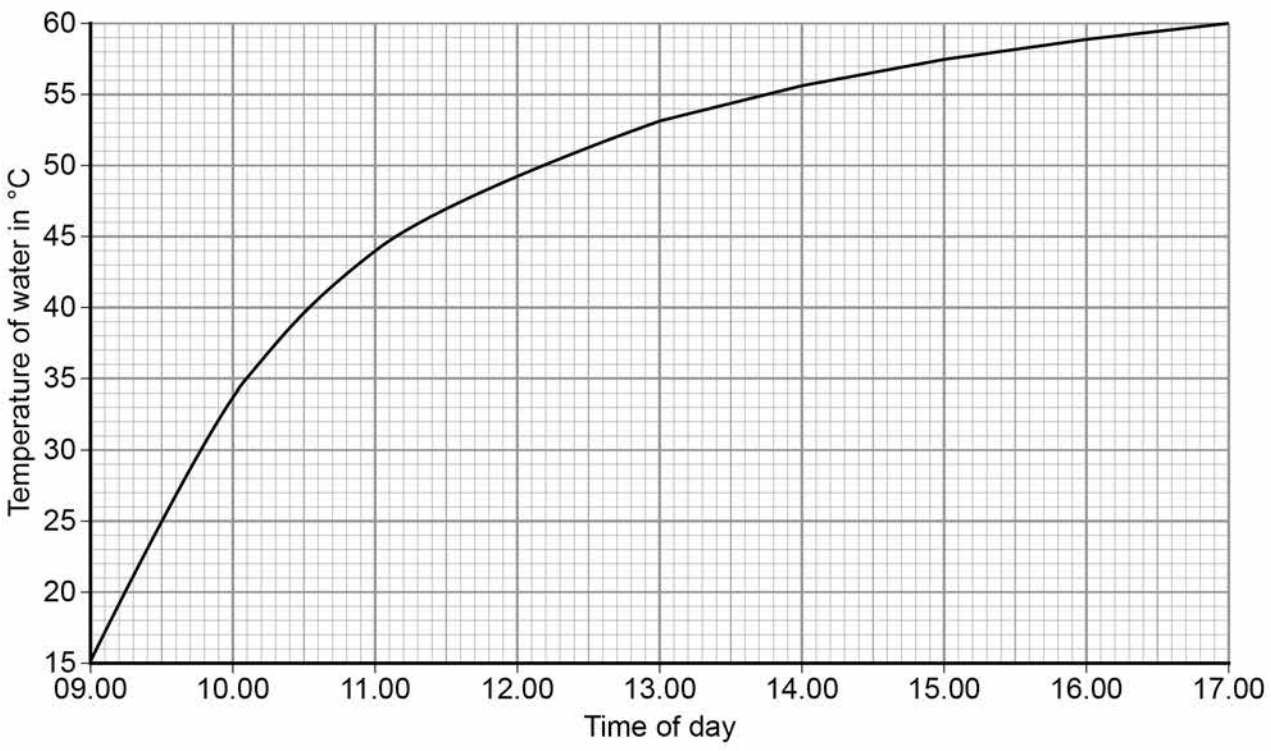


Figure 12



Do not write outside the box

0 8 . 3 Give **one** advantage and **one** disadvantage of heating the water using solar panels rather than an immersion heater.

Use only information from **Figure 11** and **Figure 12**.

[2 marks]

Advantage of solar panels Water is heated continuously.

Disadvantage of solar panels Temperature of the water is lower.

OR water may not be hot enough.

OR it takes more time to heat the water.

0 8 . 4 During one morning, a total of 4 070 000 J of energy is transferred from the electric immersion heater.

4 030 000 J of energy are transferred to the water.

Calculate the proportion of the total energy transferred to the water.

[2 marks]

$\frac{4030000}{4070000} = 0.99017...$

Proportion of total energy = 0.99

99%

Do not write outside the box

0 8 . 5 Write down the equation that links energy transferred, power and time.

[1 mark]

power = energy transferred ÷ time $P = \frac{E}{t}$

0 8 . 6 The power output of the immersion heater is 5000 W.

Calculate the time taken for the immersion heater to transfer 4 070 000 J of energy.

Give the unit.

[4 marks]

power = energy transferred ÷ time

$P = \frac{E}{t}$ ×t ×t

$Pt = E$ ÷P ÷P

$t = \frac{E}{P} = \frac{4070000}{5000} = 814$

Time = 814 Unit seconds

13.57 minutes

12

Do not write outside the box

0 9 **Figure 13** shows a lift inside a building.

Figure 13

0 9 . 1 The motor in the lift does 120 000 J of work in 8.0 seconds.

Calculate the power output of the motor in the lift.

Use the equation:

$$\text{Power output} = \frac{\text{work done}}{\text{time}}$$

[2 marks]

$P = \frac{120000}{8.0} = 15000$

Power output = 15000 W

Turn over ►

Do not write outside the box

0 9 . 2 The power input to the motor is greater than the power output.

Tick **two** reasons why.

[2 marks]

Energy is transferred in heating the surroundings. ☑ this is where the rest of the power input goes

Friction causes energy to be transferred in non-useful ways. ☑

The motor is connected to the mains electricity supply. ☐ ✗

↳ doesn't change power input > power output

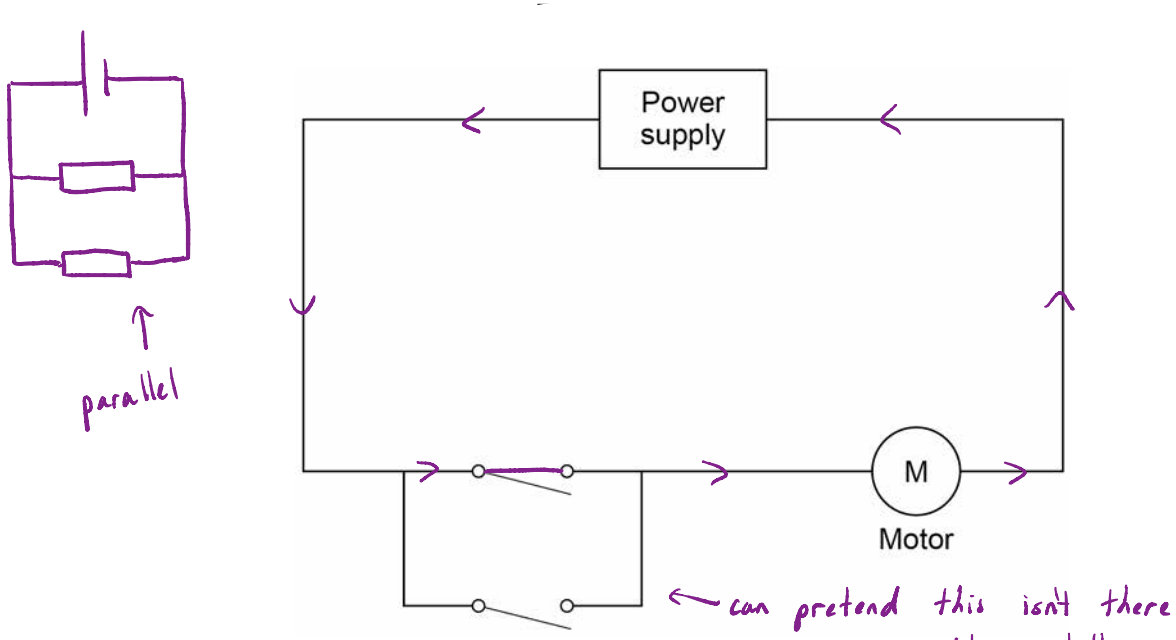
The motor is more than 100% efficient. ☐ ✗

↳ it's less than 100% efficient as power input > power output

There are only four people in the lift. ☐ ✗

↳ no. of people doesn't matter

0 9 . 3 **Figure 14** shows part of the circuit that operates the lift motor.



The lift can be operated using either of the two switches.

Explain why.

[2 marks]

The switches are in parallel, so closing either switch completes the circuit.

Do not write outside the box

0 9 . 4 Write down the equation that links gravitational field strength, gravitational potential energy, height and mass.

[1 mark]

gravitational potential energy = mass × gravitational field strength × height

$E_p = mgh$

0 9 . 5 The lift goes up 14 m. The total mass of the people in the lift is 280 kg.

gravitational field strength = 9.8 N/kg

Calculate the increase in gravitational potential energy of the people in the lift.

Give your answer to 2 significant figures.

[3 marks]

$E_p = mgh = 280 \times 9.8 \times 14 = 38416$

≈ 38000

Increase in gravitational potential energy = 38000 J

10

Turn over for the next question

Do not write outside the box

1 0 **Figure 1** shows a student walking on a carpet.

Figure 1

transfer of e⁻s

1 0 . 1 The student becomes negatively charged because of the friction between his socks and the carpet.

Explain why the friction causes the student to become charged.

[2 marks]

There is a transfer of electrons ✓ from the carpet to the boy ✓

Do not write outside the box

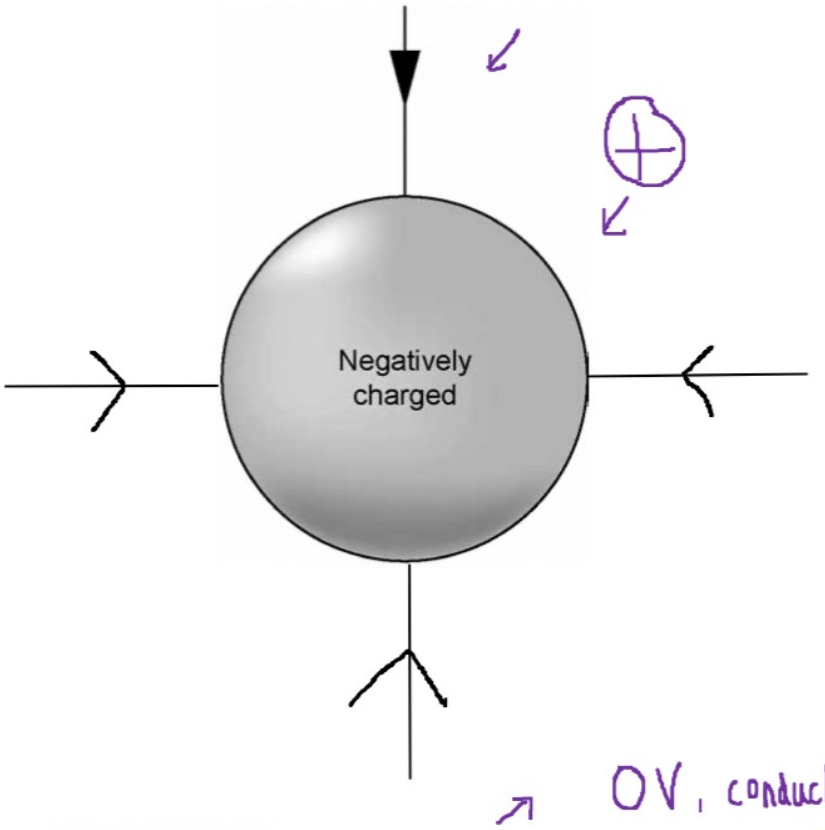
1 0 . 2 The student's head is represented by the sphere in **Figure 2.**

The student is negatively charged. The arrow shows part of the electric field around the student's head.

Draw **three** more arrows on **Figure 2** to complete the electric field pattern.

[1 mark]

Figure 2



1 0 . 3 The negatively charged student touches a metal tap and receives an electric shock.

Explain why.

[3 marks]

There is a potential difference between the student and the tap ✓
This causes a flow of electrons from the student to the tap ✓
This means that the charge has been earthed ✓

Do not write outside the box

1 0 . 4 Some carpets have thin copper wires running through them. The student is less likely to receive an electric shock after walking on this type of carpet.

Suggest why.

[2 marks]

Copper is a good conductor ✓ so electrons flow through the wire instead of the student. Smaller pd between student and carpet ✓ so the student is less likely to recieve an electric shock.

8

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

1 1 A teacher used a Geiger-Muller tube and counter to measure the number of counts in 60 seconds for a radioactive rock.

1 1 . 1 The counter recorded 819 counts in 60 seconds. The background radiation count rate was 0.30 counts per second.

Calculate the count rate for the rock.

counts per second

[3 marks]

$\frac{819}{60}$ ✓ = 13.65 ✓ counts/second

13.65 − 0.3 = 13.35

Count rate = 13.35 ✓ per second

1 1 . 2 A householder is worried about the radiation emitted by the granite worktop in his kitchen.

1 kg of granite has an activity of 1250 Bq. The kitchen worktop has a mass of 180 kg.

Calculate the activity of the kitchen worktop in Bq.

[2 marks]

×180 (1kg → 1250 Bq

180kg → 1250 × 180 ✓ = 225000

Activity = 225,000 ✓ Bq

Do not write outside the box

1 1 . 3 The average total radiation dose per year in the UK is 2.0 millisieverts.

Table 1 shows the effects of radiation dose on the human body.

Table 1

Radiation dose in millisieverts	Effects
10 000	Immediate illness; death within a few weeks
1000	Radiation sickness; unlikely to cause death
100	Lowest dose with evidence of causing cancer

The average radiation dose from the granite worktop is 0.003 millisieverts per day.

Explain why the householder should **not** be concerned about his yearly radiation dose from the granite worktop.

One year is 365 days.

[2 marks]

0.003 x 365 = 1.095 mSv ✓

This value calculated is significantly less than 100 mSv ✓ which is the lowest dose required to cause harm, so the householder does not need to be concerned.

1 1 . 4 Bananas are a source of background radiation. Some people think that the unit of radiation dose should be changed from sieverts to Banana Equivalent Dose.

Suggest **one** reason why the Banana Equivalent Dose may help the public be more aware of radiation risks.

[1 mark]

The banana equivalent dose makes it easier for people to understand radiation risks as the dose can be compared ✓ to an everyday object.

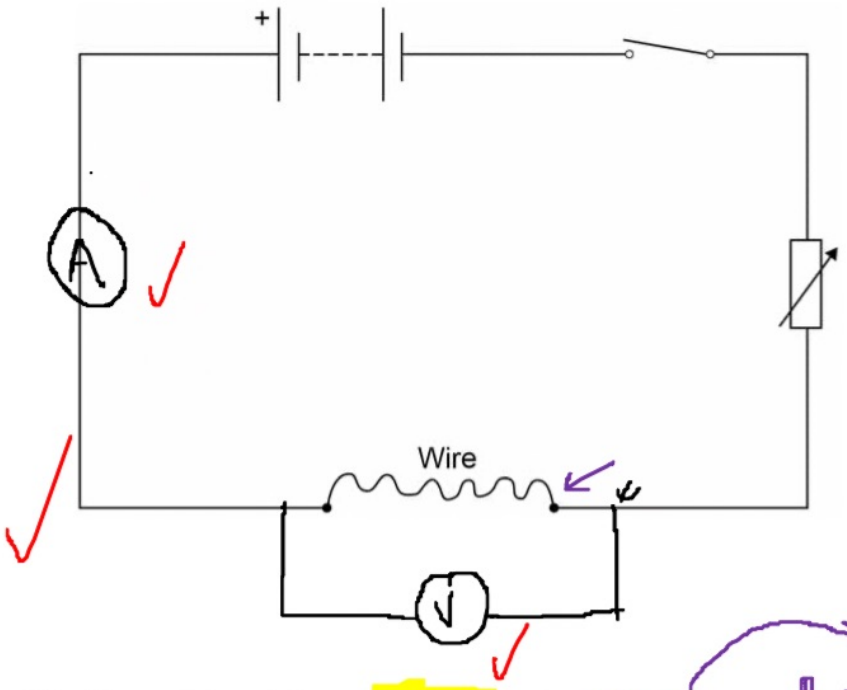
8

Do not write outside the box

1 2 A student investigated how the resistance of a piece of nichrome wire varies with length.

Figure 3 shows part of the circuit that the student used.

Figure 3



1 2 . 1 Complete **Figure 3** by adding an ammeter and a voltmeter.

Use the correct circuit symbols.

[3 marks]

Do not write outside the box

1 2 . 2 Describe how the student would obtain the data needed for the investigation.

Your answer should include a risk assessment for **one** hazard in the investigation.

[6 marks]

resistance (Ω) ↑ dependent

$R = \frac{V}{I}$

length (m) – independent

Use a ruler to measure the length of the wire, then use an ammeter to measure the current through the wire and a voltmeter to measure the potential difference across the wire. Use $R = \frac{V}{I}$ to calculate the resistance for this length.

Vary the length of the wire and repeat. Take multiple voltage and current readings for the length of wire. – plot resistance against length

The wire could heat up if high currents are used this could lead to burns, to avoid this we should use low currents.

for 6/6

all key points identified – written logically

1 2 . 3 Why would switching off the circuit between readings have improved the accuracy of the student's investigation?

Tick **one** box. control variable – temp of wire

[1 mark]

- The charge flow through the wire would not change. ☐
- The potential difference of the battery would not increase. ☐
- The power output of the battery would not increase. ☐
- The temperature of the wire would not change. ☑

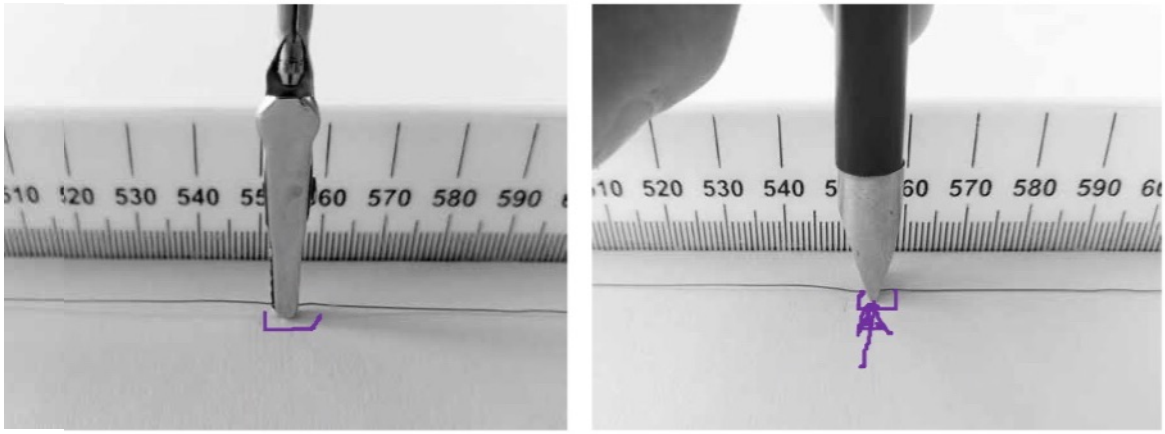
Do not write outside the box

1 2 . 4 The student used crocodile clips to make connections to the wire.

They could have used a piece of equipment called a 'jockey'.

Figure 4 shows a crocodile clip and a jockey in contact with a wire.

Figure 4



Crocodile clip **Jockey**

How would using the jockey have affected the accuracy and resolution of the student's results compared to using the crocodile clip?

how close to the true value

smallest change in length that could be measured

Tick **two** boxes.

[2 marks]

- [x] The accuracy of the student's results would be higher.
- [ ] The accuracy of the student's results would be lower.
- [ ] The accuracy of the student's results would be the same.
- [x] The resolution of the length measurement would be higher.
- [ ] The resolution of the length measurement would be lower.
- [ ] The resolution of the length measurement would be the same.

12

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED