Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE PHYSICS

H

Higher Tier Paper 1

Wednesday 22 May 2019 Afternoon Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- a protractor
- 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 not write outside the box around each page or on blank pages.
- 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	
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6	
7	
8	
9	
10	
11	
TOTAL	

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

0 1 Light bulbs are labelled with a power input.

0 1 . 1 What does power input mean?

[1 mark]

Tick (✓) **one** box.

The charge transferred each second by the bulb. ☐

The current through the bulb. ☐

The energy transferred each second to the bulb. ☐

The potential difference across the bulb. ☐

0 1 . 2 Write down the equation which links current, potential difference and power.

[1 mark]

_____

0 1 . 3 A light bulb has a power input of 40 W

The mains potential difference is 230 V

Calculate the current in the light bulb.

[3 marks]

_____

_____

_____

Current = _____ A

Do not write outside the box

Table 1 shows information about three different light bulbs.

Table 1

Light bulb	Total power input in watts	Useful power output in watts	Efficiency
P	6.0	5.4	0.90
Q	40	2.0	0.05
R	9.0	**X**	0.30

0 1 . 4 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

0 1 . 5 Calculate the value of **X** in **Table 1**.

[3 marks]

X = _____ W

0 1 . 6 In addition to power input, light bulbs should also be labelled with the rate at which they emit visible light.

Suggest why.

[2 marks]

11

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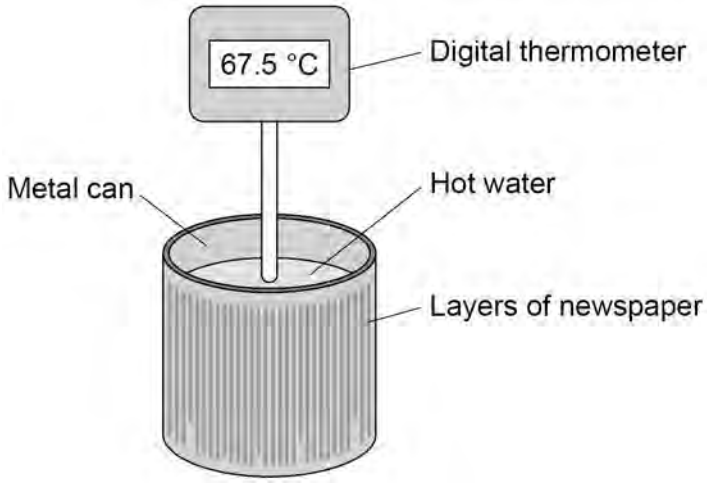
0 2 A student investigated the insulating properties of newspaper.

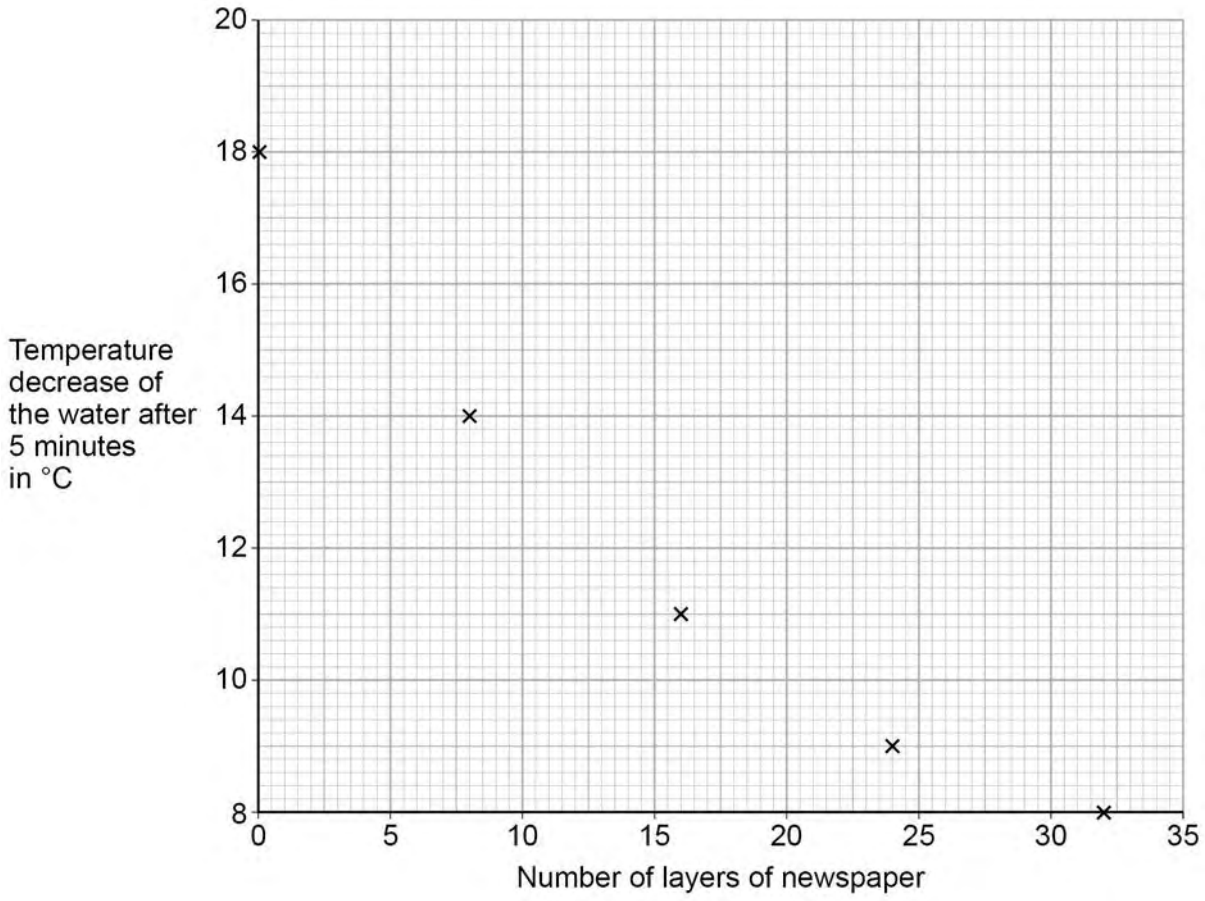
Figure 1 shows the apparatus the student used.

Figure 1



The student's results are shown in **Figure 2**.

Figure 2



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0 2 . 1 Describe a method the student could have used to obtain the results shown in **Figure 2**.

[6 marks]

Question 2 continues on the next page

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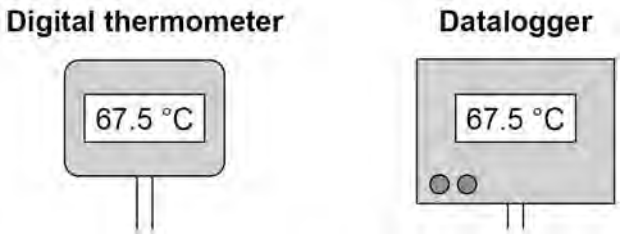
0 2 . 2 The student could have used a datalogger with a temperature probe instead of the digital thermometer.

Figure 3 shows the readings on the digital thermometer and the datalogger.

Figure 3



The datalogger records 10 readings every second.

The student considered using a temperature probe and datalogger.

Explain why it was **not** necessary to use a temperature probe and datalogger for this investigation.

[2 marks]

8

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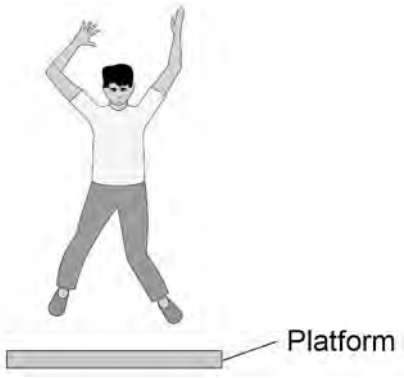
0 3 A scientist investigated how the maximum muscle power of humans varies with age and gender.

The scientist asked volunteers to stand on a platform and to jump as high as they could.

Figure 4 shows a volunteer taking part in the experiment.

Figure 4



An electronic timer measured the time that the volunteer was in the air.

0 3 . 1 The muscle power in watts per kg is calculated using the following equation:

$$\text{muscle power} = \frac{9.8 \times \text{jump height}}{\text{time}}$$

One volunteer has a muscle power of 41 W/kg

He was in the air for 0.12 s

Calculate his jump height.

[3 marks]

Jump height = _____ m

Do not write outside the box

0 3 . 2 Write down the equation which links kinetic energy, mass and speed.

[1 mark]

0 3 . 3 One volunteer had a kinetic energy of 270 J and a speed of 3.0 m/s at the moment he left the ground.

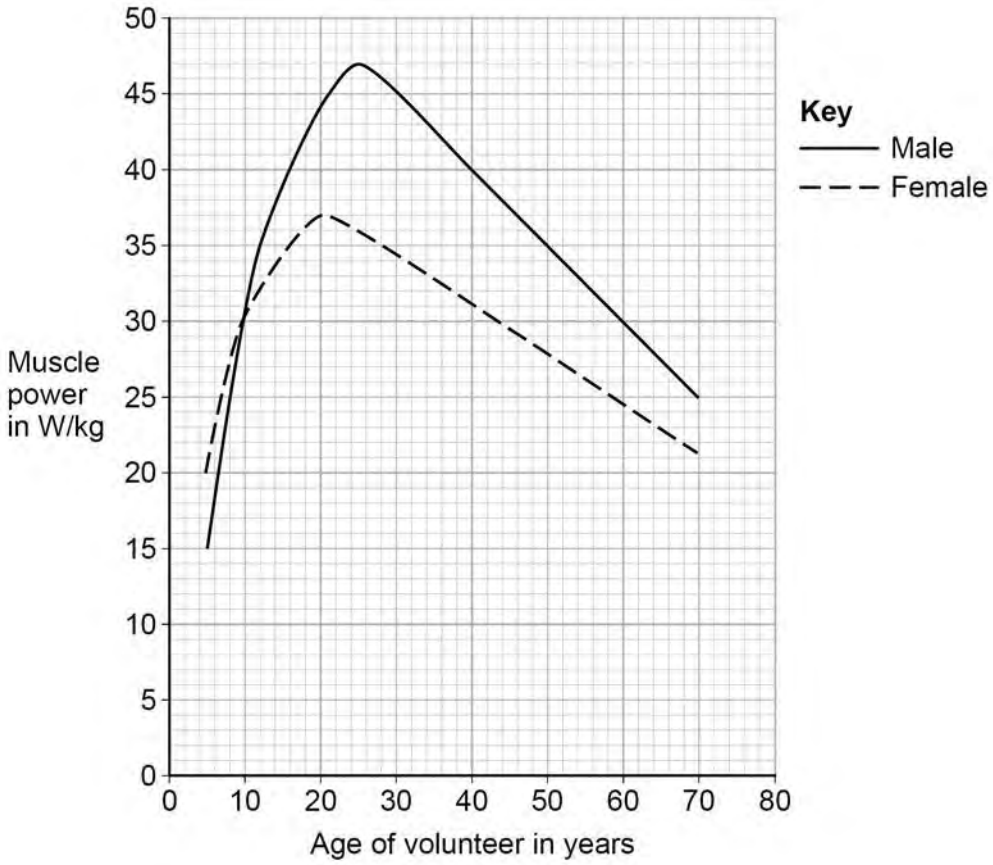
Calculate his mass.

[3 marks]

Mass = _____ kg

Figure 5 shows the scientist's results.

Figure 5



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0 3 . 4 Compare the muscle power of males with the muscle power of females.

Use data from **Figure 5** in your answer.

[4 marks]

0 3 . 5 The muscle power of each volunteer was measured five times.

The highest muscle power reading was recorded instead of calculating an average.

Suggest **one** reason why.

[1 mark]

12

Turn over for the next question

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0 4 Electric cars have motors that are powered by a battery.

Diesel cars have engines that are powered by diesel fuel.

Table 2 compares one type of electric car with one type of diesel car.

Table 2

Power source	Energy density in MJ / kg	Mass of power source in kg	Total mass of car in kg	Time to recharge battery or refill fuel tank in minutes
Battery	0.95	280	1600	40
Diesel fuel	45	51	1500	3

0 4 . 1 The electric car has a range of 400 km with a fully charged battery.

The diesel car has a range of 1120 km with a full tank of diesel.

Explain the difference in the time needed to complete a 500 km journey using the electric car compared with the diesel car.

Assume both cars travel at the same speed.

[2 marks]

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0 4 . 2 Energy density is the amount of energy stored per kilogram of the energy source.

Show why the diesel car has a greater range than the electric car.

Use data from **Table 2**.

Assume the efficiency of the two cars is the same.

Include calculations in your answer.

[3 marks]

Question 4 continues on the next page

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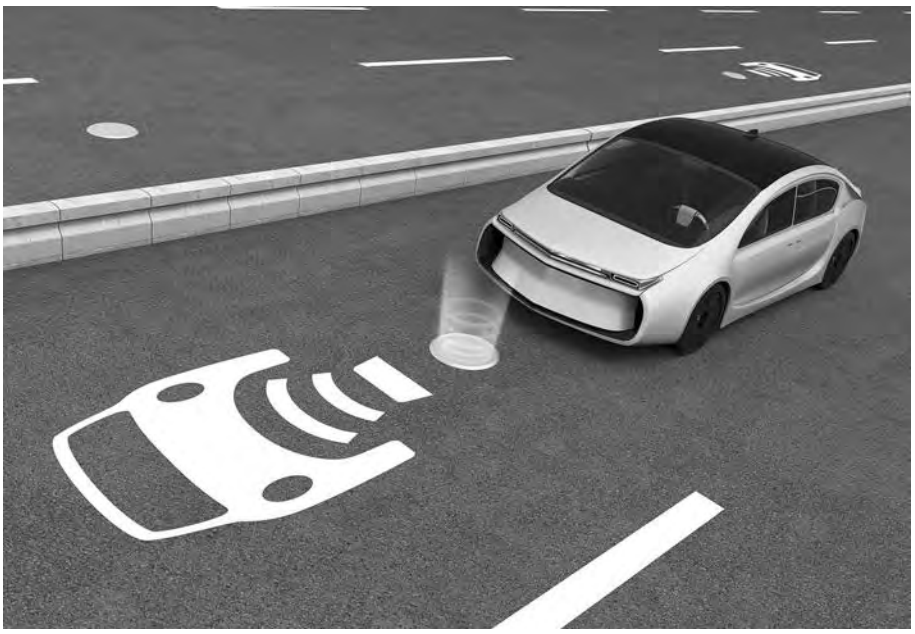
Engineers have developed a way of charging electric cars while they are driving along the road.

Coils of wire buried under the road transfer energy to the car's battery as the car is passing over the coils.

Figure 6 shows a charging lane on a motorway.

Figure 6



0 4 . 3 Suggest **two** advantages of using this method to charge electric cars compared with plugging them into the mains electricity supply.

[2 marks]

1 _____

_____

_____

_____

2 _____

_____

_____

_____

Do not write outside the box

0 4 . 4 When electric cars are not being driven, energy stored in their batteries could be used to meet sudden peaks in electricity demand.

Suggest how.

[2 marks]

9

Turn over for the next question

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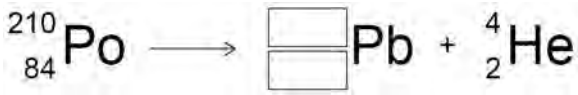
0 5 Polonium-210 $\left({}^{210}_{84}\mathrm{Po}\right)$ is a radioactive isotope that decays by emitting alpha radiation.

0 5 . 1 Complete the decay equation for polonium-210

[2 marks]



0 5 . 2 Explain why contamination of the inside of the human body by a radioactive material that emits alpha radiation is highly dangerous.

[3 marks]

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0 5 . 3 A sample of polonium-210 was left for 414 days.

After this time it had a mass of 1.45×10^{-4} g

The half-life of polonium-210 is 138 days.

Calculate the initial mass of the sample.

[3 marks]

Initial mass = _____ g

8

Turn over for the next question

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0 6 **Figure 7** shows a person using an electric lawn mower.

Figure 7

0 6 . 1 The lawn mower is connected to the mains electricity supply.

What is the frequency of the mains electricity supply in the UK?

[2 marks]

Frequency = _____ Unit _____

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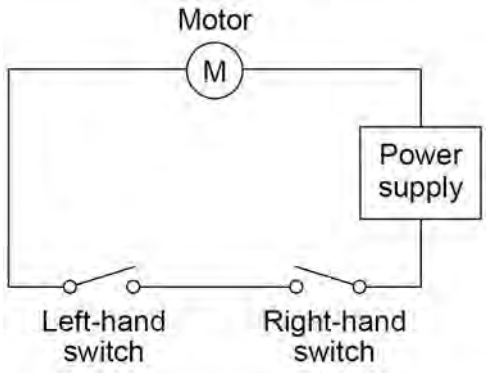
The lawn mower has a switch on each side of the handle.

Figure 8 shows the circuit diagram for the lawn mower.

Figure 8



0 6 . 2 The motor in the lawn mower can only be turned on when the person using it holds the handle of the lawn mower with both hands.

Explain why.

[2 marks]

0 6 . 3 The power input to the motor is 1.8 kW

The resistance of the motor is 32 Ω

Calculate the current in the motor.

[3 marks]

Current = _____ A

Turn over ►

Do not write outside the box

0 6 . 4 The useful power output from the motor is 1.5 kW

Calculate the time it takes for the motor to transfer 450 000 J of useful energy.

[3 marks]

Time = _____ seconds

10

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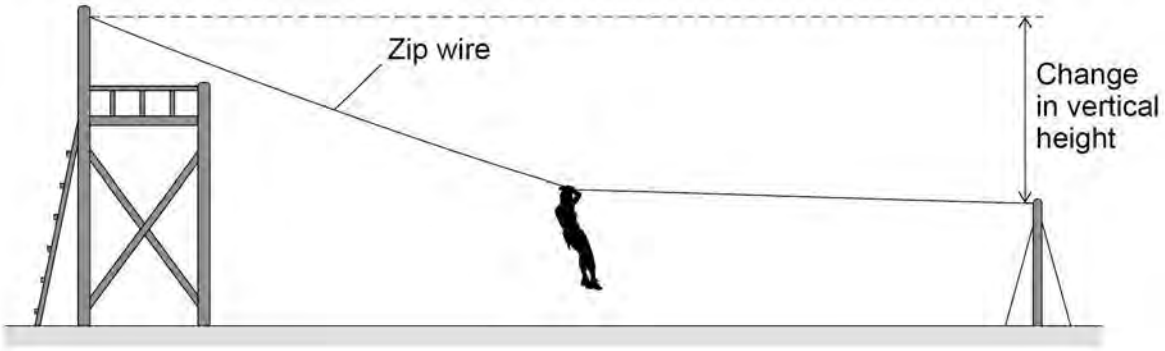
0 7 **Figure 9** shows a person sliding down a zip wire.

Figure 9



0 7 . 1 As the person slides down the zip wire, the change in the gravitational potential energy of the person is 1.47 kJ

The mass of the person is 60 kg

gravitational field strength = 9.8 N/kg

Calculate the change in vertical height of the person.

[3 marks]

Change in vertical height = _____ m

Do not write outside the box

0 7 . 2 As the person moves down the zip wire her increase in kinetic energy is less than her decrease in gravitational potential energy.

Explain why.

[2 marks]

0 7 . 3 Different people have different speeds at the end of the zip wire.

Explain why.

[2 marks]

7

Turn over for the next question

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0 8 A student investigated the thermal conductivity of different metals.

This is the method used:

1. Measure the mass of an ice cube.
2. Put the ice cube on a metal block which is at room temperature.
3. Measure the mass of the ice cube after one minute.
4. Repeat with other blocks of the same mass made from different metals.

Figure 10

Table 3 shows the student's results.

Table 3

Metal	Initial mass of ice cube in grams	Final mass of ice cube in grams	Change in mass of ice cube in grams
Aluminium	25.85	21.14	4.71
Copper	26.20	20.27	5.93
Lead	25.53	21.97	3.56
Steel	24.95	19.45	5.50

Do not write outside the box

0 8 . 1 The initial temperature of each ice cube was –15 °C

Why was it important that the initial temperature of each ice cube was the same?

[1 mark]

Tick (✓) **one** box.

Initial temperature was a continuous variable. ☐

Initial temperature was a control variable. ☐

Initial temperature was the dependent variable. ☐

Initial temperature was the independent variable. ☐

0 8 . 2 Which metal had the highest thermal conductivity?

Give a reason for your answer.

[2 marks]

Metal: _____

Reason: _____

_____

_____

0 8 . 3 Suggest **one** source of random error in the student's investigation.

[1 mark]

_____

_____

_____

_____

Do not write outside the box

0 8 . 4 An ice cube has a temperature of –15.0 °C

The total thermal energy needed to raise the temperature of this ice cube to 0.0 °C and completely melt the ice cube is 5848 J

specific heat capacity of ice = 2100 J/kg °C
specific latent heat of fusion of ice = 334 000 J/kg

Calculate the mass of the ice cube.

[5 marks]

Mass of ice cube = _____ kg

9

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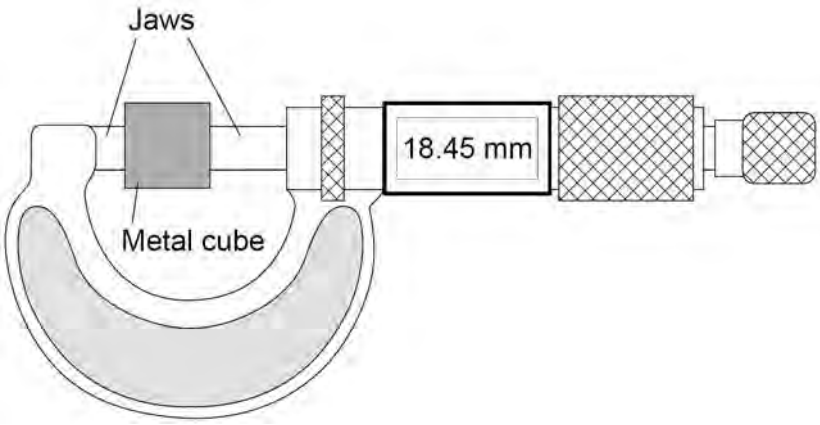
0 9 A student measured the width of a solid metal cube using a digital micrometer.

Figure 11 shows the micrometer.

Figure 11



0 9 . 1 The resolution of the micrometer is 0.01 mm

The student could have used a metre rule to measure the width of the cube.

Explain how using a metre rule would have affected the accuracy of the student's measurement of width.

[2 marks]

Question 9 continues on the next page

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0 9 . 2 The mass of the metal cube was measured using a top pan balance.

The balance had a zero error.

Explain how the zero error may be corrected after readings had been taken from the balance.

[2 marks]

0 9 . 3 The width of the cube was 18.45 mm. The density of the cube was 8.0×10^3 kg/m^3

Calculate the mass of the cube.

[5 marks]

Mass = _____ kg

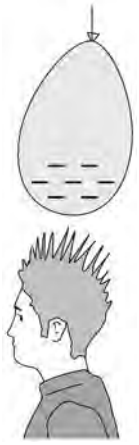
9

Do not write outside the box

1 0 **Figure 12** shows a student after rubbing a balloon on his hair.

The balloon and hair have become charged.

Figure 12



1 0 . 1 Describe the force that acts on the student's hair in **Figure 12**.

[2 marks]

1 0 . 2 An earthed conductor was brought near the charged student.
A spark jumped between the conductor and the student.

The potential difference between the conductor and the student was 2.5 kV
The energy transferred by the spark was 0.0050 J

Calculate the charge transferred by the spark.

[3 marks]

Charge = _____ C

Turn over ►

Do not write outside the box

1 0 . 3 A defibrillator can transfer a charge to regulate a person's heartbeat.

Figure 13 shows a defibrillator.

Figure 13

When the defibrillator is in use, a potential difference of 4800 V is applied across the person's chest.

A charge of 0.16 coulombs passes through the person's chest in 4.0 ms

Calculate the resistance of the person's chest.

[5 marks]

Resistance = _____ Ω

10

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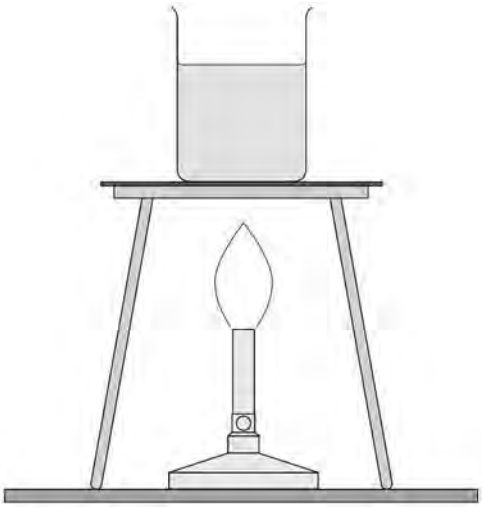
1 1 **Figure 14** shows a Bunsen burner heating some water in a beaker. Eventually the water changes into steam.

Figure 14



1 1 . 1 Explain how the internal energy of the water changes as it is heated from 20 °C to 25 °C

[2 marks]

1 1 . 2 How is the particle model used to explain the difference in density between a liquid and a gas?

[1 mark]

Tick (✓) **one** box.

Particles in a gas have less kinetic energy than particles in a liquid. ☐

Particles in a gas have more potential energy than particles in a liquid. ☐

Particles in a liquid are further apart than particles in a gas. ☐

Particles in a liquid are larger than particles in a gas. ☐

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1 1 . 3 A student measured the mass of boiling water that was turned into steam in five minutes.

Explain how the student could use this information to estimate the power output of the Bunsen burner in watts.

[4 marks]

7

END OF QUESTIONS

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