Please write clearly in block capitals.

Centre number						Candidate number				

Surname ______________________

Forename(s) ______________________

Candidate signature ______________________

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Physics Paper 2F

Friday 14 June 2019 Morning Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a protractor
- a ruler
- 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 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 70.
- 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	
TOTAL	

0 1 Magnetic force is a non-contact force.

0 1 . 1 Which **two** of these are also non-contact forces?

[2 marks]

Tick (✓) **two** boxes.

Air resistance ☐

Electrostatic ☐

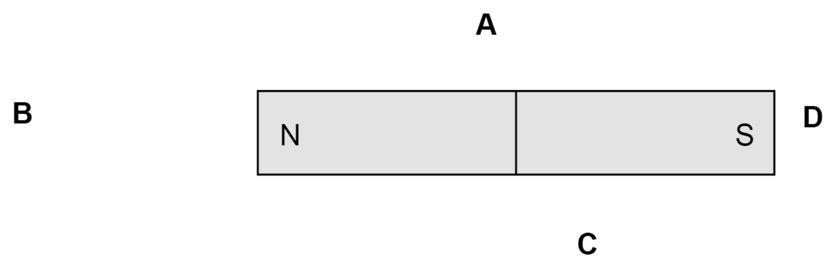
Friction ☐

Gravitational ☐

Tension ☐

0 1 . 2 **Figure 1** shows a bar magnet.

Figure 1



Which letter shows the position where the magnetic field around the bar magnet is strongest?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Do not write outside the box

0 1 . 3 When two magnets are brought close to each other they exert a force on each other.

Describe how two bar magnets can be used to demonstrate a force of attraction and a force of repulsion.

[2 marks]

Force of attraction ____

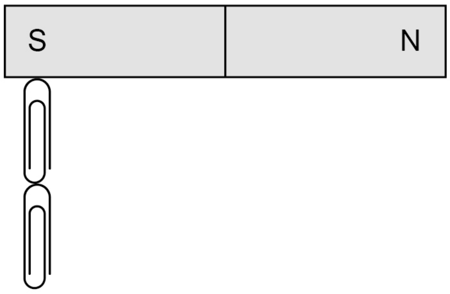
____

Force of repulsion ____

____

Figure 2 shows some paper clips that are attracted to a permanent magnet.

Figure 2



0 1 . 4 The paperclips become magnetised when they are close to the permanent magnet.

What is the name of this type of magnetism?

[1 mark]

Tick (✓) **one** box.

Forced magnetism ☐

Induced magnetism ☐

Strong magnetism ☐

0 1 . 5 Label the north and south poles of the two magnetised paper clips in **Figure 2**.

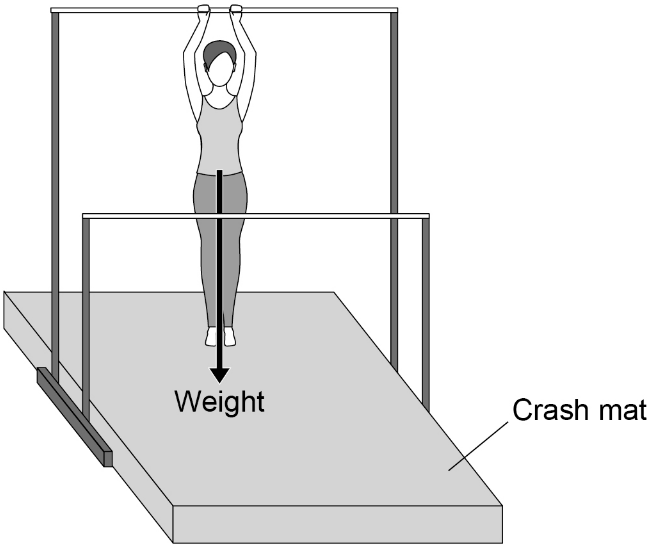
[2 marks]

8

0 2 **Figure 3** shows a gymnast on a piece of gymnastic equipment.

The equipment consists of two bars at different heights.

Figure 3



0 2 . 1 The gymnast exerts a downward force on the bar.

What is the size of the upward force acting on the gymnast from the bar?

[1 mark]

Tick (✓) **one** box.

It is greater than the downward force. ☐

It is less than the downward force. ☐

It is the same size as the downward force. ☐

Do not write outside the box

0 2 . 2 Why is the weight of the gymnast represented by an arrow?

[1 mark]

Tick (✓) **one** box.

Weight is a constant. ☐

Weight is a scalar. ☐

Weight is a unit. ☐

Weight is a vector. ☐

0 2 . 3 **Figure 3** shows the weight of the gymnast acting from a point.

What name is given to this point?

[1 mark]

Tick (✓) **one** box.

Centre of force ☐

Centre of mass ☐

Centre of tension ☐

Centre of weight ☐

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 The gymnast has a mass of 45 kg

gravitational field strength = 9.8 N/kg

Calculate the weight of the gymnast.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = ____________________ N

0 2 . 5 The gymnast swings from one bar to the other bar several times.

Describe how the gravitational potential energy store and the kinetic energy store of the gymnast change as she moves between the bars.

[4 marks]

Do not write outside the box

0 2 . 6 Falling on the crash mat reduces the average deceleration of the gymnast compared with falling on a hard surface.

Explain why reducing the deceleration is important to the gymnast.

[2 marks]

____

____

____

____

____

____

11

Turn over for the next question

Do not write outside the box

0 3 **Figure 4** shows two children playing table tennis.

The boy hits the ball from one end of the table.

Figure 4

0 3 . 1 Why does the velocity of the ball change when the boy hits it?

[1 mark]

Tick (✓) **one** box.

The direction of the ball does not change. ☐

There is a resultant force on the ball. ☐

The mass of the ball increases. ☐

The speed of the ball is constant. ☐

Do not write outside the box

0 3 . 2 The ball has an average speed of 11 m/s

The ball takes 0.25 s to travel the same distance as the length of the table.

Calculate the length of the table.

Use the equation:

distance travelled = speed × time

[2 marks]

____

____

____

____

Length of table = ________________________ m

Question 3 continues on the next page

0 3 . 3 A table tennis ball should only be used if it bounces to at least 75% of the height it was dropped from.

A manufacturer tested a table tennis ball.

Table 1 shows the results.

Table 1

Height ball was dropped from in cm	Height of bounce in cm
30.0	25.1

Determine whether the ball can be used.

Use the data from **Table 1**.

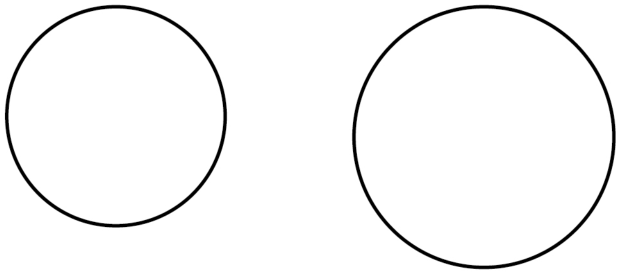
[3 marks]

Do not write outside the box

0 3 . 4 **Figure 5** shows two table tennis balls.

The balls are different sizes but have the same mass.

Figure 5



Both balls were dropped onto the table from the same height.

After they were dropped, the resultant force on the smaller ball was greater than the resultant force on the larger ball.

Explain why.

[2 marks]

____

____

____

____

8

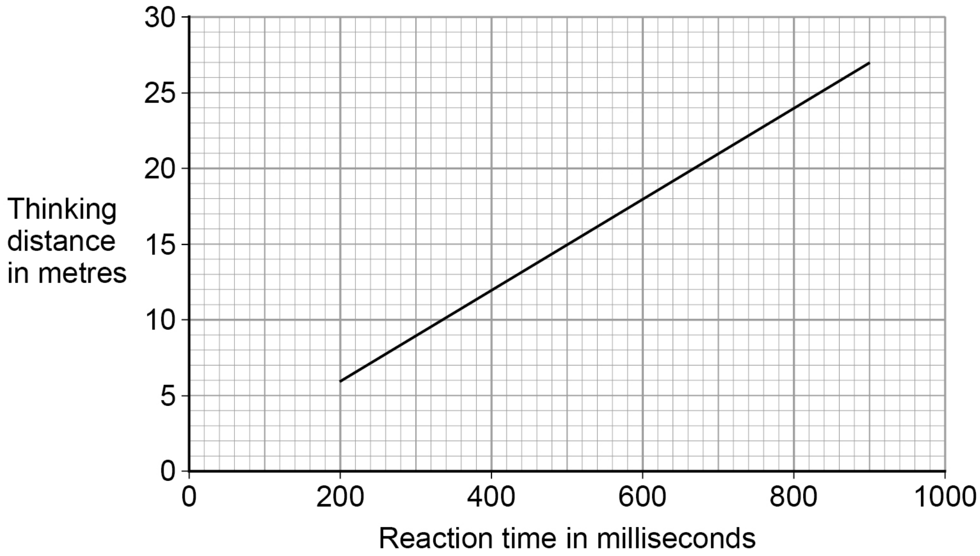
Turn over for the next question

Do not write outside the box

0 4 The thinking distance of a car depends on the reaction time of the driver.

Figure 6 shows how thinking distance varies with reaction time for a car travelling at 30 m/s

Figure 6



0 4 . 1 The reaction time of a driver can double if the driver is distracted.

Explain the effect doubling the reaction time has on the thinking distance.

Use data from **Figure 6**.

[2 marks]

0 4 . 2 Give the reason why there are no values of thinking distance for reaction times less than 200 milliseconds.

[1 mark]

A driver measured her reaction time using an online test. She did the test five times.

Table 2 shows the results.

Table 2

Reaction time in milliseconds				
258	265	302	248	327

0 4 . 3 How does the data in **Table 2** show that it was important that the driver did the test five times?

[1 mark]

____

____

0 4 . 4 Calculate the mean reaction time of the driver.

[2 marks]

____

____

____

____

Mean reaction time = ____________________ ms

0 4 . 5 The driver is driving her car at 30 m/s

Determine the thinking distance.

Use **Figure 6** and your answer from Question **04.4**

[1 mark]

Thinking distance = ____________________ m

Do not write outside the box

0 4 . 6 The driver applies the brakes and the car comes to a stop.

The force exerted by the brakes affects the braking distance.

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

[2 marks]

1 ____________________

2 ____________________

0 4 . 7 Write down the equation that links distance, force and work done.

[1 mark]

____

0 4 . 8 When the driver applies the brakes, there is a constant resultant force of 6.0 kN on the car.

The car travels a distance of 75 m before stopping.

Calculate the work done in stopping the car.

[3 marks]

____

____

____

____

____

____

Work done = ____________________ J

13

Do not write outside the box

0 5 The Sun emits all types of electromagnetic waves.

Figure 7 shows the electromagnetic spectrum.

Figure 7

Radio waves	Microwaves	Infrared	Visible light	Ultraviolet	X-rays	Gamma rays

0 5 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

frequency	**mass**	**power**
velocity		**wavelength**

In a vacuum, all electromagnetic waves travel at the same ____________________ .

Gamma waves have the greatest ____________________ .

Radio waves have the greatest ____________________ .

0 5 . 2 Explain why it is important that the Earth's atmosphere absorbs gamma rays emitted by the Sun.

[2 marks]

____

____

____

____

0 5 . 3 Some microwaves are **not** absorbed by the Earth's atmosphere.

Why is this useful?

[1 mark]

____

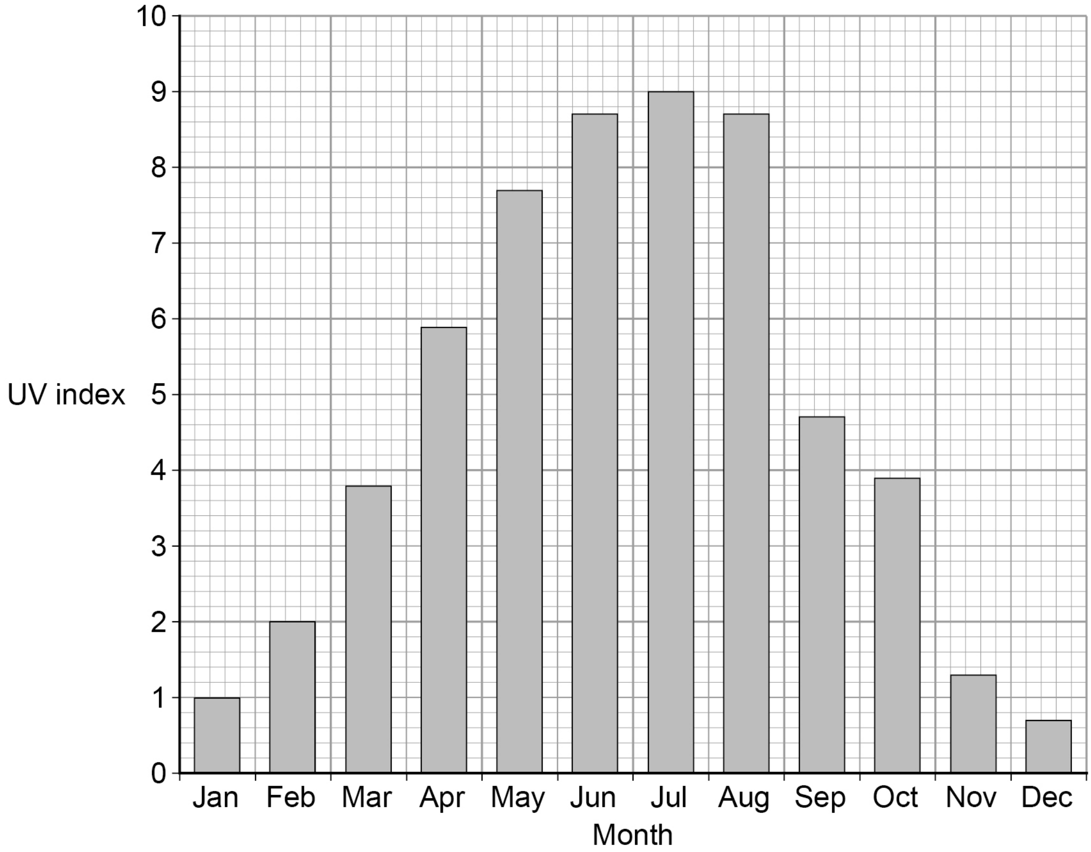
Turn over ►

Some ultraviolet (UV) radiation from the Sun passes through the atmosphere and reaches the surface of the Earth.

The amount of UV radiation that reaches the surface of the Earth can be measured on a scale called the UV index.

Figure 8 shows the average midday UV index in the UK for 1 year.

Figure 8



0 5 . 4 Why is exposure to UV radiation harmful to humans?

[1 mark]

____

____

Do not write outside the box

0 5 . 5 Compare the risk from UV radiation at different times of year in the UK.

Use data from **Figure 8**.

[2 marks]

____

____

____

____

9

Turn over for the next question

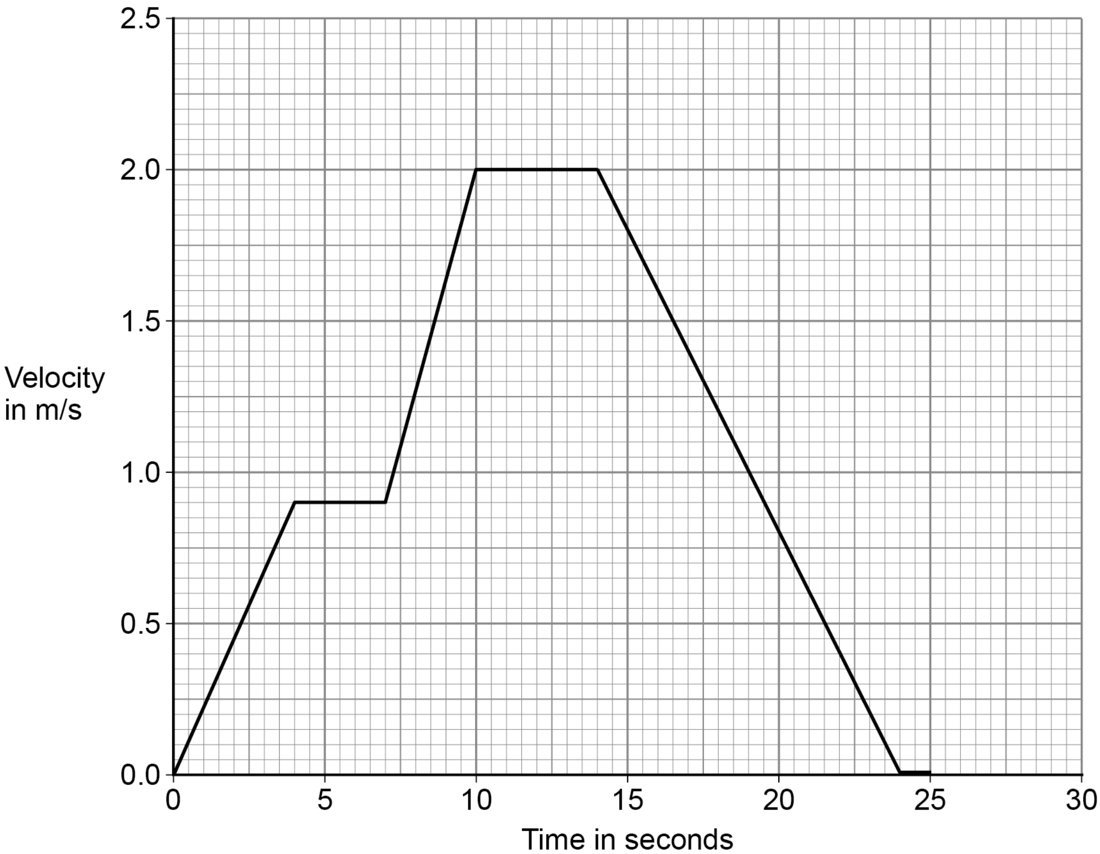
Do not write outside the box

0 6 **Figure 9** shows a runner using a smart watch and a mobile phone to monitor her run.

Figure 9

Figure 10 is a velocity–time graph for part of the runner's warm-up.

Figure 10



Do not write outside the box

0 6 . 1 Determine the total time for which the velocity of the runner was increasing.

[2 marks]

Time = ____________________ s

0 6 . 2 Determine the deceleration of the runner.

[2 marks]

Deceleration = ____________________ m/s^2

Question 6 continues on the next page

The smart watch and mobile phone are connected to each other by a system called Bluetooth.

Bluetooth is wireless and uses electromagnetic waves for communication.

0 6 . 3 Suggest why the phone and watch being connected by a wireless system is an advantage when running.

[1 mark]

____

____

0 6 . 4 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

____

0 6 . 5 The electromagnetic waves have a frequency of 2 400 000 000 Hz

The speed of electromagnetic waves is 300 000 000 m/s

Calculate the wavelength of the electromagnetic waves.

[3 marks]

____

____

____

____

____

____

Wavelength = ____________________ m

Do not write outside the box

0 6 . 6 **Table 3** shows some information about four types of Bluetooth.

Table 3

Type	Power in milliwatts	Range in metres
1	100	100
2	2.50	10.0
3	1.00	1.00
4	0.50	0.50

Mobile phones use type **2** Bluetooth to communicate with other devices.

Suggest **two** reasons why.

[2 marks]

1 ____

____

2 ____

____

11

Turn over for the next question

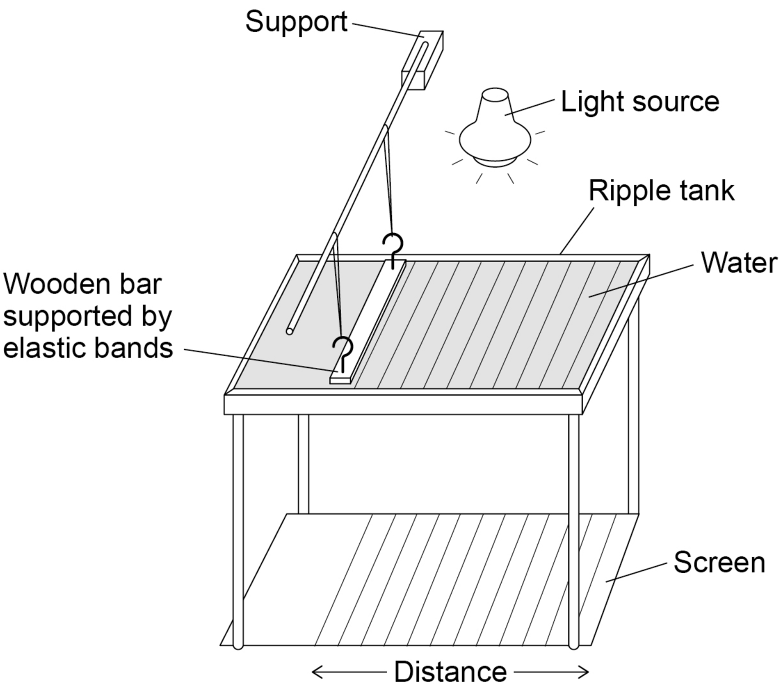
Do not write outside the box

0 7 **Figure 11** shows the equipment a teacher used to determine the speed of a water wave.

The equipment includes:

- a ripple tank filled with water
- a wooden bar that creates ripples on the surface of the water
- a light source which causes a shadow of the ripples on the screen.

Figure 11



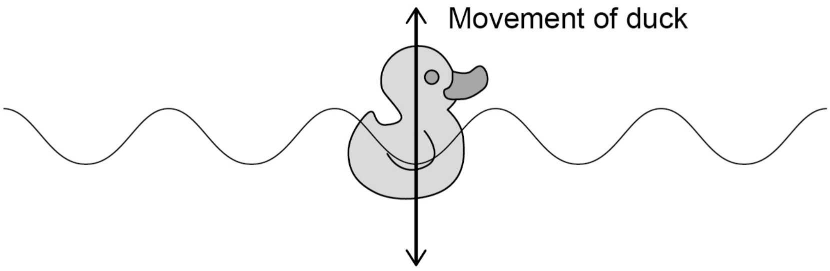
0 7 . 1 Describe how equipment in **Figure 11** can be used to measure the wavelength, frequency and speed of a water wave.

[6 marks]

The teacher put a plastic duck in the ripple tank as shown in **Figure 12**.

The plastic duck moved up and down as the waves in the water passed.

Figure 12



0 7 . 2 How does the movement of the plastic duck in **Figure 12** demonstrate that water waves are transverse?

[1 mark]

Question 7 continues on the next page

Do not write outside the box

0 7 . 3 The teacher measured the maximum height and the minimum height of the plastic duck above the screen as the wave passed.

The teacher repeated his measurements.

Table 4 shows the teacher's measurements.

Table 4

Maximum height in mm	509	513	511
Minimum height in mm	503	498	499

Calculate the mean amplitude of the water wave.

[3 marks]

____

____

____

____

____

____

Mean amplitude = ______________________ mm

10

END OF QUESTIONS

AQA

Please write clearly in block capitals.

Centre number	
Candidate number	
Surname	
Forename(s)	
Candidate signature	

GCSE PHYSICS

F

Foundation 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	
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6	
7	
8	
9	
10	
11	
TOTAL	

J U N 1 9 8 4 6 3 1 F 0 1

IB/G/Jun19/E21

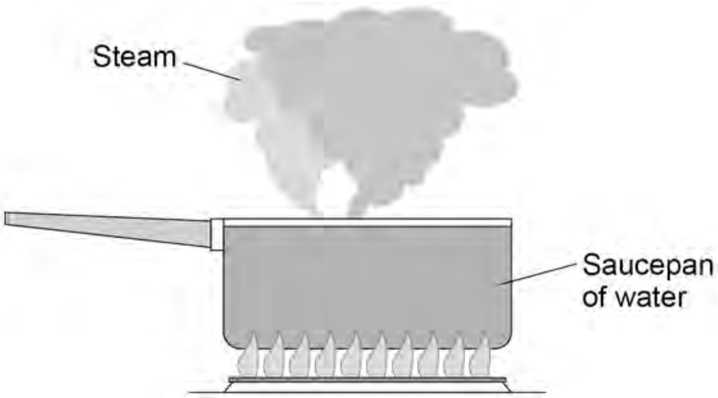
8463/1F

Do not write outside the box

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

0 1 **Figure 1** shows water being heated. Eventually the water changed into steam.

Figure 1



0 1 . 1 Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[2 marks]

greater than	**less than**	**the same as**

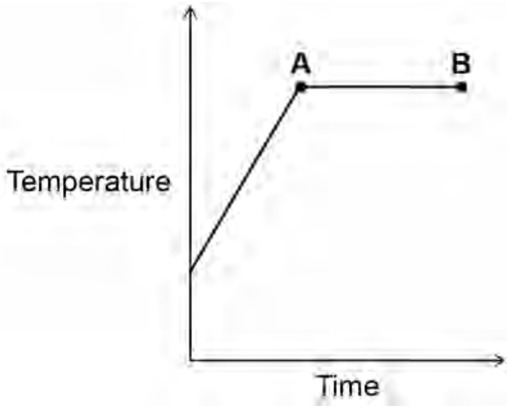
The distance between the particles in steam is ____________________ the distance between the particles in liquid water.

The density of steam is ____________________ the density of liquid water.

Do not write outside the box

Figure 2 shows how the temperature of the water varied with time.

Figure 2



0 1 . 2 What is the name of the process that is taking place between points **A** and **B**?

Give a reason for your answer.

[2 marks]

Process ____

Reason ____

____

0 1 . 3 A mass of 0.063 kg of water was turned into steam.

The specific latent heat of vaporisation of water is 2 260 000 J/kg

Calculate the thermal energy transferred to the water to turn it into steam.

Use the equation:

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

[2 marks]

____

____

____

Energy = ______________________ J

Turn over ►

Do not write outside the box

0 1 . 4 The mass of the steam was 0.063 kg

The volume of the steam was 0.105 m^3

Calculate the density of steam.

Use the equation:

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

Choose the unit from the box.

[3 marks]

kg	**m^3 / kg**	**kg / m^3**

Density = ______________________ Unit ________________

9

Do not write outside the box

0 2 Polonium-210 $\left({}^{210}_{84}\mathrm{Po}\right)$ is a radioactive isotope that decays by emitting alpha radiation.

0 2 . 1 Which is the correct decay equation for polonium-210?

[1 mark]

Tick (✓) **one** box.

$${}^{210}_{84}\mathrm{Po} \rightarrow {}^{214}_{86}\mathrm{X} + {}^{4}_{2}\mathrm{He}$$ ☐

$${}^{210}_{84}\mathrm{Po} \rightarrow {}^{206}_{86}\mathrm{X} + {}^{4}_{2}\mathrm{He}$$ ☐

$${}^{210}_{84}\mathrm{Po} \rightarrow {}^{206}_{82}\mathrm{X} + {}^{4}_{2}\mathrm{He}$$ ☐

0 2 . 2 Why is alpha radiation dangerous inside the human body?

[1 mark]

Tick (✓) **one** box.

Alpha radiation is electromagnetic radiation. ☐

Alpha radiation is highly ionising. ☐

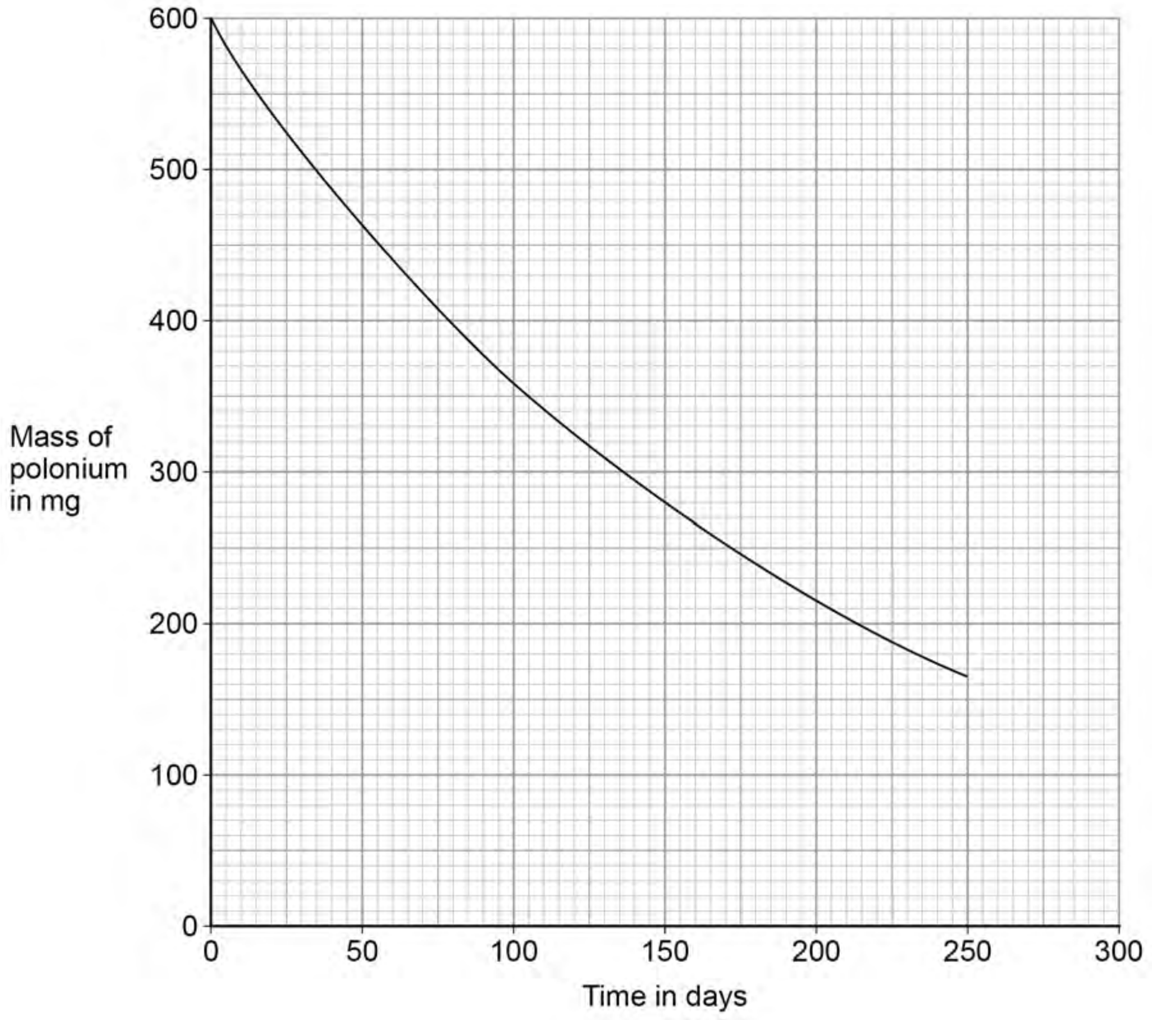
Alpha radiation is very penetrating. ☐

Question 2 continues on the next page

Do not write outside the box

Figure 3 shows how the mass of a sample of polonium-210 changes with time.

Figure 3



0 2 . 3 Determine the change in mass of the sample of polonium-210 between 50 and 150 days.

[2 marks]

____

____

____

Change in mass = ________________________ mg

Do not write outside the box

0 2 . 4 Estimate the mass of polonium-210 remaining after 300 days.

[1 mark]

____

Mass = ____________________ mg

0 2 . 5 Nuclear radiation can cause ionisation.

Complete the sentences.

Choose answers from the box.

[2 marks]

a negative	**an electron**	**a neutron**	**a positive**	**a proton**	**a zero**

An atom becomes an ion when it loses ______________________________.

The resulting ion has ______________________________ charge.

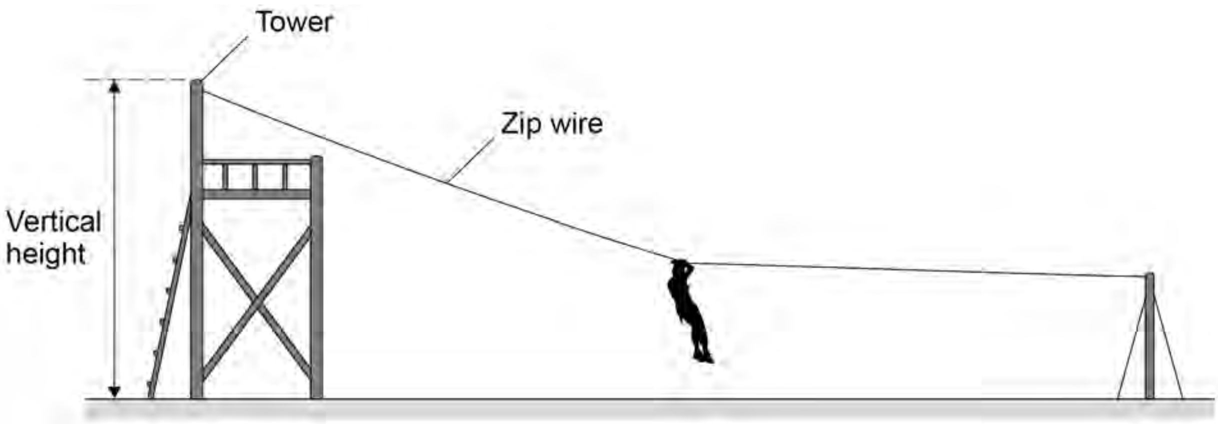
7

Turn over for the next question

Do not write outside the box

0 3 **Figure 4** shows a person sliding down a zip wire.

Figure 4



0 3 . 1 Describe how the vertical height of the tower could be measured accurately.

[2 marks]

____

____

____

____

0 3 . 2 When using the zip wire, the person moved through a vertical height of 2.0 m

The person has a mass of 45 kg

gravitational field strength = 9.8 N/kg

Calculate the change in gravitational potential energy of the person.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

____

____

____

____

Change in gravitational potential energy = ____________________ J

Do not write outside the box

0 3 . 3 Give **three** factors that affected the kinetic energy of the person as she reached the bottom of the zip wire.

[3 marks]

1 ____

____

2 ____

____

3 ____

____

7

Turn over for the next question

Do not write outside the box

0 4 The ancient Greeks thought that atoms were tiny spheres that could not be divided into anything smaller.

Since then, different discoveries have led to the model of the atom changing.

Some of the discoveries are given in **Table 1**.

Table 1

The mass of an atom is concentrated in the nucleus.	**A**
Electrons orbit the nucleus at specific distances.	**B**
The nucleus contains neutrons.	**C**
The nucleus contains positively charged protons.	**D**

0 4 . 1 Which discovery was the earliest?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 4 . 2 Which discovery was the most recent?

[1 mark]

Tick (✓) **one** box.

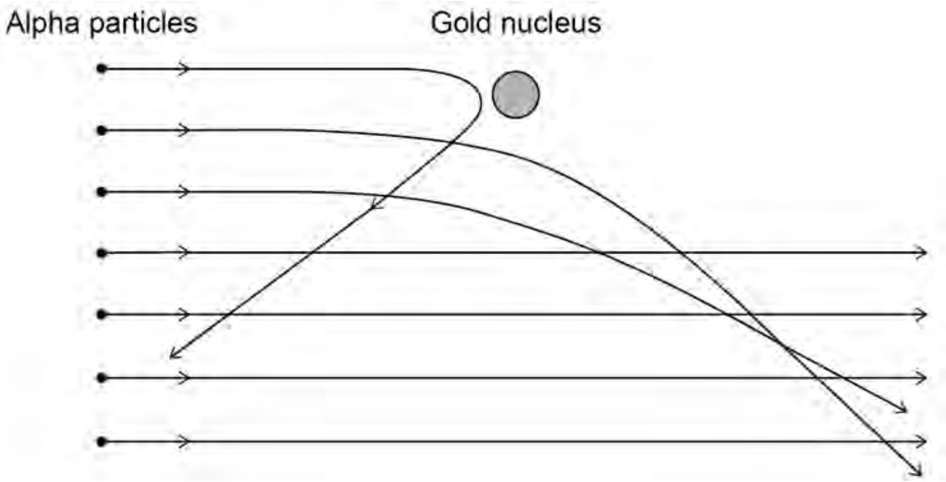
A ☐ **B** ☐ **C** ☐ **D** ☐

Do not write outside the box

0 4 . 3 The alpha particle scattering experiment led to the nuclear model of the atom.

Figure 5 shows the paths of alpha particles travelling close to a gold nucleus.

Figure 5



Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[3 marks]

attracts	**decreases**	**does not change**
increases	**reflects**	**repels**

Alpha particles and gold nuclei are both positively charged.

The gold nucleus ______________________________ the alpha particles.

As the alpha particle approaches the gold nucleus, the electric field strength experienced by the alpha particle ______________________________ .

As an alpha particle approaches the gold nucleus, the force experienced by the alpha particle ______________________________ .

Do not write outside the box

0 4 . 4 The results of the alpha particle scattering experiment were reproducible.

What does reproducible mean?

[1 mark]

Tick (✓) **one** box.

Another scientist repeats the experiment and gets the same results. ☐

Another scientist repeats the experiment and gets different results. ☐

The same scientist repeats the experiment and gets the same results. ☐

The same scientist repeats the experiment and gets different results. ☐

6

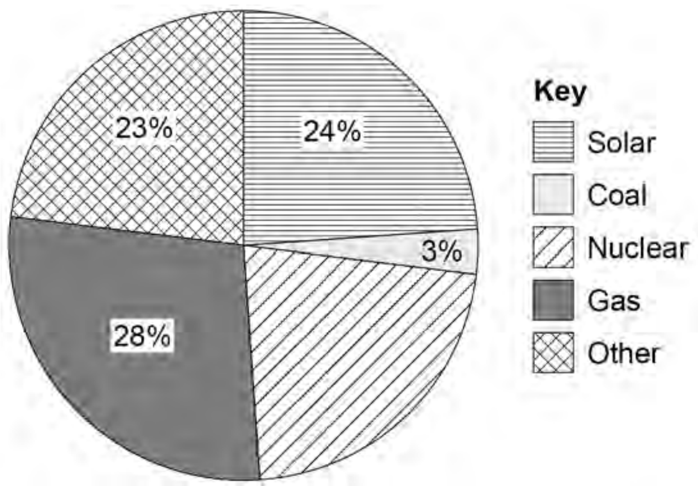
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 5 **Figure 6** shows how different energy resources were used in the United Kingdom (UK) to generate electricity on one day in June 2018.

Figure 6



0 5 . 1 The UK government plans to stop using coal-fired power stations by 2025.

Explain **one** environmental problem caused when electricity is generated by burning coal.

[2 marks]

____

____

____

____

____

0 5 . 2 Give **two** renewable energy resources that could make up the 'Other' energy resources in **Figure 6**.

[2 marks]

1 ____

____

2 ____

____

Do not write outside the box

0 5 . 3 Determine the percentage of electricity generated in nuclear power stations that day.

Use data from **Figure 6**.

[2 marks]

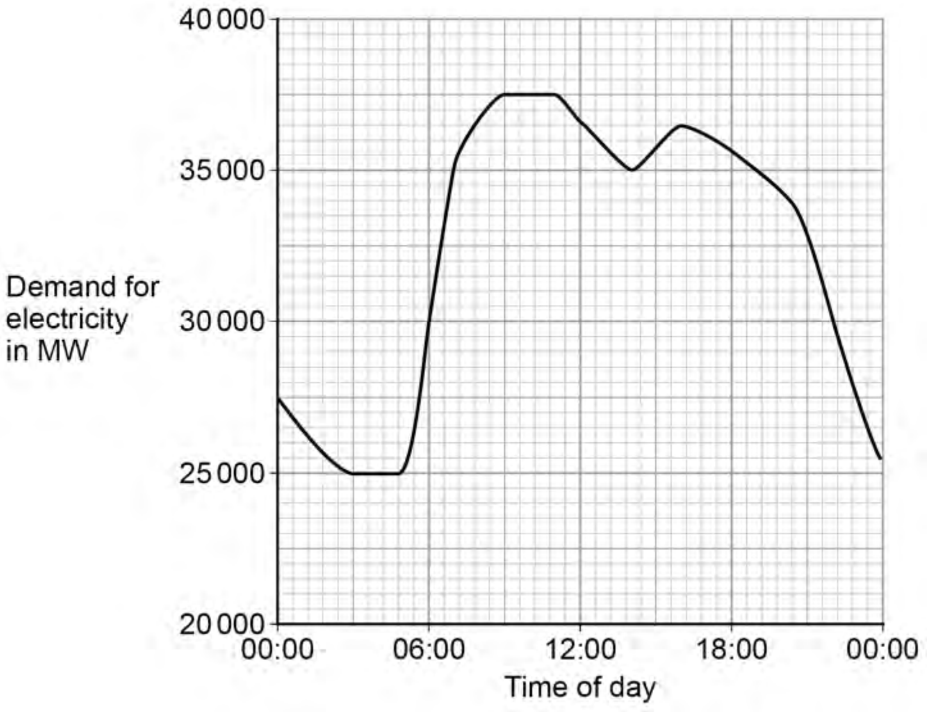
Percentage of electricity generated in nuclear power stations = ____________ %

Question 5 continues on the next page

Do not write outside the box

Figure 7 shows how the demand for electricity varied with the time of day.

Figure 7



0 5 . 4 What was the difference between the maximum demand and minimum demand for electricity during this day?

[2 marks]

___

___

___

___

Difference = ____________________ MW

Do not write outside the box

0 5 . 5 **Figure 7** shows that the demand for electricity increased between 06:00 and 09:00

Solar power could have met the demand if there were enough solar panels installed in the UK.

Explain why.

[2 marks]

____

____

____

____

10

Turn over for the next question

Do not write outside the box

0 6 An electric car has a motor that is powered by a battery.

A diesel car has an engine that is powered by diesel fuel.

0 6 . 1 **Table 2** compares an electric car and a diesel car.

Table 2

Power source	Maximum acceleration in m/s^2	Mass of power source in kg	Range in km	Maximum power output in kW
Battery	4.8	420	220	200
Diesel fuel	3.2	51	1120	120

Give **two** advantages of the diesel car compared with the electric car in **Table 2**.
[2 marks]

1 ____

____

2 ____

____

0 6 . 2 The mass of the battery in the electric car is 420 kg

The total mass of the electric car is 1610 kg

Calculate the mass of the battery as a percentage of the total mass of the electric car.
[2 marks]

____

____

____

____

Percentage of total mass = ____________________ %

Do not write outside the box

0 6 . 3 Designers of electric car batteries want to increase the amount of energy that can be stored in a battery.

Suggest **two** reasons why.

[2 marks]

1 ____

____

2 ____

____

Figure 8 shows an electric car being recharged.

Figure 8

0 6 . 4 Write down the equation which links energy transferred, power and time.

[1 mark]

____

____

0 6 . 5 The charger has a power output of 7000 W

Calculate the time taken to transfer 420 000 J of energy to the car battery.

[3 marks]

____

____

____

____

Time = ____________________ s

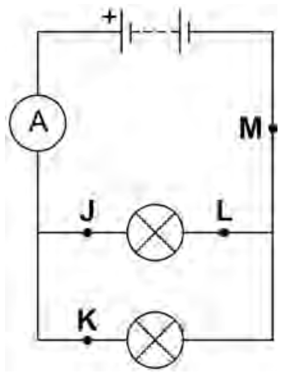
10

Turn over ►

Do not write outside the box

0 7 **Figure 9** shows a circuit diagram.

Figure 9



0 7 . 1 In which position could a switch be placed so that both lamps can be switched on or off at the same time?

[1 mark]

Tick (✓) **one** box.

J ☐ **K** ☐ **L** ☐ **M** ☐

0 7 . 2 Draw the circuit symbol for a switch in the box below.

[1 mark]

Do not write outside the box

0 7 . 3 In 30 seconds, 24 coulombs of charge flow through the battery.

Calculate the current in the battery.

Use the equation:

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

[2 marks]

Current = ____________________ A

0 7 . 4 There is a potential difference of 3.6 V across the battery.

Calculate the energy transferred by the battery when 60 coulombs of charge flows through the battery.

Use the equation:

$$\text{energy transferred} = \text{charge flow} \times \text{potential difference}$$

[2 marks]

Energy transferred = ____________________ J

Question 7 continues on the next page

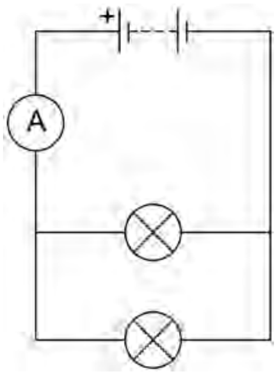
Do not write outside the box

A student built **Circuit X** and **Circuit Y** shown in **Figure 10**.

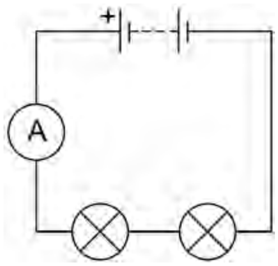
The components used in each circuit were identical.

Figure 10

Circuit X



Circuit Y



0 7 . 5 How would the reading on the ammeter in **Circuit Y** compare to the reading on the ammeter in **Circuit X**?

[1 mark]

Tick (✓) **one** box.

The reading in **Y** would be higher. ☐

The reading in **Y** would be lower. ☐

The readings would be the same. ☐

0 7 . 6 How does the total resistance of **Circuit Y** compare with the total resistance of **Circuit X**?

[1 mark]

Tick (✓) **one** box.

The total resistance of **Y** is greater. ☐

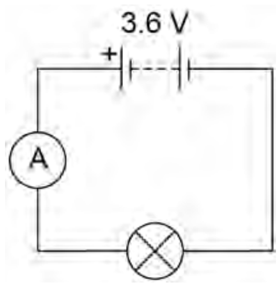
The total resistance of **Y** is less. ☐

The total resistance is the same. ☐

Do not write outside the box

The student built another circuit which is shown in **Figure 11**.

Figure 11



0 7 . 7 Write down the equation which links current, potential difference and resistance.

[1 mark]

____

0 7 . 8 There is a potential difference of 3.6 V across the lamp in **Figure 11**.

The current through the lamp is 0.80 A

Calculate the resistance of the lamp.

[3 marks]

____

____

____

Resistance = ____________________ Ω

12

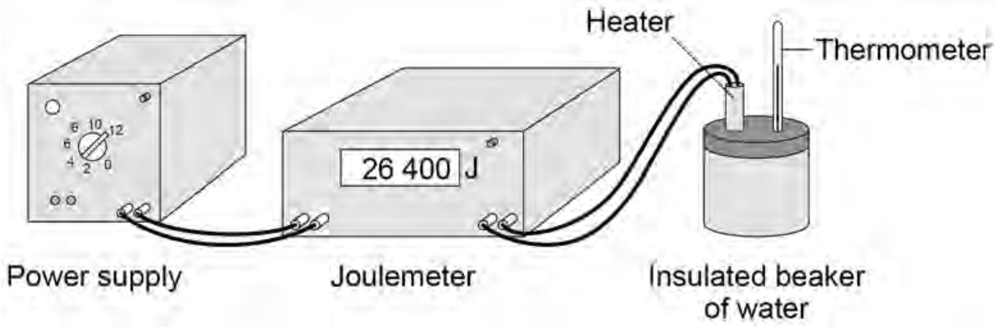
Turn over for the next question

Do not write outside the box

0 8 A student carried out an experiment to determine the specific heat capacity of water.

Figure 12 shows the equipment the student used to heat the water.

Figure 12



0 8 . 1 Why did the student insulate the beaker of water?

[1 mark]

Tick (✓) **one** box.

To increase energy transfer to the surroundings. ☐

To reduce energy transfer to the surroundings. ☐

To stop energy transfer to the surroundings. ☐

0 8 . 2 One hazard in this experiment is the hot water.

Give **one** risk to the student caused by this hazard.

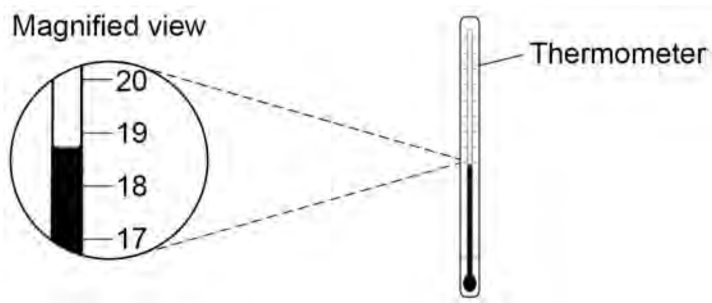
[1 mark]

____

____

0 8 . 3 **Figure 13** shows the thermometer that the student used.

Figure 13



What is the resolution of the thermometer?

[1 mark]

Tick (✓) **one** box.

1 °C ☐

3 °C ☐

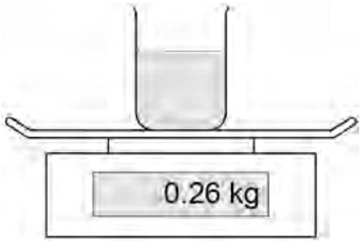
19 °C ☐

Question 8 continues on the next page

Do not write outside the box

0 8 . 4 **Figure 14** shows the beaker of water on a balance.

Figure 14



The mass of the water was 0.20 kg

What was the mass of the beaker?

[1 mark]

Tick (✓) **one** box.

0.06 kg ☐

0.20 kg ☐

0.26 kg ☐

0.46 kg ☐

Do not write outside the box

0 8 . 5 The energy transferred to the water was 26 400 J

The mass of water was 0.20 kg

The temperature increase of the water was 30 °C

Calculate the specific heat capacity of water using the data from this experiment.

Use the Physics Equations Sheet.

Choose the unit from the box.

[4 marks]

J/kg	**J/kg°C**	**J/°C**

Specific heat capacity = ____________________ Unit __________

8

Turn over for the next question

Do not write outside the box

0 9 Light bulbs are labelled with a power input.

0 9 . 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 9 . 2 Write down the equation which links current, potential difference and power.

[1 mark]

____

0 9 . 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 3 shows information about three different light bulbs.

Table 3

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 9 . 4 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

____

0 9 . 5 Calculate the value of **X** in **Table 3**.

[3 marks]

____

____

____

____

X = ____________________ W

0 9 . 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]

____

____

____

____

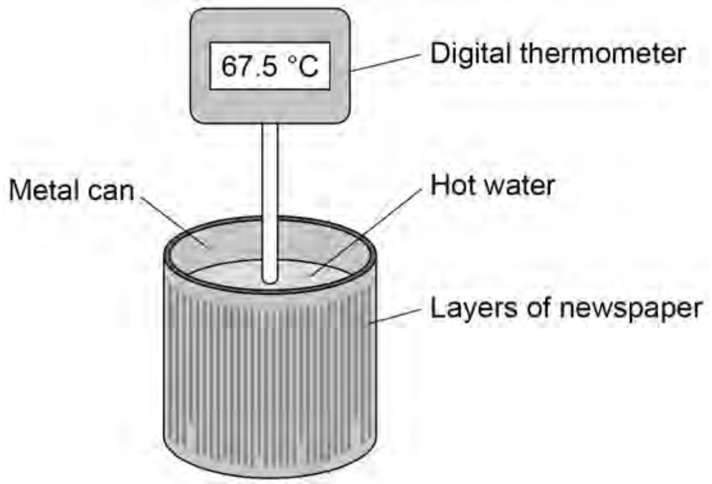
11

Do not write outside the box

1 0 A student investigated the insulating properties of newspaper.

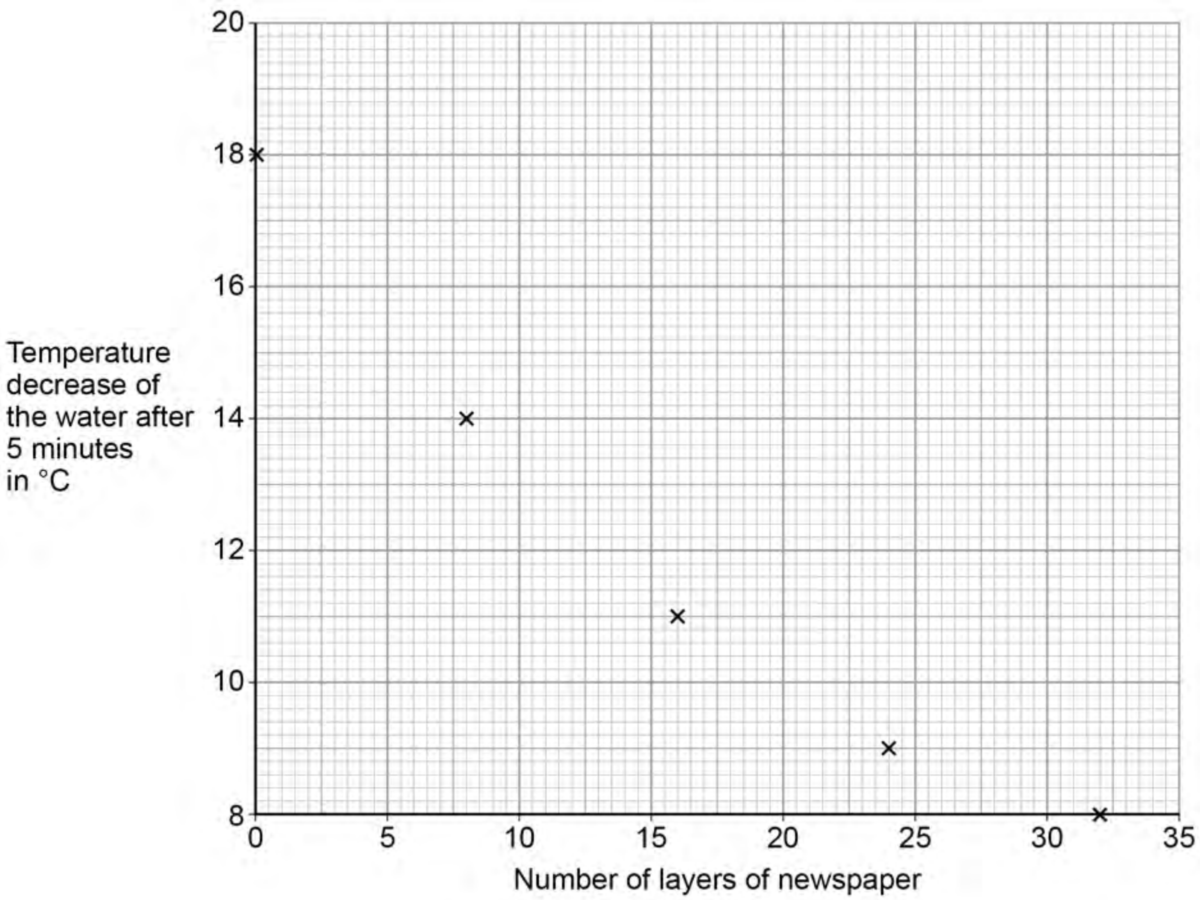
Figure 15 shows the apparatus the student used.

Figure 15



The student's results are shown in **Figure 16**.

Figure 16



Do not write outside the box

1 0 . 1 Describe a method the student could have used to obtain the results shown in **Figure 16**.

[6 marks]

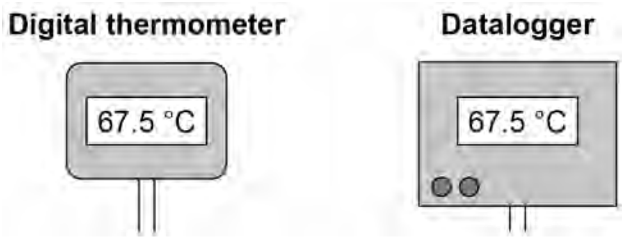
Question 10 continues on the next page

Do not write outside the box

1 0 . 2 The student could have used a datalogger with a temperature probe instead of the digital thermometer.

Figure 17 shows the readings on the digital thermometer and the datalogger.

Figure 17



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

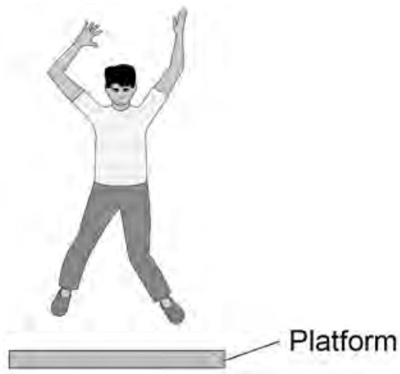
Do not write outside the box

1 1 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 18 shows a volunteer taking part in the experiment.

Figure 18



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

1 1 . 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

Turn over ►

Do not write outside the box

1 1 . 2 Write down the equation which links kinetic energy, mass and speed.

[1 mark]

____

1 1 . 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]

____

____

____

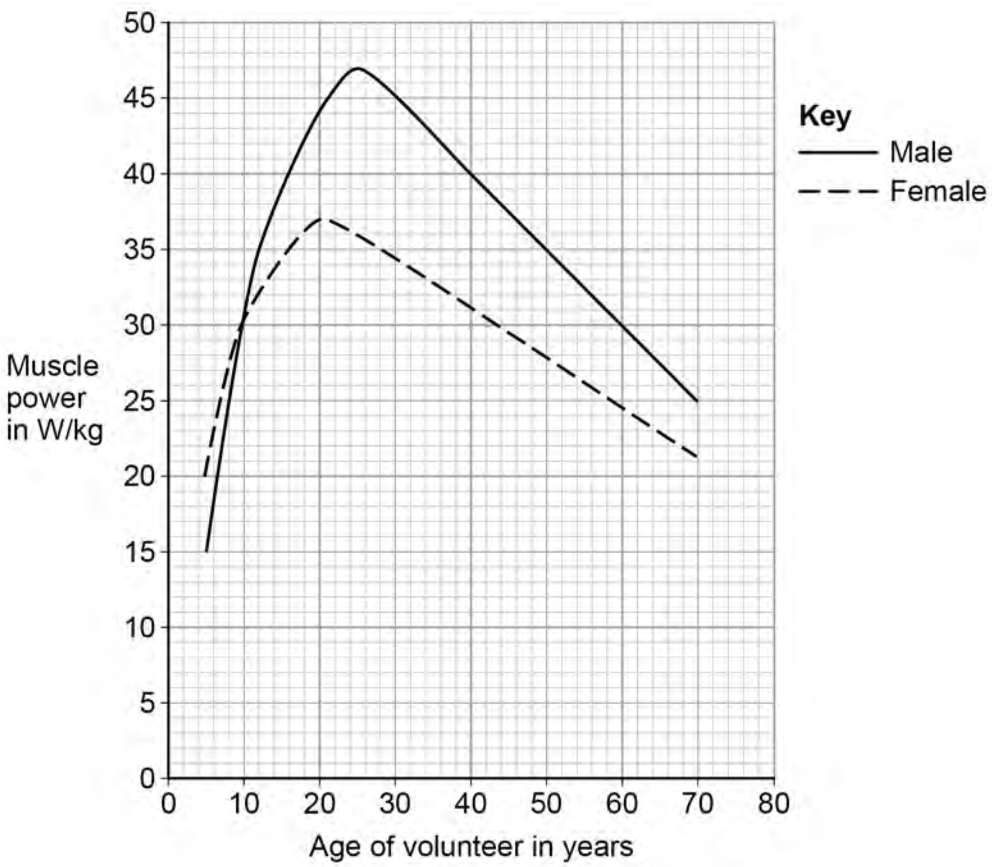
____

____

Mass = ____________________ kg

Figure 19 shows the scientist's results.

Figure 19



Do not write outside the box

11.4 Compare the muscle power of males with the muscle power of females.

Use data from **Figure 19** in your answer.

[4 marks]

11.5 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

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/2F

Physics Paper 2F

Mark scheme

June 2019

Version: 1.0 Final

1 9 6 G 8 4 6 4 P 2 F / M S

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Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do not accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	electrostatic gravitational		1 1	AO1 6.5.1.2	A
01.2	D		1	AO2 6.7.1.1	A
01.3	bring two unlike poles close together bring two like poles close together	allow north and south poles allow opposite poles allow two north / south poles allow N for north and S for south	1 1	AO1 6.7.1.1	E
01.4	induced magnetism		1	AO1 6.7.1.1	A
01.5	all 4 poles correctly labelled north and south	allow N for north and S for south allow 1 mark for 2 or 3 correctly labelled poles	2	AO3 6.7.1.1	E
Total			**8**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.1	it is the same size as the downward force		1	AO2 6.5.4.3.2	A
02.2	weight is a vector		1	AO1 6.5.1.1	A
02.3	centre of mass		1	AO2 6.5.1.3	A
02.4	W = 45 × 9.8 W = 441 (N)	an answer of 441 (N) scores **2** marks allow 440 (N)	1 1	AO2 6.5.1.3	E
02.5	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.		3–4	AO1 6.1.1.1	E
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.		1–2		
	No relevant content.		0		
	Indicative content • as height changes gravitational potential energy changes • gravitational potential energy decreases when moving to the lower bar • as speed changes kinetic energy changes • kinetic energy increases when moving to the lower bar • transfer from gravitational potential energy to kinetic energy as height decreases • the sum of the kinetic energy and gravitational potential energy is constant				
02.6	reduces the force exerted the risk of injury to gymnast is reduced	ignore impact allow so the gymnast does not get injured	1 1	AO3 6.5.4.2.2	E
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	there is a resultant force on the ball		1	AO1 6.5.4.2.1	A
03.2		an answer of 2.75 scores **2** marks		AO2 6.5.4.1.2	E
	s = 11 × 0.25		1		
	s = 2.75 (m)	allow 2.8 (m)	1		
03.3	$\frac{75}{100} \times 30.0$	allow any correct method of determining 75% of 30	1	AO3 6.5.4.1.2	E
	22.5 (cm)		1		
	(25.1 > 22.5) therefore the ball can be used	this mark can only be awarded if a supporting calculation has been done allow any correct supported conclusion allow a conclusion consistent with an incorrect percentage calculation	1		
	OR				
	$\frac{25.1}{30.0}$ ×100 (1)				
	84 % (1)				
	(84% > 75%) therefore the ball can be used (1)	this mark can only be awarded if a supporting calculation has been done allow any correct supported conclusion allow a conclusion consistent with an incorrect percentage calculation			
03.4	the smaller ball has a smaller area		1	AO2 6.5.4.2.1	E
	(so) air resistance is less (on the smaller ball)		1		
Total			**8**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	(thinking distance) will double any correct pair of points from graph eg (200,6) and (400,12)	allow graph shows direct proportionality (after 200 ms) allow **1** mark for thinking distance increases with supporting data.	1 1	AO3 6.5.4.3.2	E
04.2	(most) people cannot react any quicker than 200 ms		1	AO1 6.5.4.3.2	E
04.3	there is variation in the measurements	allow the data is not very precise allow lots of random error ignore references to accuracy / reliability / average	1	AO3 6.5.4.3.2	E
04.4	(258+265+302+248+327) / 5 280 (ms)	an answer of 280 gains **2** marks	1 1	AO2 6.5.4.3.2	E
04.5	8.4 (m)	allow 7.9 (m) to 8.9 (m) allow ecf from **04.4**	1	AO2 6.5.4.3.2	E
04.6	any **two** from: • (material of) road surface • condition of the tyres • speed of the car • wet / icy road surface • gradient of road • mass / weight of the car	Ignore any reference to brakes	2	AO1 6.5.4.3.3	
04.7	work done = force × distance (along the line of action of the force)	allow W = F s allow any correct re-arrangement	1	AO1 6.5.2	

04.8	F = 6000 N W = 6000 × 75 W = 450 000 (J)	an answer of 450 000 scores 3 marks allow a correct substitution using an incorrectly / not converted value of F allow a correct calculation using an incorrectly / not converted value of F	1 1 1	AO2 6.5.2	
Total			**13**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	velocity frequency wavelength		1 1 1	AO1 6.6.2.3	G
05.2	so people are not exposed to (as much) gamma radiation because gamma radiation can damage human tissue	allow less gamma radiation reaches the Earth's surface allow increases the risk of cancer or (cell) mutation allow gamma rays are ionising ignore any reference to temperature / heating of the atmosphere	1 1	AO1 6.6.2.3	E
05.3	(microwaves) are used in (satellite) communications	ignore any reference to temperature / heating of the atmosphere	1	AO2 6.6.2.4	E
05.4	can cause skin cancer / premature ageing	allow sunburn allow eye / skin damage cancer on its own is insufficient	1	AO1 6.6.2.3	E
05.5	risk from UV radiation is highest in July / summer two correct readings from the bar chart which support their comparison	allow any sensible comparison of named months / seasons if no other mark scored, two correct readings from the graph scores **1** mark	1 1	AO3 6.6.2.3	E
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	$(4 - 0) + (10 - 7)$ **or** $4 + 3$ **or** $10 - 3$ 7 (s)	an answer of 7 (s) gains **2** marks	1 1	AO2 6.5.4.1.5	E
06.2	gradient = $\frac{0-2}{24-14}$ (-) 0.2 (m/s^2)	an answer of 0.2 (m/s^2) gains **2** marks allow readings from any two points correctly substituted allow correct use of $a = \frac{\Delta v}{t}$	1 1	AO2 6.5.4.1.5	E
06.3	(there are no wires) to get tangled / disconnected	allow easier to move arms allow wires are inconvenient allow easier to transfer data	1	AO3 6.6.2.4	E
06.4	wave speed = frequency × wavelength	allow $v = f\lambda$ allow any correct re-arrangement	1	AO1 6.6.1.2	E
06.5	$300\,000\,000 = 2\,400\,000\,000 \times \lambda$ $\lambda = \frac{300\,000\,000}{2\,400\,000\,000}$ $\lambda = 0.125$ (m)	an answer of 0.125 (m) or 0.13 (m) scores **3** marks allow $\lambda = 0.13$ (m)	1 1 1	AO2 6.6.1.2	E
06.6	range is far enough (for most uses) power is not too great so the battery will not drain quickly	allow power not too great so the phone will not overheat allow the range per milliwatt is greatest or 4 metres	1 1	AO3 6.6.2.4	E

Total			**11**		

Question	Answers	Mark	AO / Spec. Ref.	ID
07.1	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.6.1.2	E
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4		
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2		
	No relevant content.	0		
	Indicative content • if two quantities have been determined, $v = f \lambda$ can be used to find the third. **Frequency** • use a stopclock • count the number of waves passing a point in a fixed time period • divide the time by the number of waves to determine the time for one wave, T • $f = 1/T$ • read the frequency off the oscillator **Wavelength** • use a camera to freeze the image • use a metre rule to measure the distance between two wavefronts • count the number of waves between the wavefronts • divide distance by the number of waves to determine λ **Velocity** • determine a mean value of frequency • determine a mean value of wavelength • measure the time it takes one wavefront to travel the length of the screen • measure the length of the screen • speed = distance / time To access Level 3 there must be a description of how frequency, wavelength and velocity can be determined			

07.2	(the duck) moves perpendicular to the direction of wave travel	duck moves up and down is insufficient	1	AO2 6.6.1.1	E
07.3	mean maximum height = 511 **and** mean minimum height = 500 511 – 500 = 11 11 / 2 = 5.5 (mm)	an answer of 5.5 (mm) gains **3** marks allow a calculated difference from incorrect means allow their difference divided by 2 any correct method of determining the mean amplitude can score 3 marks	1 1 1	AO2 6.6.1.2	E
Total			**10**		

GCSE
PHYSICS
8463/1F

Foundation Tier Paper 1

Mark scheme

June 2019

Version: 1.0 Final

196G8463/1F/MS

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Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, ‘allow’ is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1.1	greater than less than	in this order only	1 1	4.3.1.1 AO1
1.2	<u>boiling</u> temperature is constant	ignore evaporation allow temperature remains the same	1 1	4.3.2.3 AO1
1.3	$E = 0.063 \times 2\ 260\ 000$ $E = 140\ 000$ (J)	a correct answer that rounds to 140 000 (J) scores **2** marks allow 142 380 (J)	1 1	4.3.2.3 AO2
1.4	density = $\frac{0.063}{0.105}$ density = 0.6 kg / m^3	an answer of 0.6 scores **2** marks	1 1 1	4.3.1.1 AO2
Total			**9**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2.1	$^{210}_{84}\text{Po} \rightarrow {}^{206}_{82}\text{X} + {}^{4}_{2}\text{He}$		1	4.4.2.2 AO1
2.2	Alpha radiation is highly ionising		1	4.4.2.1 AO1
2.3	Change in mass = 460 – 280 Change in mass = 180 (mg)	allow reading between 460 and 465 allow reading between 278 and 282 allow an answer between 178 and 187 inclusive for **2** marks	1 1	4.4.2.3 AO2
2.4	130 (mg)	allow an answer between 126 and 150 (mg) inclusive	1	4.4.2.3 AO3
2.5	an electron a positive	in this order only	1 1	4.4.1.2 AO1
Total			**7**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3.1	use a tape measure one person holding the top and another person holding the bottom **or** use a set square to ensure tape measure is vertical **or** take repeat readings and calculate a mean	allow use a metre rule allow use a laser measure allow use a plumb-line to ensure tape measure is vertical	1 1	4.1.1.2 AO3/3a
3.2	$E_p = 45 \times 9.8 \times 2.0$ $E_p = 880$ (J)	an answer of 880 (J) or 882 (J) scores **2** marks	1 1	4.1.1.2 AO2
3.3	any **3** from: • change in vertical height • mass / weight • speed / velocity • air resistance or drag • friction (between zip line and pulley) • gradient / angle (of the zip wire) • length of zip wire	allow body position allow wind ignore gravitational field strength	3	4.1.1.1 AO1
Total			**7**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4.1	A		1	4.4.1.3 AO1
4.2	C		1	4.4.1.3 AO1
4.3	repels increases increases	in this order only	1 1 1	4.4.1.3 4.2.5.2 AO1
4.4	another scientist repeats the experiment and gets the same results		1	WS3.7 4.4.1.3 AO1
Total			**6**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5.1	carbon dioxide released causing global warming **OR** particulates released (1) causing global dimming (1) **OR** sulfur dioxide released (1) causing acid rain (1)	greenhouse gases is insufficient carbon emissions is insufficient allow CO_2 allow climate change allow named consequence of global warming allow greenhouse effect air pollution is insufficient allow SO_2	1 1	4.1.3 WS1.4 AO1
5.2	any **2** from: • wind • tidal • wave • hydroelectric • geothermal • biofuel	do not accept solar allow pumped storage hydro is insufficient allow biomass or named biofuel eg wood	2	4.1.3 AO2
5.3	100 – 78 22 (%)	an answer of 22 (%) scores **2** marks allow **1** mark for calculating percentage of named resources (78%)	1 1	4.1.3 AO2

5.4	maximum demand = 37 500 (MW) **and** minimum demand = 25 000 (MW) difference in demand = 12 500 (MW)	an answer of 12 500 (MW) scores **2** marks	1 1	4.1.3 AO2
5.5	solar panels generate electricity from light power output would increase throughout the morning **or** power output would increase (between 06:00 and 09:00) **or** (between 06:00 and 09:00) the Sun is rising / shining	solar panels make energy is insufficient	1 1	4.1.3 1AO1/1 1AO3/2a
Total			**10**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6.1	(the diesel car has a) higher range (the diesel car) power source has a lower mass	allow less frequent refuelling needed allow the power source has a lower weight the diesel car has a lower mass is insufficient	1 1	4.1.3 AO3
6.2	% of total mass = $\frac{420}{1610}$ (×100) % of total mass = 26 (%)	a correct answer that rounds to 26 (%) scores **2** marks allow **1** mark for an answer of 0.26	1 1	4.1.3 AO2
6.3	any **2** from: • increase the range of electric cars • increase the time between recharges • decrease the (total) mass of the electric car • greater acceleration		2	4.1.3 AO3
6.4	energy transferred = power × time **or** $E = Pt$		1	4.1.1.4 AO1
6.5	420 000 = 7000 × t t = 420 000 / 7000 t = 60 (s)	an answer of 60 (s) scores **3** marks	1 1 1	4.1.1.4 AO2
Total			**10**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7.1	M		1	4.2.2 AO1
7.2	 **or** 		1	4.2.1.1 AO1
7.3	current $= \frac{24}{30}$ current = 0.80 (A)	an answer of 0.8 (A) scores **2** marks	1 1	4.2.1.2 AO2
7.4	E = 60 × 3.6 E = 216 (J)	an answer of 216 (J) scores **2** marks	1 1	4.2.4.2 AO2
7.5	The reading in **Y** would be lower		1	4.2.2 AO1
7.6	The total resistance of **Y** is greater		1	4.2.2 AO1
7.7	potential difference = current × resistance **or** *V* = *IR*		1	4.2.1.3 AO1
7.8	3.6 = 0.80 × R R $= \frac{3.6}{0.80}$ R = 4.5 (Ω)	an answer of 4.5 (Ω) scores **3** marks	1 1 1	4.2.1.3 AO2
Total			**12**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8.1	To reduce energy transfer to the surroundings		1	4.1.1.3 RP1 AO1
8.2	scald / burn (to skin)	ignore risk of electric shock	1	4.1.1.3 RP1 AO3
8.3	1 °C		1	4.1.1.3 RP1 AO3
8.4	0.06 kg		1	4.1.1.3 RP1 AO1
8.5	$26\,400 = 0.20 \times c \times 30$ $c = \dfrac{26\,400}{(0.20 \times 30)}$ **or** $c = \dfrac{26\,400}{6}$ c = 4400 J / kg °C	a numerical answer of 4400 scores **3** marks	1 1 1 1	4.1.1.3 RP1 AO2 AO1
Total			**8**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9.1	The energy transferred each second to the bulb.		1	4.1.1.4 AO1
9.2	power = potential difference × current **or** *P* = *VI*		1	4.2.4.1 AO1
9.3	40 = I × 230 $I = \frac{40}{230}$ I = 0.17 (A)	an answer of 0.17 (A) scores **3** marks a correct answer that rounds to 0.17 (A) scores **3** marks	1 1 1	4.2.4.1 AO2
9.4	$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$		1	4.1.2.2 AO1
9.5	$0.30 = \frac{\text{useful power output}}{9.0}$ useful power output = 0.30 × 9.0 useful power output = 2.7 (W)	an answer of 2.7 (W) scores **3** marks	1 1 1	4.1.2.2 AO2
9.6	bulbs also transfer thermal energy the efficiency of the light bulb also needs to be considered	allow light bulbs emit infrared radiation as well as visible light ignore so people know how bright the bulb is allow the cost to power the light bulb depends on the efficiency allow to see how much energy is wasted	1 1	4.1.2.2 4.1.1.4 AO1 AO3
Total			**11**	

Question 10

<table>
<tr><th>Question</th><th colspan="2">Answers</th><th>Mark</th><th>AO/
Spec. Ref</th></tr>
<tr><td rowspan="5">10.1</td><td colspan="2">Level 3: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.</td><td>5–6</td><td rowspan="5">RP2
WS2.2
4.1.2.1
AO1</td></tr>
<tr><td colspan="2">Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.</td><td>3–4</td></tr>
<tr><td colspan="2">Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.</td><td>1–2</td></tr>
<tr><td colspan="2">No relevant content</td><td>0</td></tr>
<tr><td colspan="2">Indicative content

• Wrap N layers of newspaper around the metal can
• Heated water in a kettle
or
Using a Bunsen burner
• Put hot water in the metal can
• Use a measuring cylinder to measure the volume of water
• Measure initial and final temperature with the digital thermometer
• Use a stopclock / stopwatch to measure a time of 5 minutes
• Calculate temperature decrease
• Repeat with different number of layers of newspaper
• Repeat with no layers of newspaper
• Use same initial temperature of hot water
• Use same volume of water each time

Level 3: Workable method which includes changing the number of layers and includes at least one control variable (same volume of water or same starting temperature)</td><td></td></tr>
<tr><td>10.2</td><td>the digital thermometer and the datalogger have the same resolution

only need to measure the start and end temperature
or
only need 2 readings
or
only need to calculate the temperature change</td><td>allow both measure to 1 d.p.

ignore accuracy
ignore precision
they give the same result is insufficient</td><td>1

1</td><td>RP2
WS2.3
4.1.2.1
AO3</td></tr>
<tr><td>Total</td><td></td><td></td><td>8</td><td></td></tr>
</table>

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	$41 = \frac{9.8 \times h}{0.12}$ $h = \frac{41 \times 0.12}{9.8}$ h = 0.50 (m)	an answer of 0.50 scores **3** marks allow a correct answer that rounds to 0.50 for **3** marks	1 1 1	4.1.1.2 AO2
11.2	kinetic energy = 0.5 × mass × $(\text{speed})^2$ ***or*** $E_k = \frac{1}{2} mv^2$		1	4.1.1.2 AO1
11.3	$270 = \frac{1}{2} \times m \times 3^2$ $m = \frac{270}{(\frac{1}{2} \times 3^2)}$ **or** $m = \frac{270}{4.5}$ m = 60 (kg)	an answer of 60 (kg) scores **3** marks	1 1 1	4.1.1.2 AO2

<table>
<tr><td rowspan="4">11.4</td><td colspan="2">Level 2: Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear.</td><td>3–4</td><td rowspan="4">WS3.5
4.1.1.2
AO3</td></tr>
<tr><td colspan="2">Level 1: Relevant features are identified and differences noted.</td><td>1–2</td></tr>
<tr><td colspan="2">No relevant content</td><td>0</td></tr>
<tr><td colspan="2">Indicative content
• males have a greater muscle power than females for most of their lives
• males have a greater muscle power than females above 9/10 years old
• males have a lower muscle power than females below 9/10 years old
• there is a similar pattern for males and females as age increases
• males have a peak muscle power at 25 years old whereas females have a peak muscle power at 20/21 years old
• at 9/10 years old males have the same muscle power as females
• peak muscle power for males (47 W/kg) is greater than peak muscle power for females (37 W/kg)
• the rate of increase of muscle power is greater for males than females (between 5 and 25 years old)
• the rate of decrease of muscle power is greater for males than females.
Ignore comments relating to strength</td><td></td></tr>
<tr><td>11.5</td><td>any 1 from:

• maximum height reached is a better indicator of maximum muscle power
• maximum / peak muscle power was being investigated, not mean / average muscle power
• volunteer may not use maximum effort on the first try
• performance may improve with practise
• performance may get worse with tiredness</td><td>

allow maximum time in the air for maximum height reached / jumped</td><td>1</td><td>WS3.7
4.1.1.4
AO3</td></tr>
<tr><td>Total</td><td></td><td></td><td>12</td><td></td></tr>
</table>

AQA

GCSE PHYSICS

H

Higher Tier Paper 2H

Specimen 2018 Time allowed: 1 hour 45 minutes

Materials
For this paper you must have:
- a ruler
- a calculator
- a protractor
- the Physics Equation sheet (enclosed).

Instructions
- 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.

Information
- There are 100 marks available on this paper.
- 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.
- When answering questions 04.2, 05.1, 11.3 and 12.2 you need to make sure that your answer:
  – is clear, logical, sensibly structured
  – fully meets the requirements of the question
  – shows that each separate point or step supports the overall answer.

Advice
- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals.

Centre number Candidate number

Surname

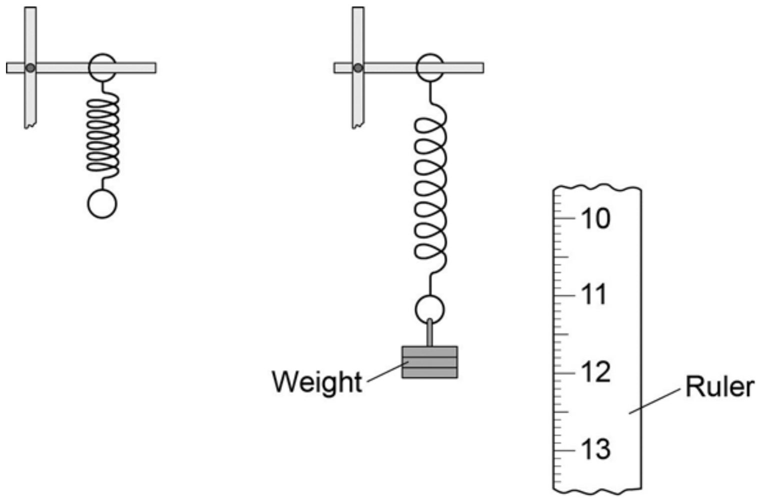
Forename(s)

Candidate signature

0 1 A student suspended a spring from a laboratory stand and then hung a weight from the spring.

Figure 1 shows the spring before and after the weight is added.

Figure 1



0 1 . 1 Measure the extension of the spring shown in **Figure 1**.

[1 mark]

Extension = ____________ mm

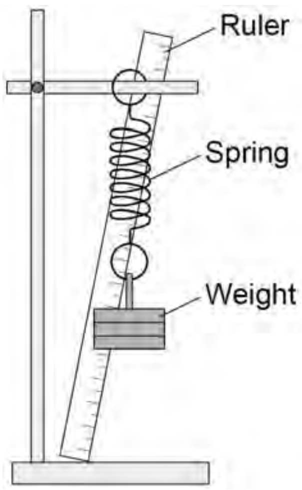
The student used the spring, a set of weights and a ruler to investigate how the extension of the spring depended on the weight hanging from the spring.

Before starting the investigation the student wrote the following prediction:

The extension of the spring will be directly proportional to the weight hanging from the spring.

Figure 2 shows how the student arranged the apparatus.

Figure 2



0 1 . 2 Before taking any measurements, the student adjusted the ruler to make it vertical.

Explain why adjusting the ruler was important.

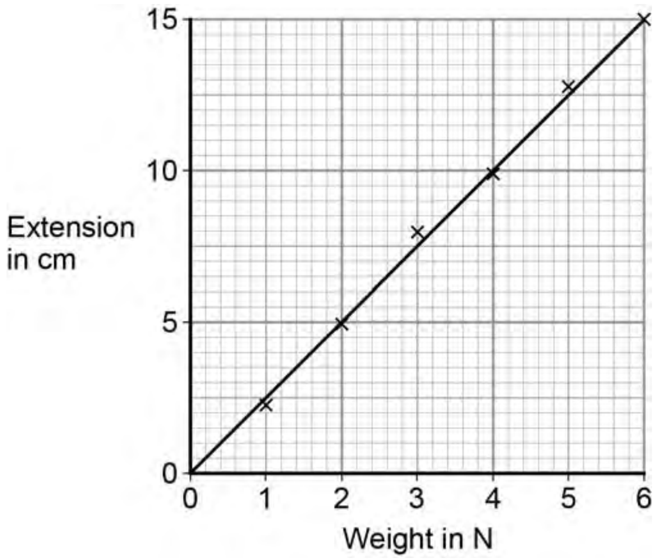
[2 marks]

Question 1 continues on the next page

The student measured the extension of the spring using a range of weights.

The student's data is shown plotted as a graph in **Figure 3**.

Figure 3



0 1 . 3 What range of weight did the student use?

[1 mark]

0 1 . 4 Why does the data plotted in **Figure 3** support the student's prediction?

[1 mark]

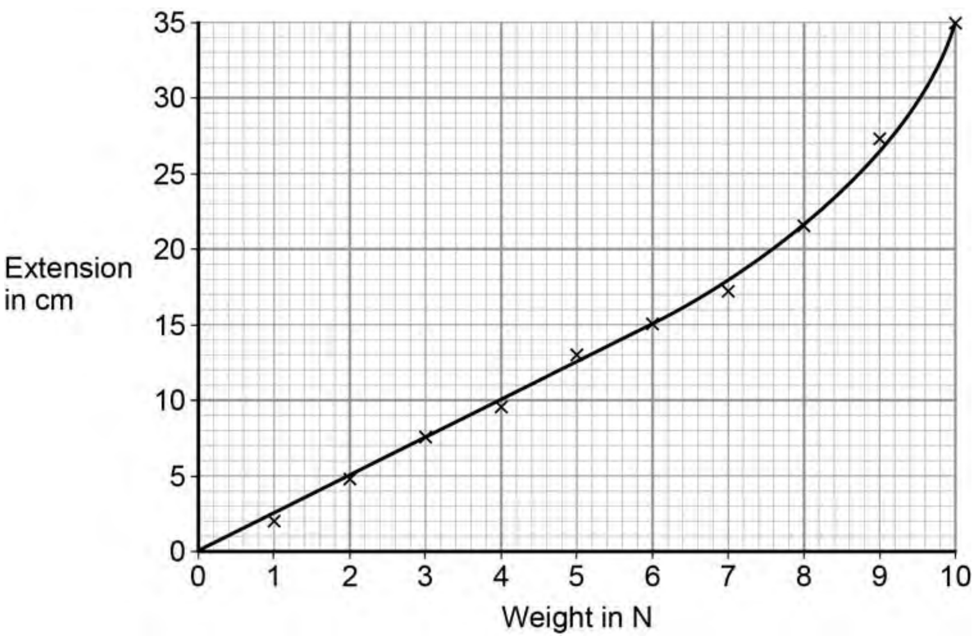
0 1 . 5 Describe **one** technique that you could have used to improve the accuracy of the measurements taken by the student.

[2 marks]

0 1 . 6 The student continued the investigation by increasing the range of weights added to the spring.

All of the data is shown plotted as a graph in **Figure 4**.

Figure 4



At the end of the investigation, all of the weights were removed from the spring.

What can you conclude from **Figure 4** about the deformation of the spring?

[2 marks]

Give the reason for your conclusion.

0 2 In 1929, the astronomer Edwin Hubble observed that the light from galaxies moving away from the Earth had longer wavelengths than expected.

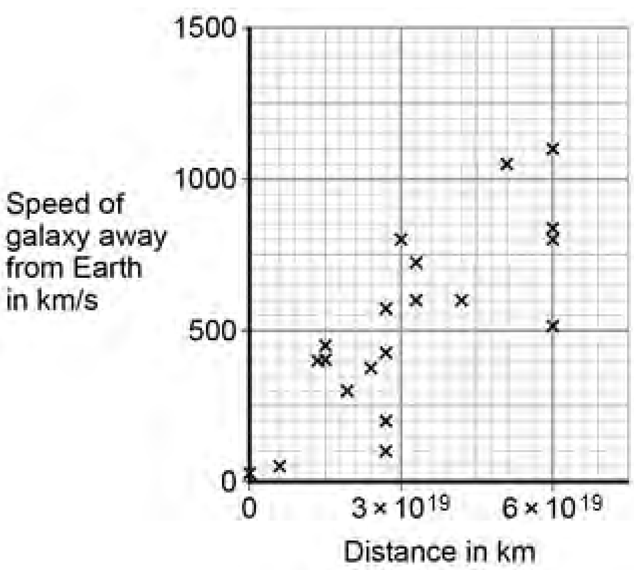
0 2 . 1 What name is given to this effect?

[1 mark]

0 2 . 2 From his observations, Hubble was able to calculate the speed of a galaxy and the distance of the galaxy from the Earth.

Figure 5 shows the results of Hubble's calculations.

Figure 5



What relationship between the speed of a galaxy and the distance is suggested by Hubble's results?

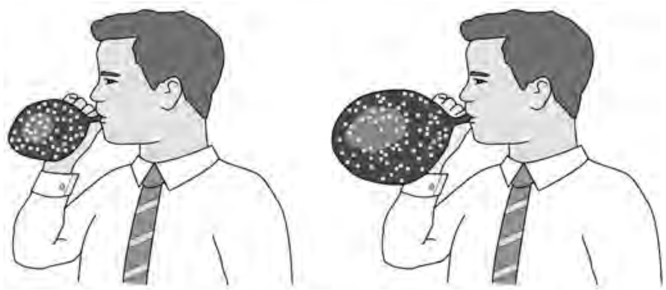
[1 mark]

The observations made by Hubble support the idea that the Universe is expanding. This means that galaxies are continually moving away from each other and from the Earth.

Figure 6 shows a student using a balloon to model the idea of an expanding Universe.

Some dots, which represent galaxies, were marked on the balloon.
The balloon was then inflated.

Figure 6



0 2 . 3 Give **one** strength and **one** weakness of this model in representing the idea of an expanding Universe.

[2 marks]

strength ____

weakness ____

In the 1950s there were two main theories to explain how the Universe began.

Theory 1	The Universe has always existed, it is continually expanding. New galaxies are formed as older galaxies die out.
Theory 2	The Universe began from a very small region that was extremely hot and dense. The Universe has been expanding ever since.

0 2 . 4 In what way do the observations made by Hubble support both Theory 1 and Theory 2?

[1 mark]

0 2 . 5 Most scientists now believe that Theory 2 is correct.

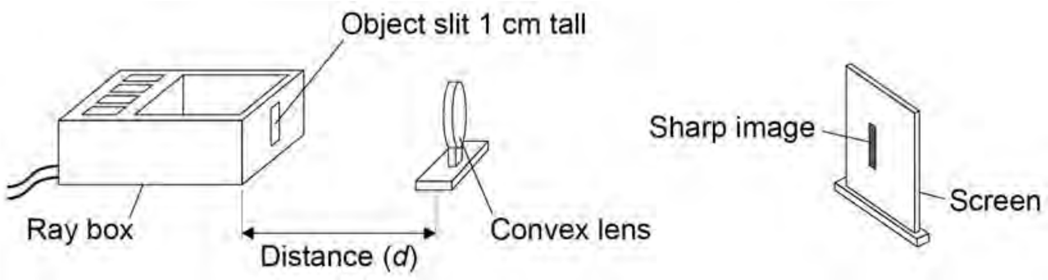
Suggest what is likely to have caused scientists to start thinking Theory 1 is wrong.

[1 mark]

0 3 A student investigated how the magnification produced by a convex lens varies with the distance (d) between the object and the lens.

The student used the apparatus shown in **Figure 7**.

Figure 7



0 3 . 1 The student measured the magnification produced by the lens by measuring the image height in centimetres.

Explain why the image height in centimetres was the same as the magnification.

[2 marks]

The data recorded by the student is given in **Table 1**.

Table 1

Distance between the object and the lens in cm	Magnification
25	4.0
30	2.0
40	1.0
50	0.7
60	0.5

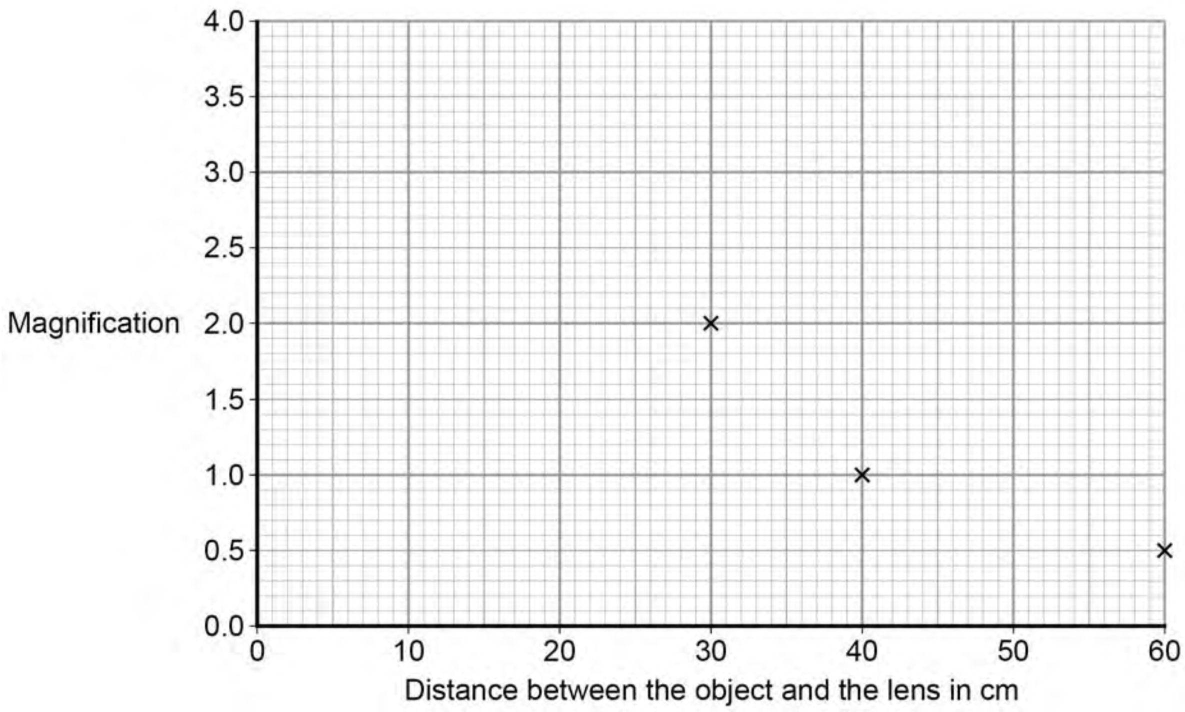
0 3 . 2 It would be difficult to obtain accurate magnification values for distances greater than 60 cm.

Suggest **one** change that could be made so that accurate magnification values could be obtained for distances greater than 60 cm.

[1 mark]

The graph in **Figure 8** is incomplete.

Figure 8



0 3 . 3 Complete the graph in **Figure 8** by plotting the missing data and then drawing a line of best fit.

[2 marks]

0 3 . 4 How many times bigger is the image when the object is 35cm from the lens compared to when the object is 55 cm from the lens?

[2 marks]

Question 3 continues on the next page

0 3 . 5 During the investigation the student also measured the distance between the lens and the image.

Table 2 gives both of the distances measured and the magnification.

Table 2

Distance between the lens and the image in cm	**Distance between the lens and the object in cm**	**Magnification**
100	25	4.0
60	30	2.0
40	40	1.0
33	50	0.7
30	60	0.5

Consider the data in **Table 2**.

Give a second way that the student could have determined the magnification of the object.

Justify your answer with a calculation.

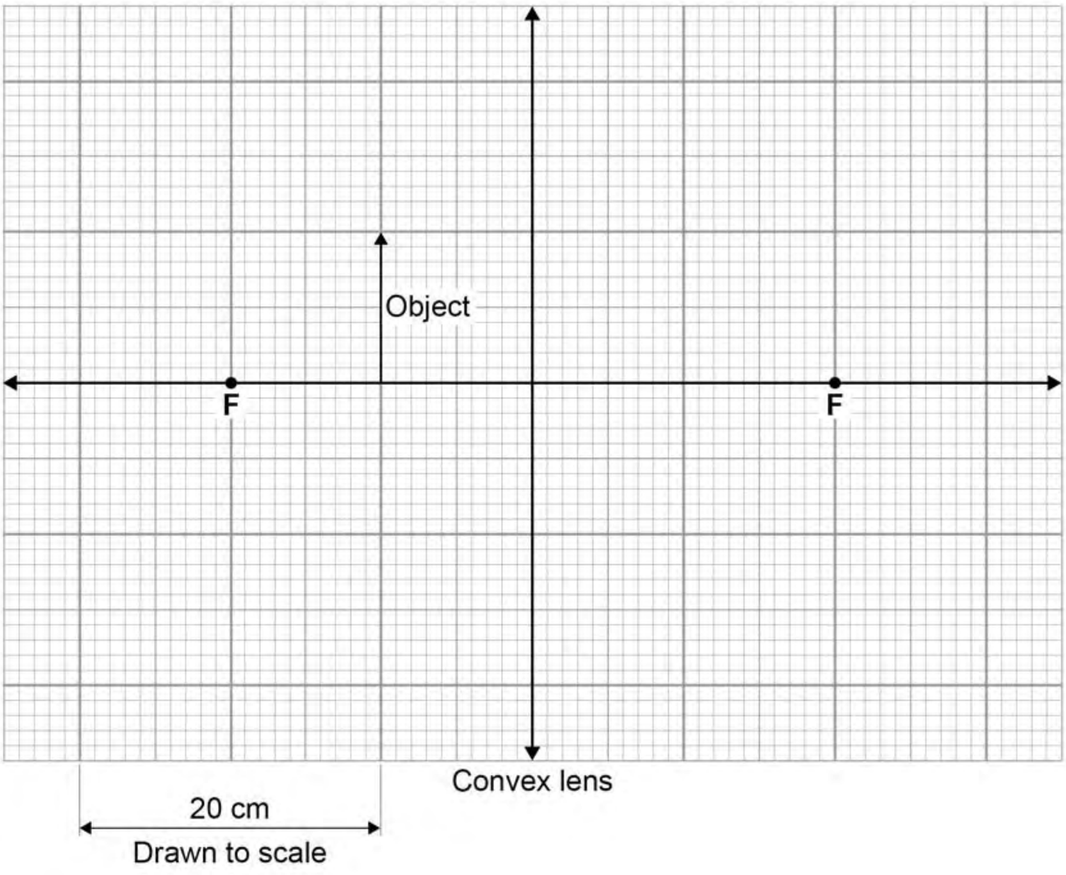
[2 marks]

0 3 . 6 Complete the ray diagram in **Figure 9** to show how the convex lens produces the image of a close object.

Use an arrow to represent the image.

[3 marks]

Figure 9

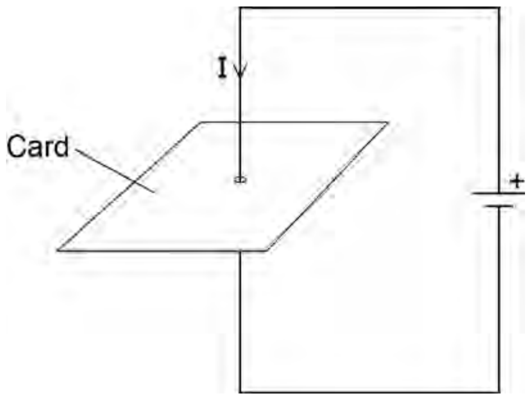


Turn over for the next question

0 4 **Figure 10** shows a straight wire passing through a piece of card.

A current (I) is passing down through the wire.

Figure 10



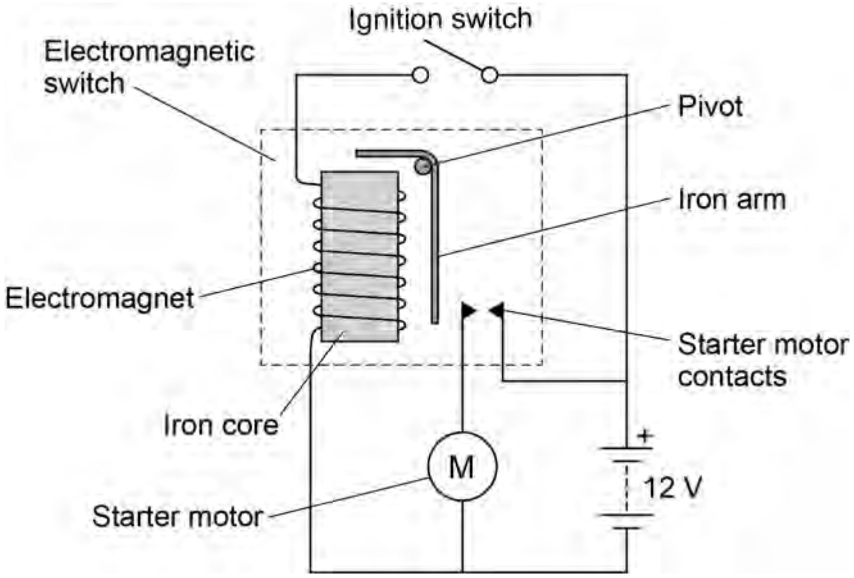
0 4 . 1 Describe how you could show that a magnetic field has been produced around the wire.

[2 marks]

0 4 . 2 **Figure 11** shows the ignition circuit used to switch the starter motor in a car on.

The circuit includes an electromagnetic switch.

Figure 11



Explain how the ignition circuit works.

[4 marks]

0 5 The data given in **Table 3** was obtained from an investigation into the refraction of light at an air to glass boundary.

Table 3

Angle of incidence	Angle of refraction
20°	13°
30°	19°
40°	25°
50°	30°

0 5 . 1 Describe an investigation a student could complete in order to obtain similar data to that given in **Table 3**.

Your answer should consider any cause of inaccuracy in the data.

A labelled diagram may be drawn as part of your answer.

[6 marks]

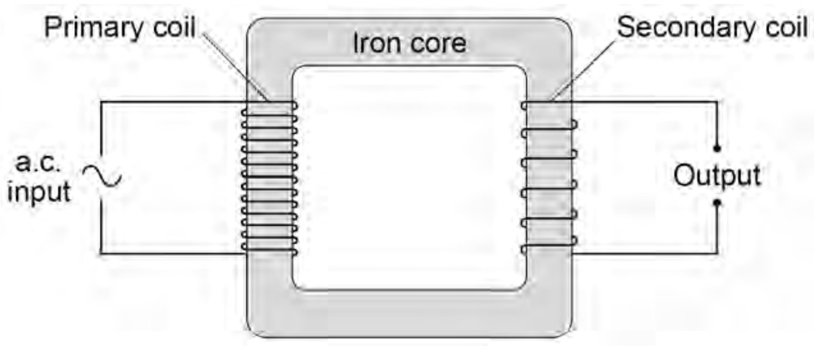
0 5 . 2 State the reason why light is refracted as it crosses from air into glass.

[1 mark]

Turn over for the next question

0 6 **Figure 12** shows the construction of a simple transformer.

Figure 12



0 6 . 1 Why is iron a suitable material for the core of a transformer?

[1 mark]

Tick **one** box.

It is a metal. ☐

It will not get hot. ☐

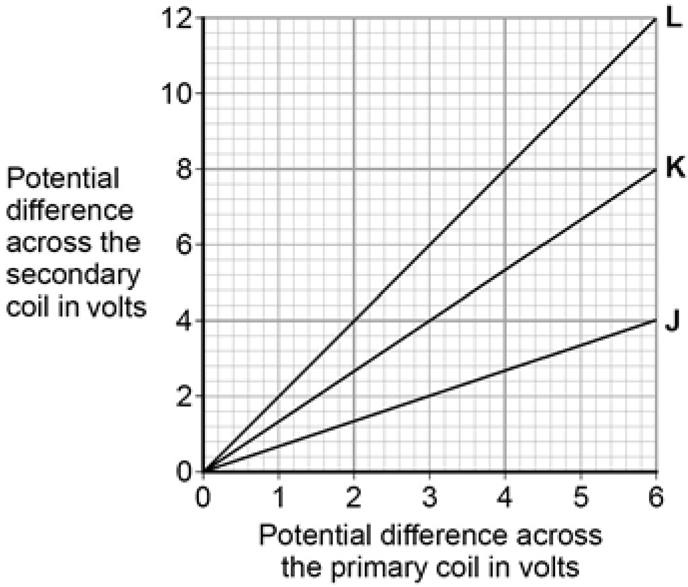
It is easily magnetised. ☐

It is an electrical conductor. ☐

A student makes three simple transformers, **J**, **K** and **L**.

Figure 13 shows how the potential difference across the secondary coil of each transformer varies as the potential difference across the primary coil of each transformer is changed.

Figure 13



0 6 . 2 How can you tell that transformer **J** is a step-down transformer?

[1 mark]

0 6 . 3 Each of the transformers has 50 turns on the primary coil.

Calculate the number of turns on the secondary coil of transformer **L**.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Number of turns on the secondary coil = ____________

0 7 In 2011, some of the scientists working at the CERN particle laboratory published the results of experiments they had conducted over the previous three years.

The scientists said that the results had shown that a particle, called a neutrino, was able to travel faster than the speed of light.

These unexpected results challenged the physics theory that nothing can travel faster than the speed of light.

0 7 . 1 Suggest why most other scientists thought that the experimental results were unbelievable.

[1 mark]

0 7 . 2 The scientists at CERN believed their results were correct but could not explain them.

Suggest **two** reasons why the scientists decided to publish their results.

[2 marks]

1

2

0 7 . 3 The experiments conducted by the scientists involved measuring the time it took neutrinos to travel from CERN to another laboratory 730 000 m away.

Using the data, the speed of the neutrinos was calculated to be 300 007 400 m/s.

Calculate the time it would take the neutrinos to travel 730 000 m at a speed of 300 007 400 m/s.

Give your answer in standard form.

[3 marks]

Time = ____________ s

In 2012, the scientists found that the unexpected results were caused by a timing error.

The error meant that the time recorded was always 60 nanoseconds less than the actual time.

0 7 . 4 Which **one** of the following is the same as 60 nanoseconds?

Tick **one** box.

[1 mark]

60×10^{-3} s ☐

60×10^{-6} s ☐

60×10^{-9} s ☐

0 7 . 5 What name is given to the type of error made by the scientists?

[1 mark]

0 7 . 6 Suggest what the scientists should do to calculate an accurate value for the speed of a neutrino.

[1 mark]

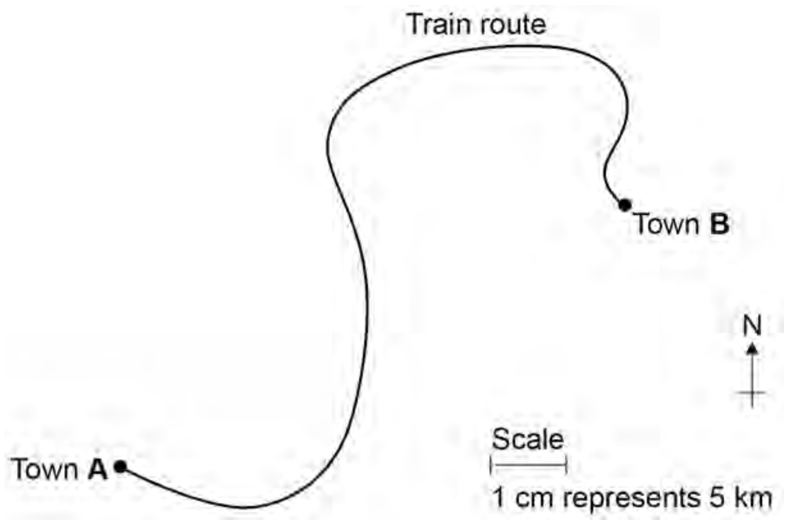
Turn over for the next question

There are no questions printed on this page

0 8 A train travels from town **A** to town **B**.

Figure 14 shows the route taken by the train.
Figure 14 has been drawn to scale.

Figure 14



0 8 . 1 The distance the train travels between **A** and **B** is not the same as the displacement of the train.

What is the difference between distance and displacement?

[1 mark]

0 8 . 2 Use **Figure 14** to determine the displacement of the train in travelling from **A** to **B**.

Show how you obtain your answer.

[2 marks]

Displacement = ____________ km

Direction = ____________

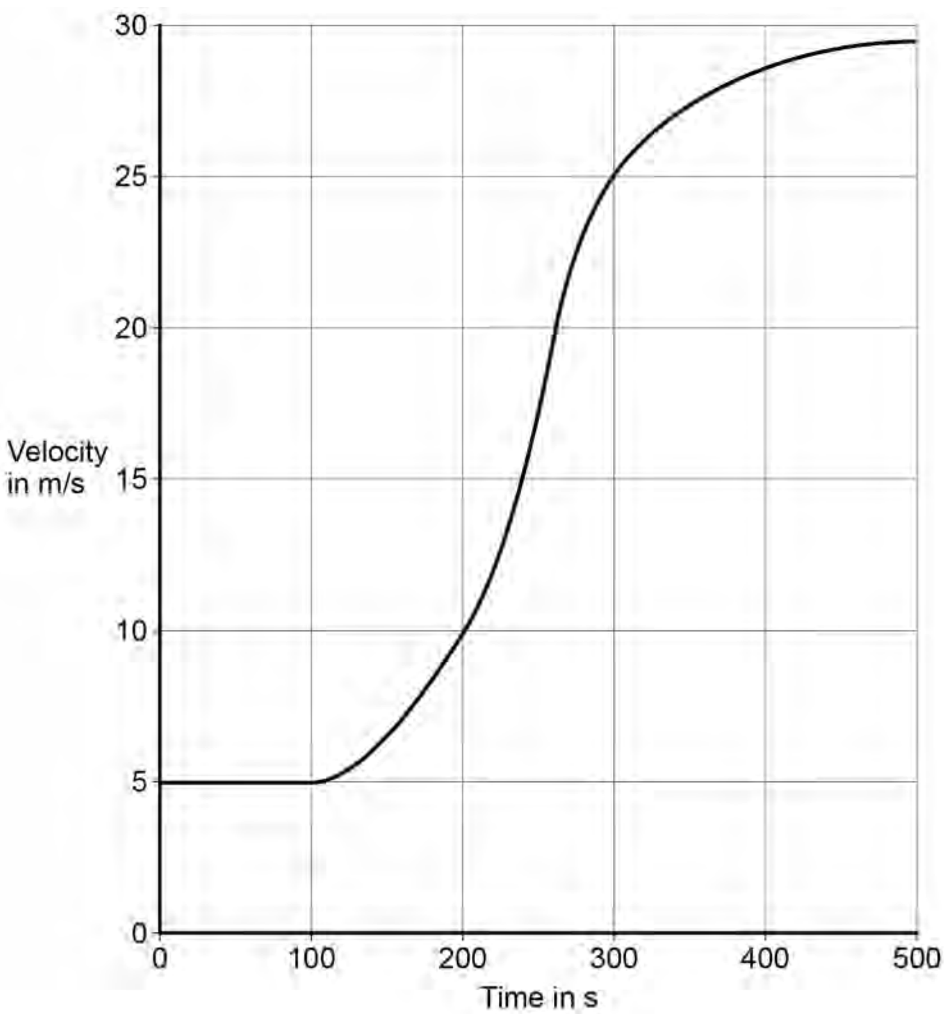
0 8 . 3 There are places on the journey where the train accelerates without changing speed.

Explain how this can happen.

[2 marks]

0 8 . 4 **Figure 15** shows how the velocity of the train changes with time as the train travels along a straight section of the journey.

Figure 15



Estimate the distance travelled by the train along the section of the journey shown in **Figure 15**.

To gain full marks you must show how you worked out your answer.

[3 marks]

Distance = ____________ m

Turn over for the next question

0 9 The stopping distance of a car is the sum of the thinking distance and the braking distance.

Table 4 shows how the thinking distance and braking distance vary with speed.

Table 4

Speed in m/s	**Thinking distance in m**	**Braking distance in m**
10	6	6.0
15	9	13.5
20	12	24.0
25	15	37.5
30	18	54.0

0 9 . 1 What is meant by the braking distance of a vehicle?

[1 mark]

0 9 . 2 The data in **Table 4** refers to a car in good mechanical condition driven by an alert driver.

Explain why the stopping distance of the car increases if the driver is very tired.

[2 marks]

0 9 . 3 A student looks at the data in **Table 4** and writes the following:

thinking distance $\propto$ speed

braking distance $\propto$ speed

Explain whether the student is correct.

[2 marks]

Applying the brakes with too much force can cause a car to skid.

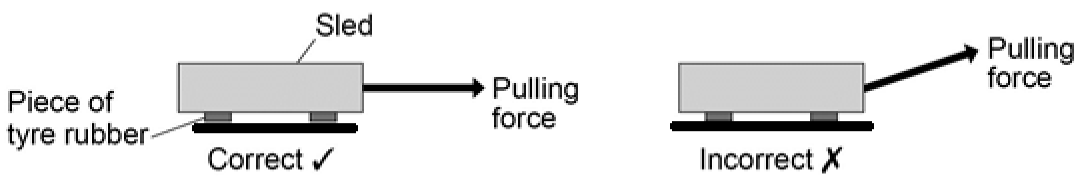
The distance a car skids before stopping depends on the friction between the road surface and the car tyres and also the speed of the car.

Friction can be investigated by pulling a device called a 'sled' across a surface at constant speed.

Figure 16 shows a sled being pulled correctly and incorrectly across a surface.

The constant of friction for the surface is calculated from the value of the force pulling the sled and the weight of the sled.

Figure 16



0 9 . 4 Why is it important that the sled is pulled at a constant speed?

[1 mark]

Tick **one** box.

If the sled accelerates it will be difficult to control. ☐

If the sled accelerates the value for the constant of friction will be wrong. ☐

If the sled accelerates the normal contact force will change. ☐

0 9 . 5 If the sled is pulled at an angle to the surface the value calculated for the constant of friction would not be appropriate.

Explain why.

[2 marks]

0 9 . 6 By measuring the length of the skid marks, an accident investigator determines that the distance a car travelled between the brakes being applied and stopping was 22 m.

The investigator used a sled to determine the friction. The investigator then calculated that the car decelerated at 7.2 m/s^2.

Calculate the speed of the car just before the brakes were applied.

Give your answer to two significant figures.

Use the correct equation from the Physics Equation Sheet.

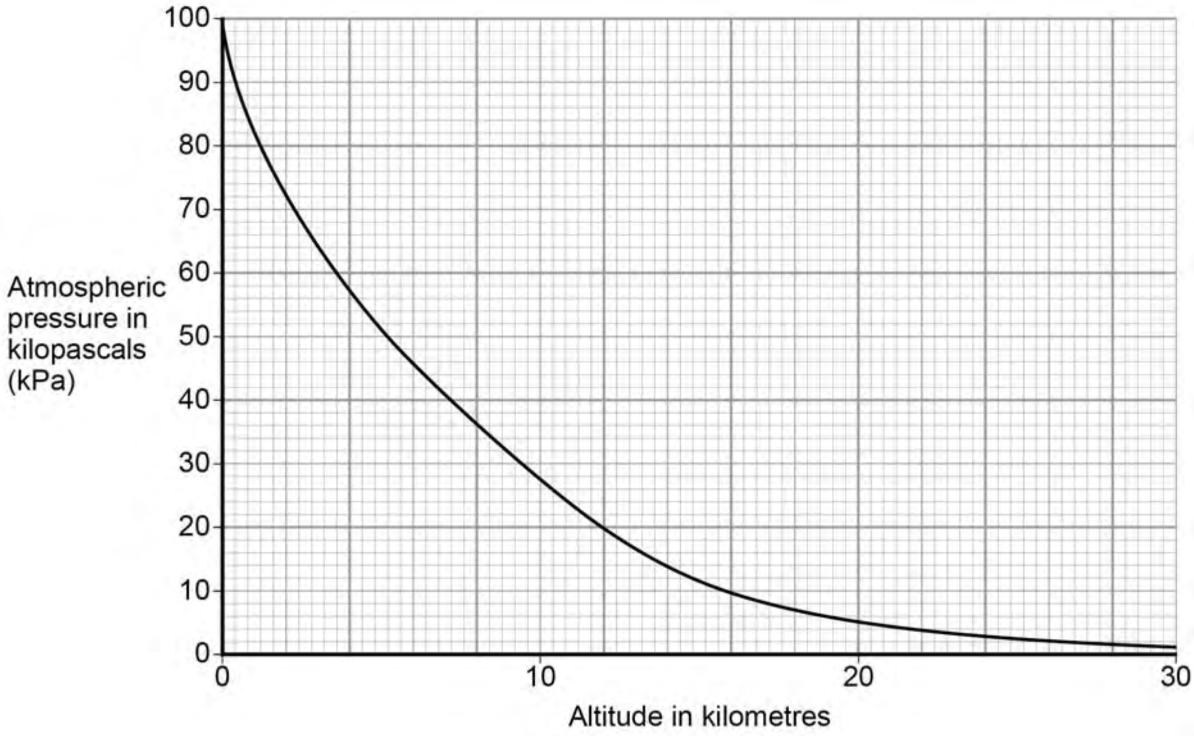
[3 marks]

Speed = ________________________ m/s

Turn over for the next question

1 0 **Figure 17** shows how atmospheric pressure varies with altitude.

Figure 17



1 0 . 1 Explain why atmospheric pressure decreases with increasing altitude.

[3 marks]

1 0 . 2 When flying, the pressure inside the cabin of an aircraft is kept at 70 kPa.

The aircraft window has an area of 810 cm^2.

Use data from **Figure 17** to calculate the resultant force acting on an aircraft window when the aircraft is flying at an altitude of 12 km.

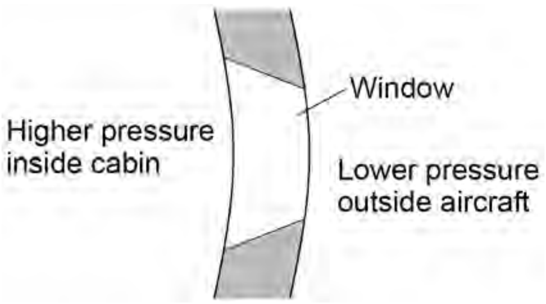
Give your answer to two significant figures

[5 marks]

Resultant force = ____________ N

1 0 . 3 **Figure 18** shows the cross-section of one type of aircraft window.

Figure 18



Explain why the window has been designed to have this shape.

[2 marks]

1 1 Waves may be either longitudinal or transverse.

1 1 . 1 Describe the difference between a longitudinal and a transverse wave.

[2 marks]

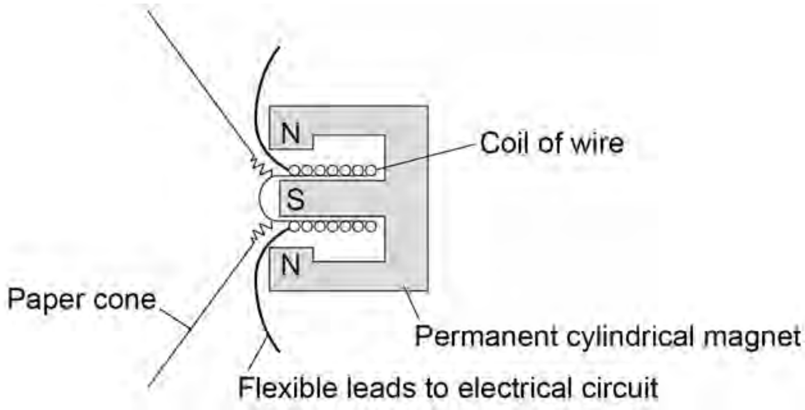
1 1 . 2 Describe **one** piece of evidence that shows when a sound wave travels through the air it is the wave and not the air itself that travels.

[1 mark]

11 . 3 **Figure 19** shows the parts of a moving-coil loudspeaker.

A coil of wire is positioned in the gap between the north and south poles of the cylindrical magnet.

Figure 19

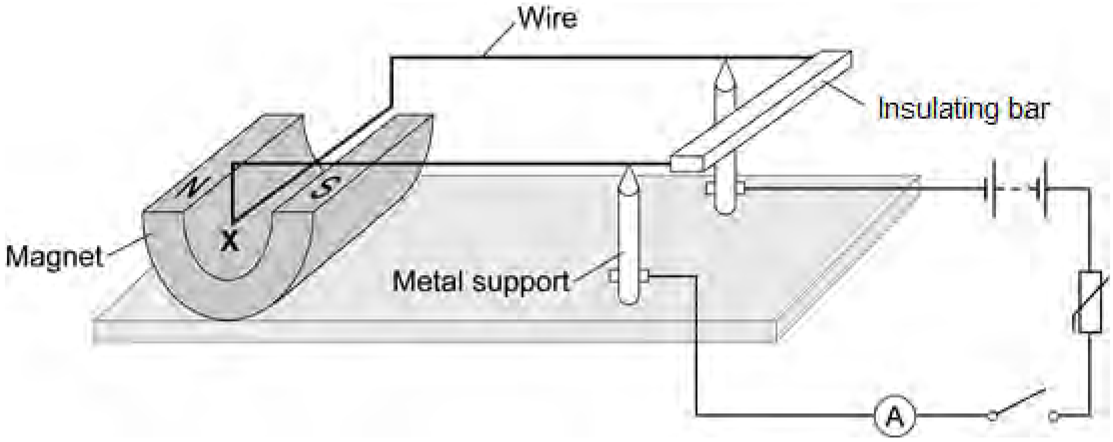


Explain how the loudspeaker converts current in an electrical circuit to a sound wave.

[6 marks]

1 2 **Figure 20** shows a piece of apparatus called a current balance.

Figure 20



When the switch is closed, the part of the wire labelled **X** experiences a force and moves downwards.

1 2 . 1 What is the name of the effect that causes the wire **X** to move downwards?

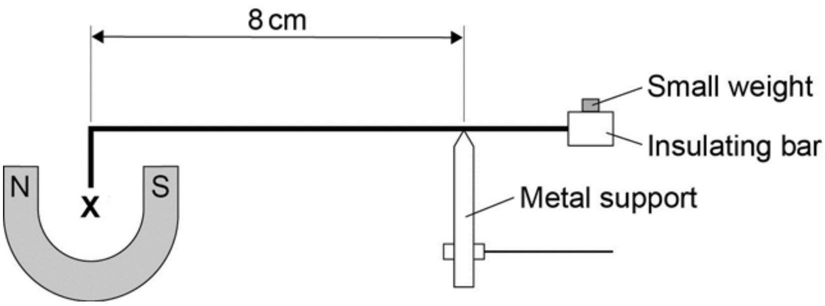
[1 mark]

1 2 . 2 Suggest one change you could make to the apparatus in **Figure 20** that would increase the size of the force that wire **X** experiences.

[1 mark]

Figure 21 shows how a small weight placed on the insulating bar makes the wire **X** go back and balance in its original position.

Figure 21



1 2 . 3 The wire **X** is 5 cm long and carries a current of 1.5 A.

The small weight causes a clockwise moment of 4.8×10^{-4} Nm.

Calculate the magnetic flux density where the wire **X** is positioned

Give the unit.

[6 marks]

Magnetic flux density = ________________ Unit ________________

END OF QUESTIONS

SPECIMEN MATERIAL

GCSE
PHYSICS

Higher Tier Paper 1H

H

Specimen 2018 Time allowed: 1 hour 45 minutes

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

Instructions
- 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.

Information
- There are 100 marks available on this paper.
- 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.
- When answering questions 02, 12 and 13.4 you need to make sure that your answer:
  - – is clear, logical, sensibly structured
  - – fully meets the requirements of the question
  - – shows that each separate point or step supports the overall answer.

Advice
- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

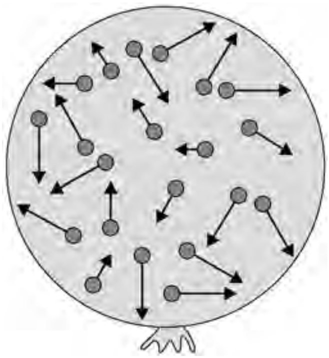
Surname

Forename(s)

Candidate signature ______________________

0 1 **Figure 1** shows a balloon filled with helium gas.

Figure 1



0 1 . 1 Describe the movement of the particles of helium gas inside the balloon.

[2 marks]

0 1 . 2 What name is given to the total kinetic energy and potential energy of all the particles of helium gas in the balloon?

[1 mark]

Tick **one** box.

External energy ☐

Internal energy ☐

Movement energy ☐

0 1 . 3 Write down the equation which links density, mass and volume.

[1 mark]

0 1 . 4 The helium in the balloon has a mass of 0.00254 kg.

The balloon has a volume of 0.0141 m^3.

Calculate the density of helium. Choose the correct unit from the box.

[3 marks]

m^3 / kg	**kg / m^3**	**kg m^3**

Density = ____________ Unit: ____________

Turn over for the next question

There are no questions printed on this page

0 2 Scientists sometimes replace one scientific model with a different model.

For example in the early 20th Century the plum pudding model of the atom was replaced by the nuclear model of the atom.

Explain what led to the plum pudding model of the atom being replaced by the nuclear model of the atom.

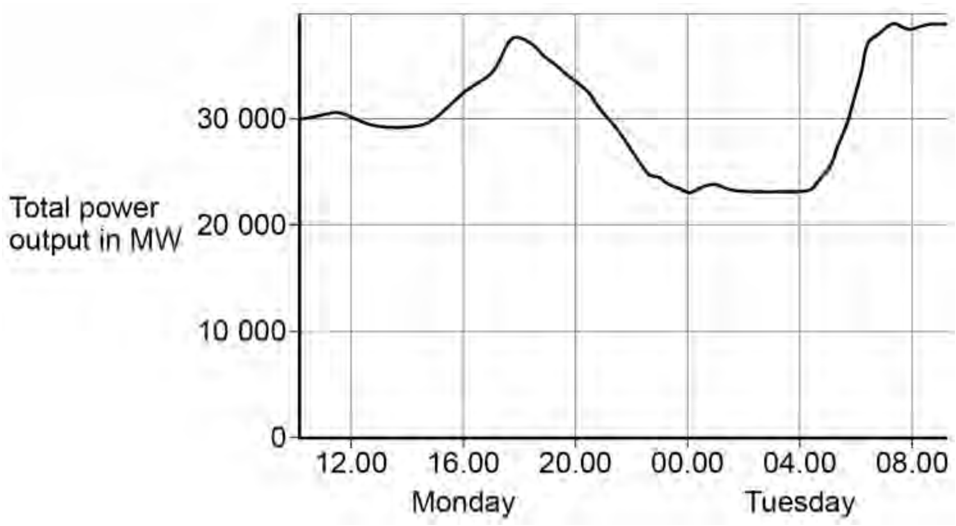
[6 marks]

Turn over for the next question

0 3 The National Grid ensures that the supply of electricity always meets the demand of the consumers.

Figure 2 shows how the output from fossil fuel power stations in the UK varied over a 24-hour period.

Figure 2



0 3 . 1 Suggest **one** reason for the shape of the graph between 15.00 and 18.00 on Monday.

[1 mark]

0 3 . 2 Gas fired power stations reduce their output when demand for electricity is low.

Suggest **one** time on **Figure 2** when the demand for electricity was low.

[1 mark]

0 3 . 3 The National Grid ensures that fossil fuel power stations in the UK only produce about 33% of the total electricity they could produce when operating at a maximum output.

Suggest **two** reasons why.

[2 marks]

1

2

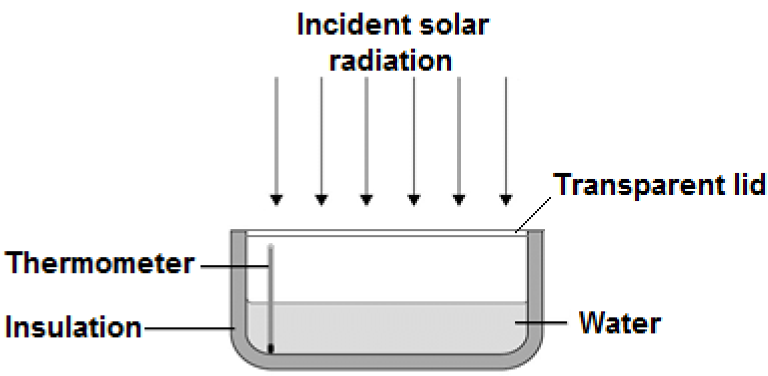
Turn over for the next question

0 4 A student investigated how much energy from the Sun was incident on the Earth's surface at her location.

She put an insulated pan of water in direct sunlight and measured the time it took for the temperature of the water to increase by 0.6 °C.

The apparatus she used is shown in **Figure 3**.

Figure 3



0 4 . 1 Choose the most appropriate resolution for the thermometer used by the student.

[1 mark]

Tick **one** box.

0.1 °C ☐

0.5 °C ☐

1.0 °C ☐

The energy transferred to the water was 1050 J.

The time taken for the water temperature to increase by 0.6 °C was 5 minutes.

The specific heat capacity of water is 4200 J/kg °C.

0 4 . 2 Write down the equation which links energy transferred, power and time.

[1 mark]

0 4 . 3 Calculate the mean power supplied by the Sun to the water in the pan.

[2 marks]

Average power = ____________ W

0 4 . 4 Calculate the mass of water the student used in her investigation.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

Mass = ____________ kg

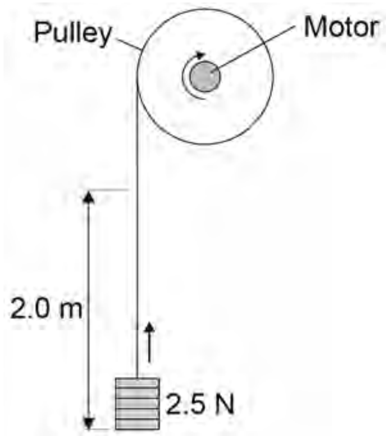
0 4 . 5 The student's results can only be used as an estimate of the mean power at her location.

Give **one** reason why.

[1 mark]

0 5 A student investigated the efficiency of a motor using the equipment in **Figure 4**.

Figure 4



He used the motor to lift a weight of 2.5 N a height of 2.0 m.

He measured the speed at which the weight was lifted and calculated the efficiency of the energy transfer.

He repeated the experiment to gain two sets of data.

0 5 . 1 Give **one** variable that the student controlled in his investigation.

[1 mark]

____

0 5 . 2 Give **two** reasons for taking repeat readings in an investigation.

[2 marks]

1 ____

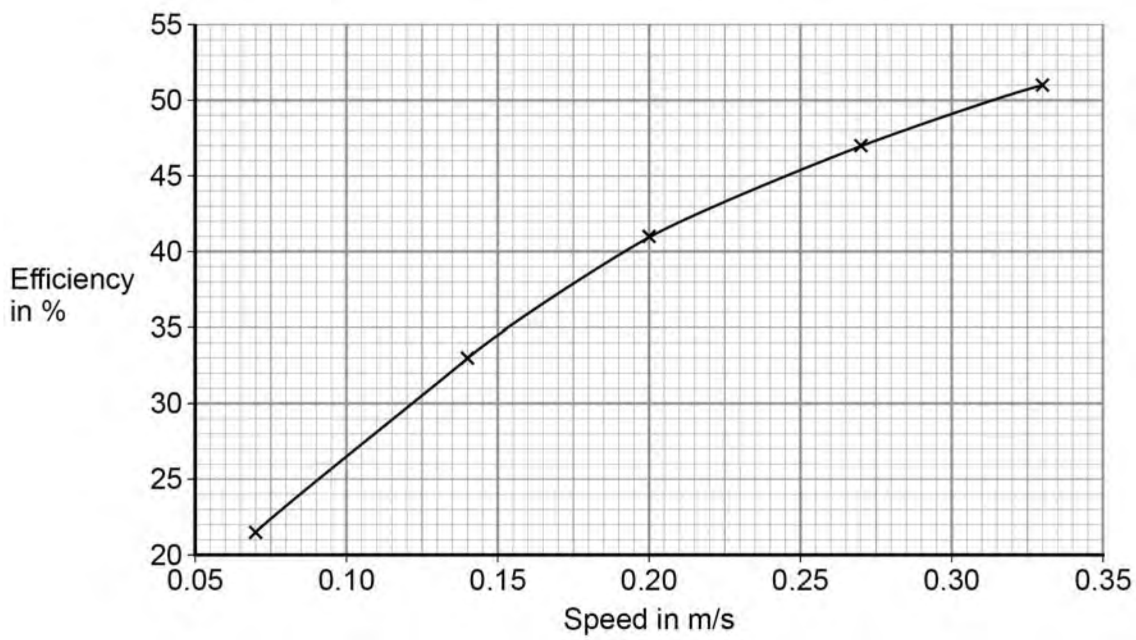
____

2 ____

____

Figure 5 shows a graph of the student's results.

Figure 5



0 5 . 3 Give **two** conclusions that could be made from the data in **Figure 5**?

[2 marks]

0 5 . 4 Give the main way that the motor is likely to waste energy.

[1 mark]

0 5 . 5 When the total power input to the motor was 5 W the motor could not lift the 2.5 N weight.

State the efficiency of the motor.

[1 mark]

Efficiency = ____________ %

0 6 **Figure 6** shows a Van de Graaff generator that is used to investigate static electricity.

Before it is switched on, the metal dome has no net charge.

After it is switched on, the metal dome becomes positively charged.

Figure 6

0 6 . 1 Explain how an uncharged object may become positively charged.

[3 marks]

0 6 . 2 **Figure 7** shows a plan view of the positively charged metal dome of a Van de Graaff generator.

Draw the electric field pattern around the metal dome when it is isolated from its surroundings.

Use arrows to show the direction of the electric field.

[2 marks]

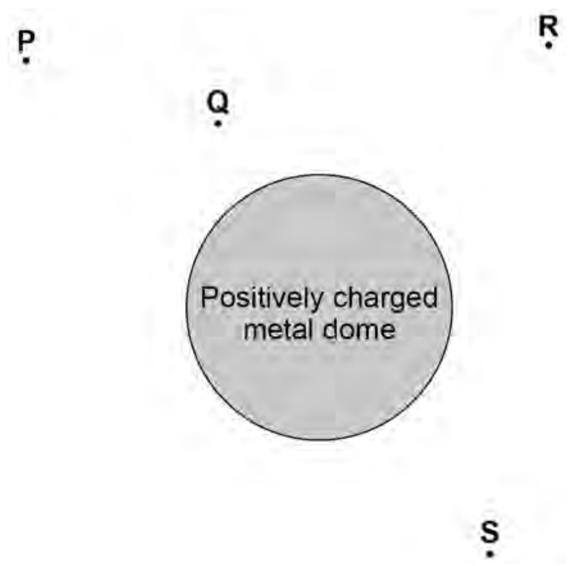
Figure 7

Question 6 continues on the next page

0 6 . 3 Another positively charged object is placed in the electric field.

Look at **Figure 8**.

Figure 8



In which position would the object experience the greatest force?

Tick **one** box.

[1 mark]

P ☐

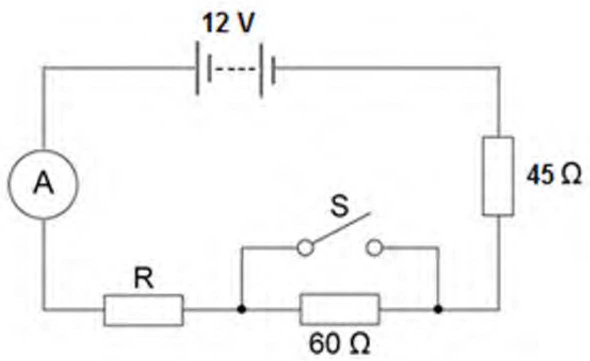
Q ☐

R ☐

S ☐

0 7 A student set up the electrical circuit shown in **Figure 9**.

Figure 9



0 7 . 1 The ammeter displays a reading of 0.10 A.

Calculate the potential difference across the 45 Ω resistor.

[2 marks]

Potential difference = ____________ V

0 7 . 2 Calculate the resistance of the resistor labelled **R**.

[3 marks]

Resistance = ____________ Ω

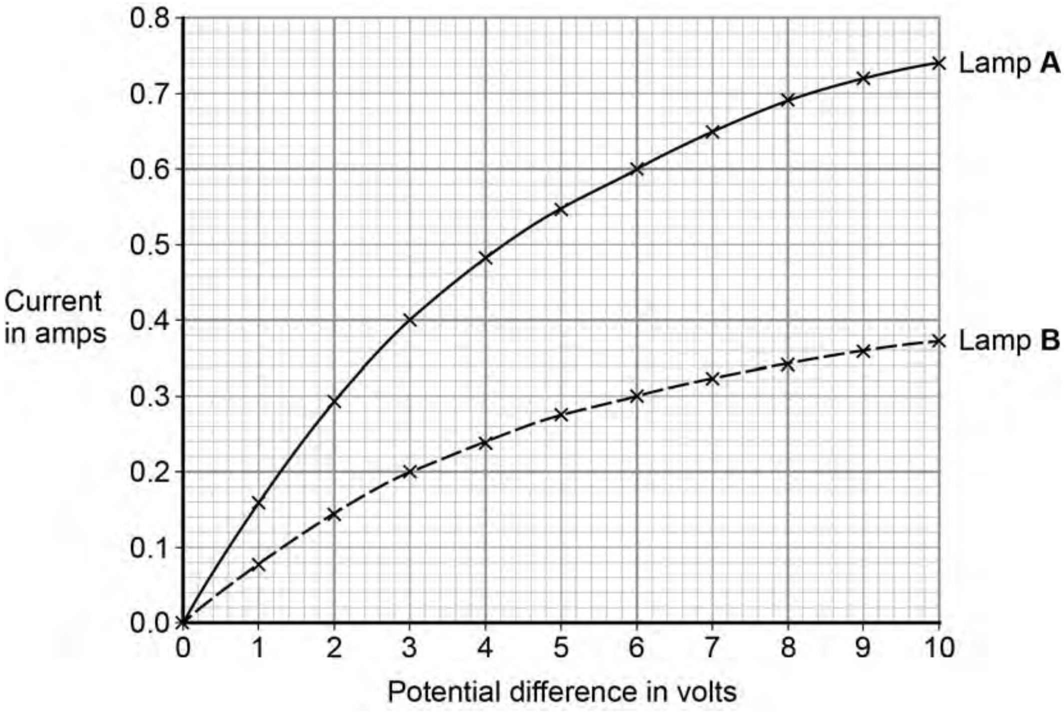
0 7 . 3 State what happens to the total resistance of the circuit and the current through the circuit when switch **S** is closed.

[2 marks]

0 8 A student investigated how current varies with potential difference for two different lamps.

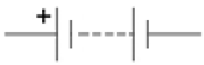
Her results are shown in **Figure 10**.

Figure 10



0 8 . 1 Complete the circuit diagram for the circuit that the student could have used to obtain the results shown in **Figure 10**.

[3 marks]



0 8 . 2 Which lamp will be brighter at any potential difference?

Explain your answer.

Use **Figure 10** to aid your explanation

[2 marks]

0 8 . 3 Lamp **B** has the higher resistance at any potential difference.

Explain how **Figure 10** shows this.

[2 marks]

0 8 . 4 Both lamps behave like ohmic conductors through a range of values of potential difference.

Use **Figure 10** to determine the range for these lamps.

Explain your answer.

[3 marks]

0 9 A student models the random nature of radioactive decay using 100 dice.

He rolls the dice and removes any that land with the number 6 facing upwards.

He rolls the remaining dice again.

The student repeats this process a number of times.

Table 1 shows his results.

Table 1

Roll number	**Number of dice remaining**
0	100
1	84
2	70
3	59
4	46
5	40
6	32
7	27
8	23

0 9 . 1 Give **two** reasons why this is a good model for the random nature of radioactive decay.

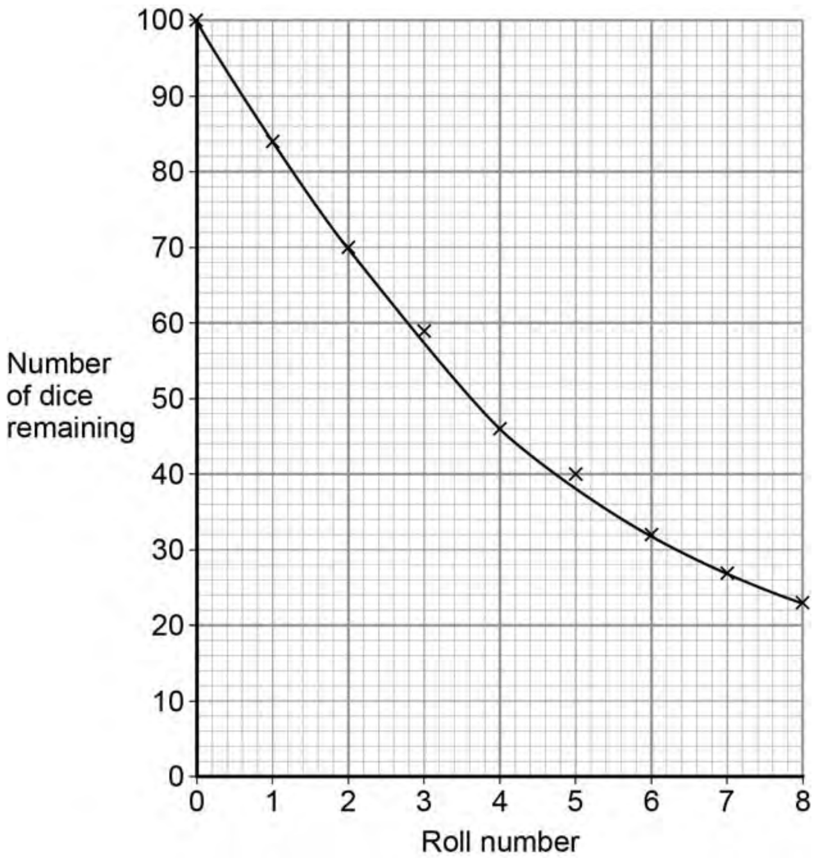
[2 marks]

1

2

The student's results are shown in **Figure 11**.

Figure 11



0 9 . 2 Use **Figure 11** to determine the half-life for these dice using this model.

Show on **Figure 11** how you work out your answer.

[2 marks]

Half-life = ____________________ rolls

Question 9 continues on the next page

A teacher uses a protactinium (Pa) generator to produce a sample of radioactive material that has a half-life of 70 seconds.

In the first stage in the protactinium generator, uranium (U) decays into thorium (Th) and alpha (α) radiation is emitted.

The decay can be represented by the equation shown in **Figure 12**.

Figure 12

$$^{238}_{92}U \longrightarrow {}^{234}_{\boxed{}}Th + \alpha$$

0 9 . 3 Determine the atomic number of thorium (Th) 234.

[1 mark]

Atomic number = ____________________

When protactinium decays, a new element is formed and radiation is emitted.

The decay can be represented by the equation shown in **Figure 13**.

Figure 13

$$^{234}_{91}Pa \rightarrow {}^{234}_{92}X + radiation$$

0 9 . 4 When protactinium decays, a new element, **X**, is formed.

Use information from **Figure 12** and **Figure 13** to determine the name of element **X**.

[1 mark]

____

0 9 . 5 Determine the type of radiation emitted as protactinium decays into a new element.

Give a reason for your answer.

[2 marks]

0 9 . 6 The teacher wears polythene gloves as a safety precaution when handling radioactive materials.

The polythene gloves do **not** stop the teacher's hands from being irradiated.

Explain why the teacher wears polythene gloves.

[2 marks]

Turn over for the next question

1 0 Electricity is generated in a nuclear power station.

Fission is the process by which energy is released in the nuclear reactor.

1 0 . 1 **Figure 14** shows the first part of the nuclear fission reaction.

Complete **Figure 14** to show how the fission process starts a chain reaction.

[3 marks]

Figure 14

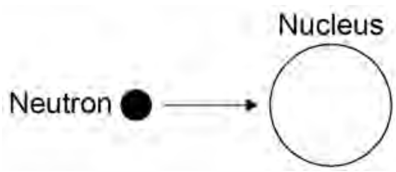
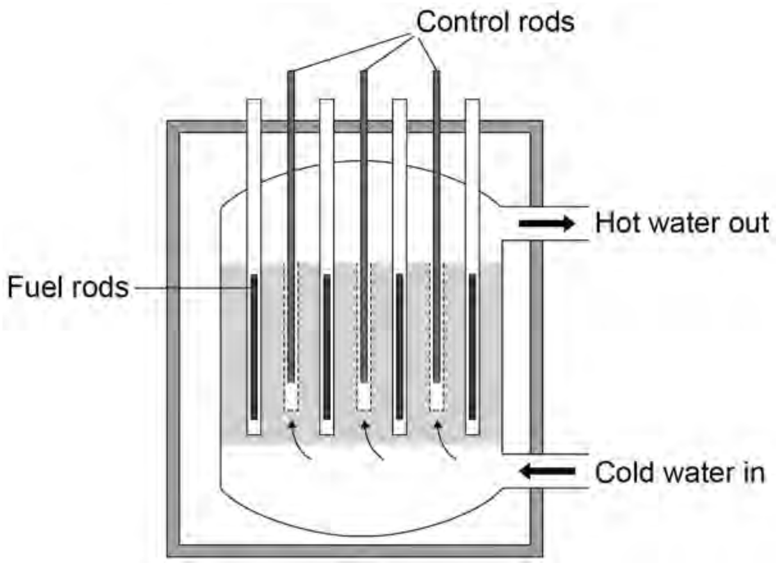


Figure 15 shows the inside of a nuclear reactor in a nuclear power station.

Figure 15



1 0 . 2 In a nuclear reactor a chain reaction occurs, which causes neutrons to be released.

The control rods absorb neutrons.

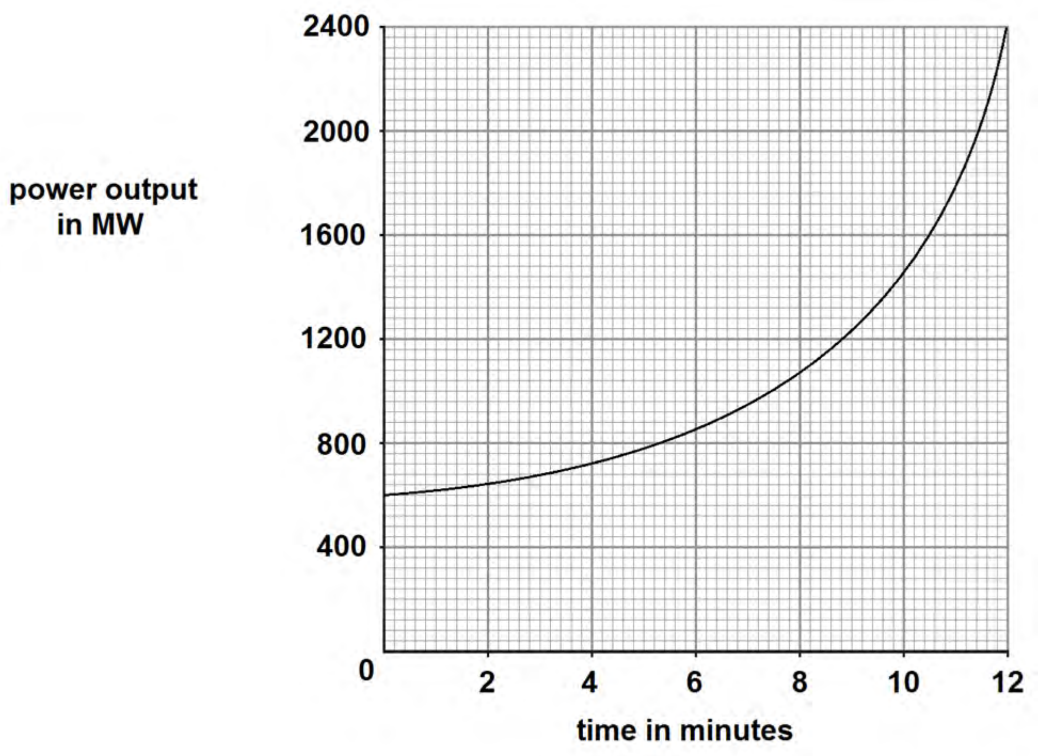
The control rods can be moved up and down.

Explain how the energy released by the chain reaction is affected by moving the control rods.

[2 marks]

Figure 16 shows how the power output of the nuclear reactor would change if the control rods were removed.

Figure 16



1 0 . 3 Calculate the rate of increase of power output at 10 minutes.

[2 marks]

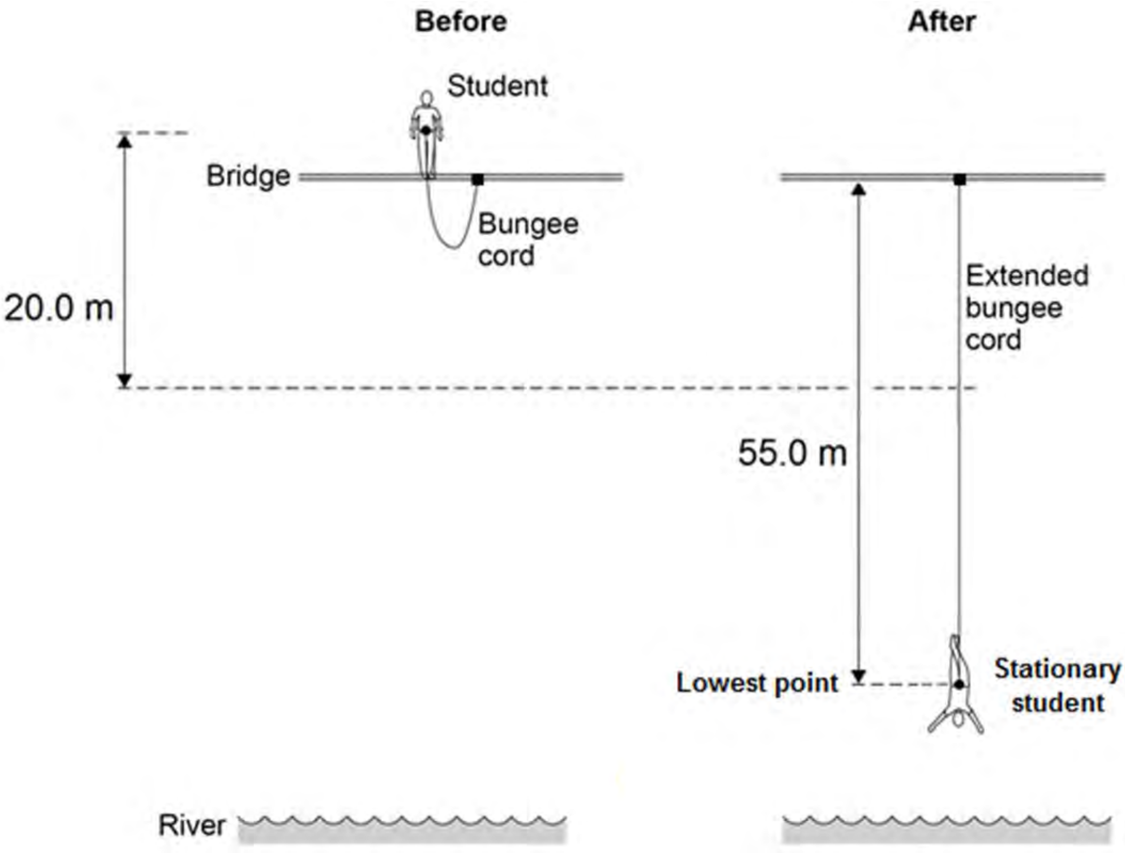
Rate of increase of power output = ____________ MW / minute

Turn over for the next question

1 1 **Figure 17** shows a student before and after a bungee jump.

The bungee cord has an unstretched length of 20.0 m.

Figure 17



The mass of the student is 50.0 kg.

The gravitational field strength is 9.8 N/kg.

1 1 . 1 Write down the equation which links gravitational field strength, gravitational potential energy, height and mass.

[1 mark]

____

1 1 . 2 Calculate the change in gravitational potential energy from the position where the student jumps to the point 20.0 m below.

[2 marks]

____

____

____

Change in gravitational potential energy = ____________________ J

1 1 . 3 80% of this change in gravitational potential energy has been transferred to the student's kinetic energy store.

How much has the student's kinetic energy store increased after falling 20.0 m?

[1 mark]

Kinetic energy gained = ____________________ J

1 1 . 4 Calculate the speed of the student after falling 20.0 m.

Give your answer to two significant figures.

[4 marks]

Speed = ____________________ m/s

1 1 . 5 At the lowest point in the jump, the energy stored by the stretched bungee cord is 24.5 kJ.

The bungee cord behaves like a spring.

Calculate the spring constant of the bungee cord.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

Spring constant = ____________________ N / m

1 2 A student wants to calculate the density of the two objects shown in **Figure 18**.

Figure 18

Metal cube

Small statue

Describe the methods that the student should use to calculate the densities of the two objects.

[6 marks]

1 3 An electrician is replacing an old electric shower with a new one.

The inside of the old shower is shown in **Figure 19**.

Figure 19

1 3 . 1 If the electrician touches the live wire he will receive an electric shock.

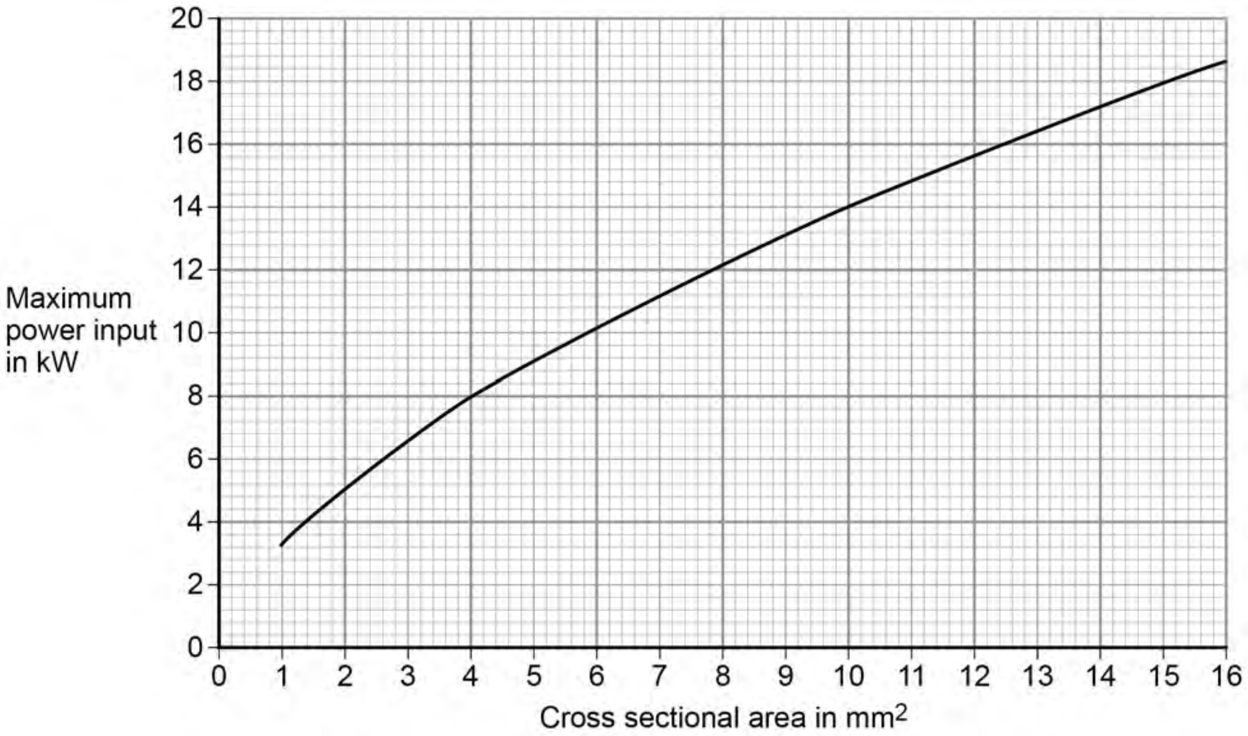
Explain why.

[4 marks]

Different electrical wires need to have a cross-sectional area that is suitable for the power output.

Figure 20 shows the recommended maximum power input to wires of different cross-sectional areas.

Figure 20



1 3 . 2 The new electric shower has a power input of 13.8 kW.

Determine the minimum **diameter** of wire that should be used for the new shower.

The diameter, d, can be calculated using the equation:

$$d = \sqrt{\frac{4A}{\pi}}$$

A is the cross-sectional area of the wire.

[2 marks]

Minimum diameter = ____________ mm

1 3 . 3 The charge that flows through the new shower in 300 seconds is 18 000 C.
The new electric shower has a power of 13.8 kW.

Calculate the resistance of the heating element in the new shower.

Write down any equations you use.

[5 marks]

Resistance = ____________________ Ω

END OF QUESTIONS

SPECIMEN MATERIAL

GCSE
PHYSICS
PAPER 2H

Mark scheme

Specimen 2018

Version 1.0

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Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	accept any value between 12 (mm) and 13(mm) inclusive		1	AO2/2 4.5.3
01.2	to reduce the error in measuring the extension of the spring as the ruler at an angle would make the measured extensions shorter	accept length for extension throughout	1 1	AO3/3a 4.5.3
01.3	1 (N) to 6 (N)	accept from 0 (N) to 6 (N)	1	AO2/2 4.5.3
01.4	gives a straight line through the origin		1	AO3/1a 4.5.3
01.5	any practical technique that would improve the accuracy of length measurement eg use a set square to line up the bottom of the spring with the ruler scale **or** attach a horizontal pointer to the bottom of the spring (1) so that the pointer goes across the ruler scale (1)		1 1	AO3/3b 4.5.3
01.6	the spring has been inelastically deformed because it went past its limit of proportionality	accept elastic limit for limit of proportionality accept it does not go back to its original length when the weights are removed	1 1	AO3/2a AO2/2 4.5.3
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	red–shift		1	AO1/1 4.8.2
02.2	the further away from the Earth, the faster a galaxy is moving		1	AO3/1a 4.8.2 WS3.5
02.3	**strength** as the balloon expands the dots get further apart, representing the galaxies moving apart **weakness** dots are only on the surface of the balloon, galaxies are throughout the universe **or** there is a limit to how far the balloon can expand		1 1	AO3/1b 4.8.2 WS1.2
02.4	both theories suggest that the Universe is expanding		1	AO1/2 4.8.2
02.5	new evidence / observations that cannot be explained by Theory 1	accept specific example of new evidence ie CMBR	1	AO1/1 4.8.2 WS1.1
Total			**6**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	$\text{magnification} = \dfrac{\text{image height}}{\text{object height}}$ dividing by an object height of 1 cm gives the same (numerical) value		1 1	AO3/1b 4.6.2.5
03.2	accept anything practical that would work eg: use a taller object use a (travelling) microscope attach a scale to the screen and used a magnifying glass		1	AO3/3b 4.6.2.5 WS2.3/7
03.3	both points plotted correctly correct line of best fit drawn	 a curve passing through all points (within ½ square), judge by eye	1 1	AO2/2 4.6.2.5 WS3.1/2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	values of 1.4 and 0.6 extracted from the graph 2.33 times bigger	accept any number between 2.3 and 2.5 inclusive	1 1	AO2/2 4.6.2.5 WS3.5
03.5	by dividing the distance between the lens and the image by the distance between the lens and the object at least one correct calculation and comparison eg 100÷25 = 4 which is the same as the measured magnification		1 1	AO3/1a AO2/2 4.6.2.5 WS3.5
03.6	any two correct construction lines upright image drawn correctly	construction lines can be dotted or solid the image line can be dotted or solid but must show correct orientation ignore any arrows drawn on construction lines	2 1	AO2/2 4.6.2.5
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	move a (magnetic/plotting) compass around the wire the changing direction of the compass needle shows a magnetic field has been produced **OR** sprinkle iron filings onto the card (1) tapping the card will move the filings to show the magnetic field (pattern) (1)		1 1	AO1/2 4.7.2.1
04.2	**Level 2:** A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that explain how the ignition circuit works.	3–4	4	AO2/1 4.7.2.1
	Level 1: Simple statements are made. The response may fail to make logical links between the points raised.	1–2		
	No relevant content	0		
	Indicative content • closing the (ignition) switch causes a current to pass through the electromagnet • the iron core (of the electromagnet) becomes magnetised • the electromagnet/iron core attracts the (short side of the) iron arm • the iron arm pushes the contacts (inside the electromagnetic switch) together • the starter motor circuit is complete • a current flows through the starter motor (which then turns)			
Total			**6**	

Question	Answers		Extra information	Mark	AO / Spec. Ref.
05.1	**Level 3:** A detailed and coherent plan covering all the major steps is provided. The steps in the method are logically ordered. The method would lead to the production of valid results. A source of inaccuracy is provided.	5-6		6	AO1/2 4.6.2.2
	Level 2: The bulk of a method is described with mostly relevant detail. The method may not be in a completely logical sequence and may be missing some detail.	3–4			
	Level 1: Simple statements are made. The response may lack a logical structure and would not lead to the production of valid results.	1–2			
	No relevant content	0			
	Indicative content place a glass block on a piece of paper draw around the glass block and then remove from the paper draw a line at 90^o to one side of the block (the normal) use a protractor to measure and then draw a line at an angle of 20^o to the normal replace the glass block using a ray box and slit point the ray of light down the drawn line mark the ray of light emerging from the block remove the block and draw in the refracted ray measure the angle of refraction with a protractor repeat the procedure for a range of values of the angle of incidence **possible source of inaccuracy** the width of the light ray which makes it difficult to judge where the centre of the ray is				
05.2	velocity/speed of the light decreases		allow velocity/speed of the light changes	1	AO1/1 4.6.2.2
Total				**7**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	It is easily magnetised.		1	AO1/1 4.7.3.3
06.2	p.d. across the secondary coil is smaller (than p.d. across the primary coil)		1	AO3/2a 4.7.3.3 WS3.5
06.3	ratio $\frac{V_p}{V_s} = \frac{6}{12}$ $\frac{6}{12} = \frac{50}{N_p}$ $N_p = 100$	accept any other correct ratio taken from the graph use of the correct turns ratio and substitution or correct transformation and substitution allow 100 with no working shown for **3** marks	1 1 1	AO2/1 4.7.3.3
Total			**5**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	any sensible suggestion eg • theory supported by results from other experiments • could not believe the 'theory' could be wrong • 'theory' is the basis of many other ideas		1	AO2/2 4.5.6 WS1.1
07.2	any **two** from: • to allow peer review of data • to assess the reproducibility of the data • to promote further enquiry / experiments • to encourage other scientists to develop explanations / new theories		2	AO3/2a 4.5.6 WS1.6
07.3	730 000 = 300 007 400 x time		1	AO2/1
	$\text{time} = \frac{730\ 000}{300\ 007\ 400}$	this step without the previous step stated gains 2 marks	1	AO2/1
	2.43(3273) x 10^{-3} s	accept 0.00243(3273) s allow 2.43(3273) x 10^{-3} with no working for **4** marks	1	AO2/1 4.5.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	60×10^{-9} s		1	AO1/1 4.5.6 WS4.4
07.5	systematic error		1	AO3/2a 4.5.6 WS3.7
07.6	add on 60 nanoseconds to each time recorded (then recalculate)		1	AO3/3b 4.5.6 WS3.7
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	distance is a scalar and displacement is a vector **or** distance has magnitude only, displacement has magnitude and direction		1	AO1/1 4.5.6.1.1
08.2	37.5 km 062^o or $N62^oE$	accept any value between 37.0 and 38.0 inclusive accept 62^o to the right of the vertical accept an angle in the range 60^o -64^o accept the angle correctly measured and marked on the diagram	1 1	AO2/2 4.5.6.1.1
08.3	train changes direction so velocity changes acceleration is the rate of change of velocity		1 1	AO1/1 4.5.6.1.3/5
08.4	number of squares below line = 17 each square represents 500 m distance = number of squares x value of each square correctly calculated – 8500 m	accept any number between 16 and 18 inclusive	1 1 1	AO2/2 4.5.6.1.5
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	the distance travelled under the braking force		1	AO1/1 4.5.6.3.1
09.2	the reaction time will increase increasing the thinking distance (and so increasing stopping distance)	increases stopping distance is insufficient	1 1	AO1/1 4.5.6.3.2
09.3	No, because although when the speed increases the thinking distance increases by the same factor the braking distance does not. eg increasing from 10 m/s to 20 m/s increases thinking distance from 6 m to 12 m but the braking distance increases from 6 m to 24 m		1 1	AO3/1a 4.5.6 WS3.3/5
09.4	If the sled accelerates the value for the constant of friction will be wrong.		1	AO1/2 4.5.6.2.1
09.5	only a (the horizontal) component of the force would be pulling the sled forward the vertical component of the force (effectively) lifts the sled reducing the force of the surface on the sled		1 1	AO1/2 4.5.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	$-u^2 = 2 \times -7.2 \times 22$	award this mark even with 0^2 and / or the negative sign missing	1	AO2/2 4.5.6.1.5 WS4.6
	$u = 17.7(99)$		1	
	18		1	
		allow 18 with no working shown for **3** marks allow 17.7(99) then incorrectly rounded to 17 for **2** marks		
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	air molecules colliding with a surface create pressure		1	AO1/1 4.5.5.2
	at increasing altitude distance between molecules increases **or** at increasing altitude fewer molecules (above a surface)		1	
	so number of collisions with a surface decreases **or** or so always less weight of air than below (the surface)		1	
10.2	atmospheric pressure = 20 kPa from graph **and** conversion of 810 cm^2 to 0.081 m^2	allow ecf for an incorrect value clearly obtained from the graph	1	AO2/1
	$5 \times 10^4 = \frac{F}{0.081}$		1	AO2/1
	$F = 5 \times 10^4 \times 0.081$		1	AO2/1
	4050		1	AO2/1
	4100 (N)	allow 4100 (N) with no working shown for **5** marks allow 4050 with no working shown for **4** marks	1	AO2/1 4.5.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	force from air pressure acting from inside to outside bigger than force acting inwards so keeps the window in position		1 1	AO2/1 4.5.5.1.1
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	in a longitudinal wave the oscillations/vibrations are parallel to the direction of energy transfer.	accept wave travel for energy transfer throughout	1	AO1/1 4.6.1.1
	in a transverse wave the oscillations/vibrations are perpendicular to the direction of energy transfer.		1	AO1/1 4.6.1.1
11.2	accept any sensible suggestion eg. a vibrating drum skin does not move the air away to create a vacuum (around the drum)		1	AO1/2 4.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.3	**Level 3:** A detailed explanation linking variations in current to the pressure variations of a sound wave, with a logical sequence.	5-6	6	AO1/2 4.6.1.1 4.7.2.4
	Level 2: A number of relevant points made, but not precisely. A link between the loudspeaker and a sound wave is made.	3–4		
	Level 1: Some relevant points but fragmented with no logical structure.	1–2		
	No relevant content	0		
	Indicative content the current in the electrical circuit is varying the current passes through the coil the coil experiences a force (inwards or outwards) reversing the current reverses the force the size of the current affects the size of the force the varying current causes the coil to vibrate the (vibrating) coil causes the cone to vibrate the vibrating cone causes the air molecules to move the movement of the air molecules produces the pressure variations in the air needed for a sound wave the air molecules bunch together forming compressions and spread apart forming rarefactions			
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12.1	motor effect		1	AO1/1 4.7.2.2
12.2	increase the strength of the magnet **or** increase the current		1	AO2/1 4.7.2.2
12.3	$4.8 \times 10^{-4} = F \times 8 \times 10^{-2}$ $F = 6 \times 10^{-3}$ (N) $6 \times 10^{-3} = B \times 1.5 \times 5 \times 10^{-2}$ $B = \frac{6 \times 10^{-3}}{7.5 \times 10^{-2}}$ $B = 8 \times 10^{-2}$ or 0.08	allow 8×10^{-2} **or** 0.08 with no working shown for **5** marks a correct method with correct calculation using an incorrect value of F gains **3** marks	1 1 1 1 1	AO2/1 4.7.2.2 4.5.4
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When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	range of speeds moving in different directions	accept random motion	1 1	AO1/1 4.3.3.1
01.2	internal energy		1	AO1/1 4.3.2.1
01.3	density = mass / volume		1	AO1/1 4.3.1.1
01.4	0.00254/0.0141 0.18 kg/m^3	accept 0.18 with no working for the **2** calculation marks	1 1 1	AO2/1 AO2/1 AO1/1 4.3.1.1
Total			**7**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2	**Level 3:** A detailed and coherent explanation is provided. The student gives examples that argue a strong case and demonstrate deep knowledge. The student makes logical links between clearly identified, relevant points.	5–6	6	2xAO2/2
	Level 2: An attempt to link the description of the experiment and the results with differences between the two models. The student gives examples of where the plum pudding model does not explain observations. The logic used may not be clear.	3–4		1xAO1/1 1xAO2/2
	Level 1: Simple statements are made that the nuclear model is a better model. The response may fail to make logical links between the points raised.	1–2		2x AO1/1 4.4.1.3
	No relevant content	0		
	Indicative content • alpha particle scattering experiment • alpha particles directed at gold foil • most alpha particles pass straight through • (so) most of atom is empty space • a few alpha particles deflected through large angles • (so) mass is concentrated at centre of atom • (and) nucleus is (positively) charged • plum pudding model has mass spread throughout atom • plum pudding model has charge spread throughout atom			
Total			**6**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	power output increases (to meet demand) due to people returning home from work / school	accept many electrical appliances are switched on (which increases demand) accept other sensible suggestions	1	AO3/1a 4.1.3
03.2	00.00	accept midnight allow answers between 00.00 and 04.00	1	AO3/1a 4.1.3 WS3
03.3	any **two** from: • conserves fuel reserves • spare capacity to compensate for unreliable renewable resources • provides spare capacity in case of power station emergency shut-down • so as to not make unnecessary environmental impact		2	AO2/1 4.1.3
Total			**4**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	0.1 (ºC)		1	AO3/3a 4.1.1.3 WS2.3
04.2	power = energy transferred / time	allow P = E / t	1	AO1/1 4.1.1.4
04.3	correct substitution ie 1050 / 300 3.5 (W)	accept 3.5 (W) with no working shown for **2** marks	1 1	AO2/1 AO2/1 4.1.1.4
04.4	1050 = m x 4200 x 0.6 m = 1050 / (4200 x 0.6) m = 0.417 (kg)	(substitution) (rearrangement) (answer) accept 0.417 (kg) with no working shown for **3** marks	1 1 1	AO2/2 4.1.1.3
04.5	any **one** from: • energy used to heat metal pan (as well as the water) • energy transfer to the surroundings (through the insulation) • angle of solar radiation will have changed during investigation • intensity of solar radiation may have varied during investigation		1	AO3/3a 4.1.1.3 WS3
Total			**8**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	weight (lifted) **or** height (lifted)		1	AO3/3a 4.1.2.2 WS2
05.2	any **two** from: • calculate a mean • spot anomalies • reduce the effect of random errors		2	AO3/3a 4.1.2.2 WS3
05.3	as speed increases, the efficiency increases (but) graph tends towards a constant value **or** appears to reach a limit	accept efficiency cannot be greater than 100%	1 1	AO3/2b 4.1.2.1
05.4	heating the surroundings		1	AO1/1 4.1.2.1
05.5	0 (%)		1	AO1/1 4.1.2.2
Total			**7**	

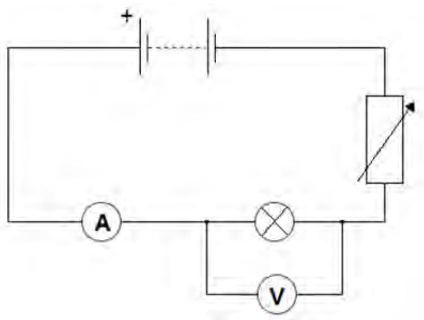
Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	negatively charged electrons are transferred from the (neutral) object		1 1 1	AO1/1 4.2.5.1
06.2	minimum of four lines drawn perpendicular to surface of sphere minimum of one arrow shown pointing away from sphere	judge by eye do **not** accept any arrow pointing inwards.	1 1	AO1/1 4.2.5.2
06.3	Q		1	AO3/1a 4.2.5.2
Total			**6**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	V = 0.10 x 45 4.5 (V)		1 1	AO2/1 4.2.2 4.2.1.3
07.2	R = 12 / 0.10 total resistance = 120 (Ω) R = 120 – 105 = 15 (Ω)		1 1 1	AO2/1 4.2.2 4.2.1.3
07.3	(total) resistance decreases (so) current increases		1 1	AO1/2 4.2.2 4.2.1.3
Total			**7**	

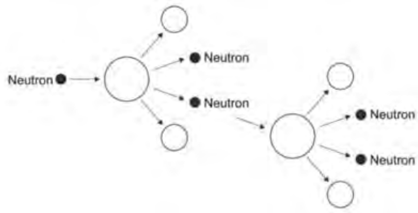
Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1		battery in series with bulb and ammeter voltmeter in parallel with bulb variable resistor **or** variable power pack **or** potentiometer	1 1 1	AO1/2 4.2.1.1/3 WS2.2
08.2	A is brighter because it has a higher current (than lamp B at any p.d.) (therefore A has a) higher power output (than bulb B)	accept higher energy output per second	1 1	AO3/1a AO1/1 4.2.4.1/3
08.3	lower current (than lamp A) for the same potential difference lower gradient (than lamp A)	accept answer in terms of $R = V/I$	1 1	AO1/1 AO2/2 4.2.1.3/4
08.4	0 – 2 Volts (for an ohmic conductor) current is directly proportional to potential difference (so) resistance is constant	allow a range from 0 V up to any value between 1 and 2 V. allow lines (of best fit) are straight and pass through the origin	1 1 1	AO3/2b 4.2.1.3/4
Total			**10**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	cannot predict <u>which</u> dice / atom will 'decay' cannot predict <u>when</u> a dice / atom will 'decay'	accept answers given in terms of 'roll a 6'	1 1	AO3/1b 4.4.2.3 WS1
09.2	3.6 to 3.7 (rolls)	allow **1** mark for attempt to read graph when number of dice = 50	2	AO2/2 4.4.2.3 WS3
09.3	90		1	AO2/1 4.4.2.2
09.4	uranium		1	AO2/1 4.4.1.2
09.5	beta proton number has gone up (as neutron decays to proton and e^{-})		1 1	AO1/1 AO3/2a 4.4.2.2
09.6	prevents contamination **or** prevents transfer of radioactive material to teacher's hands which would cause damage / irradiation over a longer time period.		1 1	AO1/1 AO2/1 4.4.2.4
Total			**10**	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	Nucleus splitting into two fragments and releasing two or three neutrons (at least one) fission neutron shown to be absorbed by additional large nucleus and causing fission two or three additional neutrons released from fission reaction	This diagram would gain all **3** marks: 	1 1 1	AO1/1 4.4.4.1
10.2	lowering the control rods increases the number of neutrons absorbed (so) energy released decreases	accept converse description allow changing the position of the control rods affects the number of neutrons absorbed for **1** mark	1 1	AO2/2 AO1/1 4.4.4.1
10.3	rate of increase between 240 and 276 (MW / min)	allow **1** mark for attempt to calculate gradient of line at 10 minutes	2	AO2/1 4.4.4.1
Total			**7**	

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	g.p.e. = mass × gravitational field strength × height	accept $E_p = mgh$	1	AO1/1 4.1.1.2
11.2	$E_p = 50 \times 9.8 \times 20$ 9800 (J)	allow 9800 (J) with no working shown for **2** marks answer may also be correctly calculated using W = Fs ie allow W = 490 x 20 for **1** mark or answer of 9800 (J) using this method for **2** marks	1 1	AO2/1 4.1.1.2
11.3	7840 (J)	allow ecf from '11.2'	1	AO2/1 4.1.1.2
11.4	$7840 = \frac{1}{2} \times 50 \times v^2$ $v = \sqrt{\frac{7840}{1/2 \times 50}}$ 17.7(0875) (m/s) 18 (m/s)	allow $v^2 = \frac{7840}{(1/2 \times 50)}$ for this point allow ecf from '11.3' correctly calculated for **3** marks allow 18 (m/s) with no working for **2** marks answer may also be correctly calculated using $v^2 - u^2 = 2as$	1 1 1 1	AO2/1 4.1.1.2

11.5	extension = 35 (m) and conversion of 24.5 kJ to 24500 J		1	AO2/2 4.1.1.2 WS4.3
	24 500 = ½ x k x 35^2		1	
	40		1	
		allow 40 with no working shown for **3** marks an answer of '16.2' gains **2** marks		

Total			**11**

Question 12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12	**Level 3:** Clear and coherent description of both methods including equation needed to calculate density. Steps are logically ordered and could be followed by someone else to obtain valid results.	5-6	6	AO1/2 4.3.1.1 WS2.2 Required practical
	Level 2: Clear description of one method to measure density **or** partial description of both methods. Steps may not be logically ordered.	3–4		
	Level 1: Basic description of measurements needed with no indication of how to use them.	1–2		
	No relevant content	0		
	Indicative content **For both:** • measure mass using a balance • calculate density using $\rho = m/V$ **Metal cube:** • measure length of cube's sides using a ruler • calculate volume **Small statue:** • immerse in water • measure volume / mass of water displaced • volume of water displaced = volume of small statue			
Total			**6**	

Question 13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13.1	(because the) potential of the live wire is 230 V		1	AO1/1 4.2.3.2
	(and the) potential of the electrician is 0 V		1	
	(so there is a) large potential difference between live wire and electrician		1	
	charge / current passes through his body	allow voltage for potential difference	1	
13.2	diameter between 3.50 and 3.55 (mm)	allow correct use of value of cross-sectional area of 9.5 to 9.9 (mm^2) with no final answer given for **1** mark	2	AO2/2 4.2.3.2 WS3
13.3	18000 = I x 300		1	AO2/1
	I = 18000/300 = 60		1	AO2/1
	13 800 = (60^2) x R		1	AO2/1
	R = 13 800 / 60^2		1	AO2/1
	3.83 (Ω)		1	AO2/1
		allow 3.83(Ω) with no working shown for **5** marks answer may also be correctly calculated using P = IV and V = IR if 230 V is used.		4.2.1.2 4.2.4.1
Total			**11**	

SPECIMEN MATERIAL

GCSE
PHYSICS

Foundation Tier   Paper 2F

F

Specimen 2018   Time allowed: 1 hour 45 minutes

Materials
For this paper you must have:
- a ruler
- a calculator
- a protractor
- the Physics Equation sheet (enclosed).

Instructions
- 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.

Information
- There are 100 marks available on this paper.
- 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.
- When answering questions 03.1, 10.6, 13.2 and 14 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

Advice
- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals.

Centre number ☐☐☐☐☐   Candidate number ☐☐☐☐

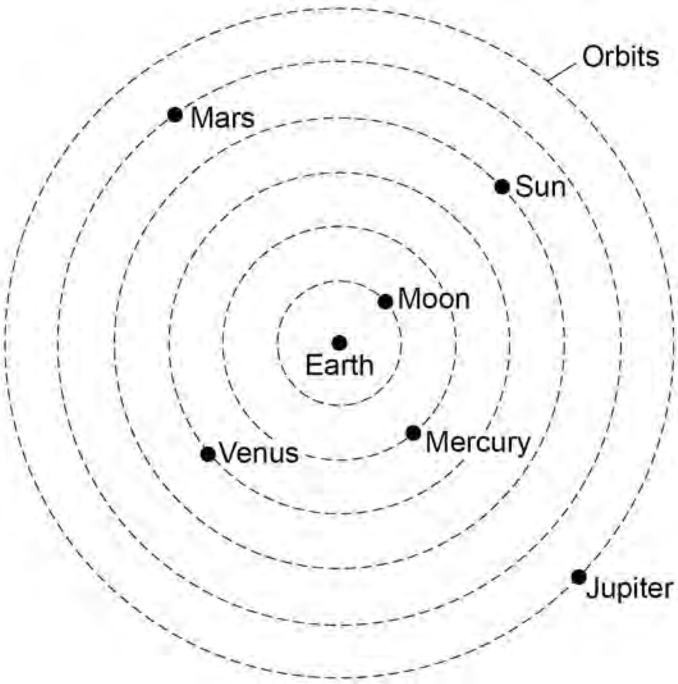
Surname

Forename(s)

Candidate signature ____________________

0 1 **Figure 1** shows what scientists over 1000 years ago thought the solar system was like.

Figure 1



0 1 . 1 Give **one** way that the historical model of the solar system shown in **Figure 1** is different from what we now know about the solar system.

[1 mark]

0 1 . 2 Give **one** way that the solar system shown in **Figure 1** is the same as what we now know about the solar system.

[1 mark]

0 1 . 3 The first artificial satellite to orbit the Earth was launched into space in 1957.

Describe the orbit of an artificial satellite.

[1 mark]

0 1 . 4 What provides the force needed to keep a satellite in its orbit?

Tick **one** box.

[1 mark]

friction ☐

gravity ☐

tension ☐

0 1 . 5 All stars go through a lifecycle.

The star Mira will go through a supernova stage in its lifecycle but the Sun will not.

How is the star Mira different to the Sun?

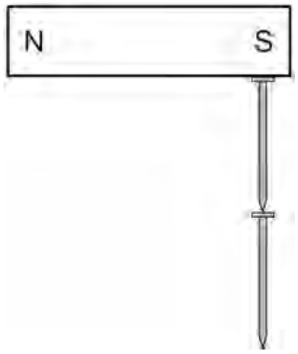
[1 mark]

Turn over for the next question

0 2 **Figure 2** shows two iron nails hanging from a bar magnet.

The iron nails which were unmagnetised are now magnetised.

Figure 2



0 2 . 1 Complete the sentence.

Use a word from the box.

[1 mark]

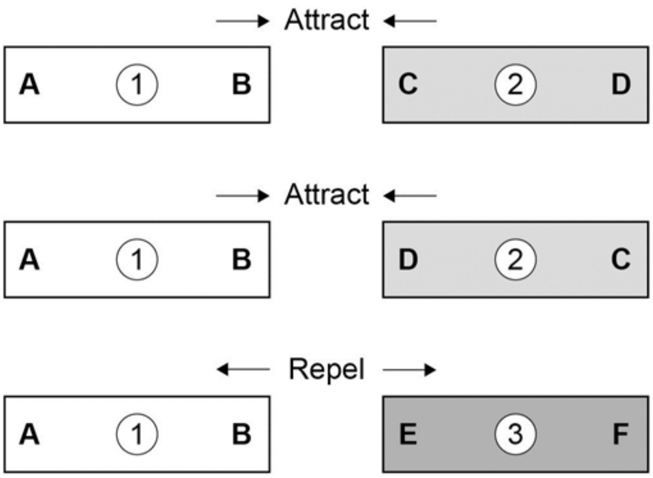
forced	**induced**	**permanent**

The iron nails have become ____________________________ magnets.

0 2 . 2 Each of the three metal bars in **Figure 3** is either a bar magnet or a piece of unmagnetised iron.

The forces that act between the bars when different ends are placed close together are shown by the arrows.

Figure 3



Which **one** of the metal bars is a piece of unmagnetised iron?

[2 marks]

Tick **one** box.

Bar 1 ☐

Bar 2 ☐

Bar 3 ☐

Give the reason for your answer.

____

____

A student investigated the strength of different fridge magnets by putting small sheets of paper between each magnet and the fridge door.

The student measured the maximum number of sheets of paper that each magnet was able to hold in place.

0 2 . 3 Why was it important that each small sheet of paper had the same thickness?

[1 mark]

0 2 . 4 Before starting the investigation the student wrote the following hypothesis:

'The bigger the area of a fridge magnet the stronger the magnet will be.'

The student's results are given in **Table 1**.

Table 1

Fridge magnet	Area of magnet in mm^2	Number of sheets of paper held
A	40	20
B	110	16
C	250	6
D	340	8
E	1350	4

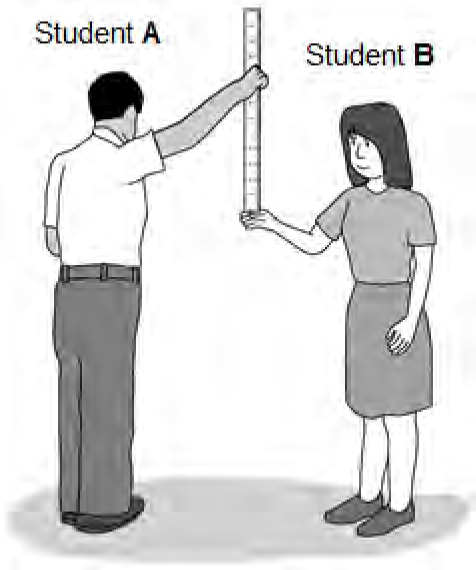
Give **one** reason why the results from the investigation **do not** support the student's hypothesis.

[1 mark]

Turn over for the next question

0 3 . 1 **Figure 4** shows two students investigating reaction time.

Figure 4



Student **A** lets the ruler go.

Student **B** closes her hand the moment she sees the ruler fall.

This investigation can be used to find out if listening to music changes the reaction times of a student.

Explain how.

[4 marks]

A second group of students used a stop clock and computer simulation test to measure their reaction times.

Table 2 shows their results.

Table 2

Student	**Reaction time in seconds**		
	Test 1	**Test 2**	**Test 3**
X	0.44	0.40	0.34
Y	0.28	0.24	0.22
Z	0.36	0.33	0.47

0 3 . 2 Give **one** conclusion that can be made from the results for student **X** and student **Y**.

[1 mark]

0 3 . 3 Test **3** for student **Z** gave an anomalous result.

Suggest **two** possible reasons why this anomalous result occurred.

[2 marks]

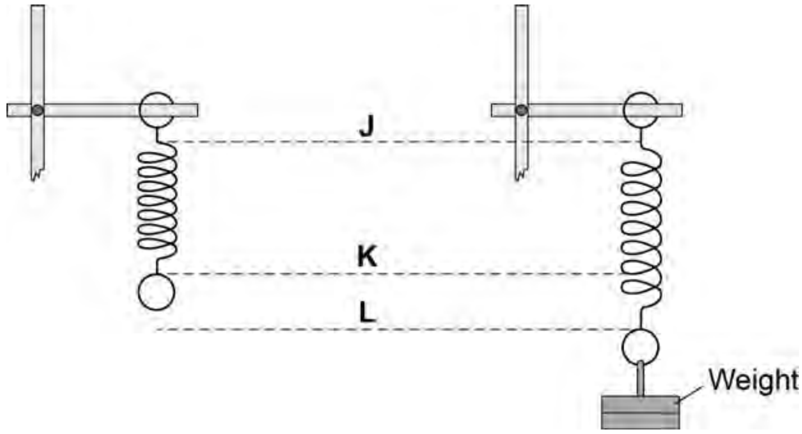
1

2

0 4 A student suspended a spring from a laboratory stand and then hung a weight from the spring.

Figure 5 shows the spring before and after the weight is added.

Figure 5



0 4 . 1 Which distance gives the extension of the spring?

Tick **one** box.

[1 mark]

from **J** to **K** ☐

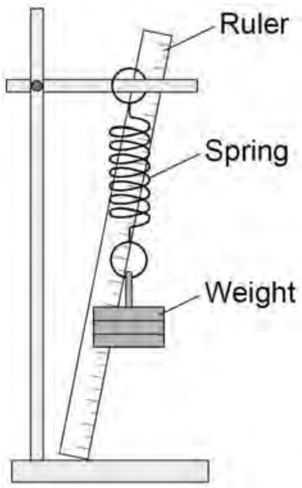
from **K** to **L** ☐

from **J** to **L** ☐

The student used the spring, a set of weights and a ruler to investigate how the extension of the spring depended on the weight hanging from the spring.

Figure 6 shows that the ruler is in a tilted position and not upright as it should be.

Figure 6



0 4 . 2 How would leaving the ruler tilted affect the weight and extension data to be recorded by the student?

Use answers from the box to complete each sentence.

Each answer may be used once, more than once or not at all.

[2 marks]

greater than	**the same as**	**smaller than**

The weight recorded by the student would be ______________________________ the actual weight.

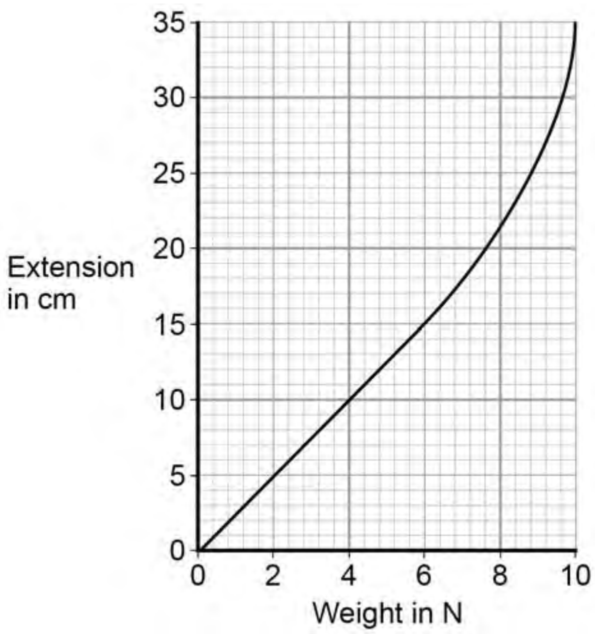
The extension recorded by the student would be ______________________________ the actual extension of the spring.

The student moves the ruler so that it is upright and not tilted.

The student then completed the investigation and plotted the data taken in a graph.

The student's graph is shown in **Figure 7**.

Figure 7



0 4 . 3 Use **Figure 7** to determine the additional force needed to increase the extension of the spring from 5cm to 15cm.

[1 mark]

Additional force = ______________________ N

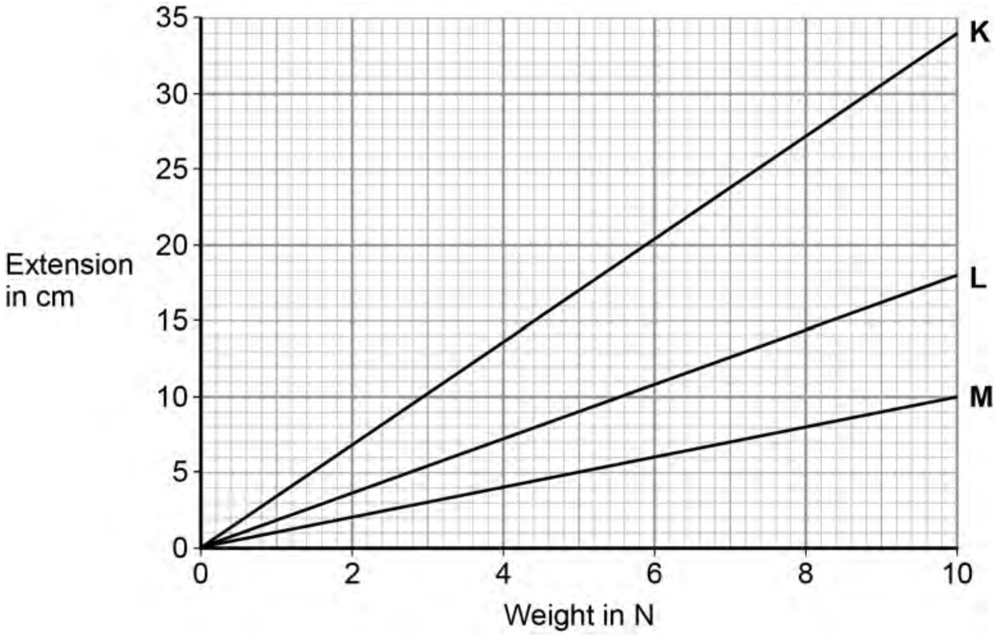
0 4 . 4 What can you conclude from **Figure 7** about the limit of proportionality of the spring?

[1 mark]

The student repeated the investigation with three more springs, **K**, **L** and **M**.

The results for these springs are given in **Figure 8**.

Figure 8



0 4 . 5 All three springs show the same relationship between the weight and extension.

What is that relationship?

[1 mark]

Tick **one** box.

The extension increases non-linearly with the increasing weight. ☐

The extension is inversely proportional to the weight. ☐

The extension is directly proportional to the weight. ☐

0 4 . 6 Which statement, **A**, **B** or **C**, should be used to complete the sentence?

Write the correct letter, **A**, **B** or **C**, in the box below.

[1 mark]

A a lower spring constant than

B the same spring constant as

C a greater spring constant than

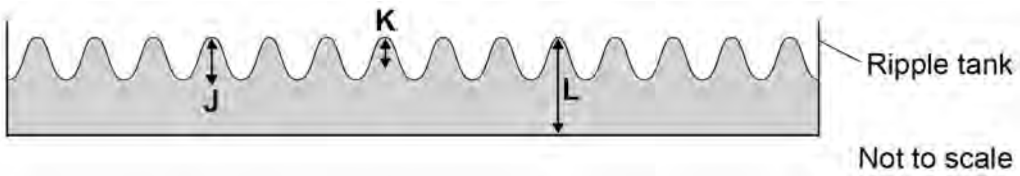
From **Figure 8** it can be concluded that spring **M** has ☐ the other two springs.

Turn over ▸

0 5 Small water waves are created in a ripple tank by a wooden bar. The wooden bar vibrates up and down hitting the surface of the water.

Figure 9 shows a cross-section of the ripple tank and water.

Figure 9



0 5 . 1 Which letter shows the amplitude of a water wave?

Tick **one** box.

[1 mark]

J ☐

K ☐

L ☐

0 5 . 2 The speed of the wooden bar is changed so that the bar hits the water fewer times each second.

What happens to the frequency of the waves produced?

Tick **one** box.

[1 mark]

Increases ☐

Does not change ☐

Decreases ☐

0 5 . 3 Describe how the wavelength of the water waves in a ripple tank can be measured accurately.

[2 marks]

0 5 . 4 The speed of a wave is calculated using the following equation.

wave speed = frequency × wavelength

The water waves in a ripple tank have a wavelength of 1.2 cm and a frequency of 18.5 Hz.

How does the speed of these water waves compare to the typical speed of a person walking?

[4 marks]

Turn over for the next question

0 6 **Figure 10** shows an incomplete electromagnetic spectrum.

Figure 10

A	**microwaves**	**B**	**C**	**ultraviolet**	**D**	**gamma**

0 6 . 1 What name is given to the group of waves at the position labelled **A** in **Figure 10**?

[1 mark]

Tick **one** box.

infrared ☐

radio ☐

visible light ☐

X-ray ☐

0 6 . 2 Electromagnetic waves have many practical uses.

Draw **one** line from each type of electromagnetic wave to its use.

[3 marks]

Electromagnetic wave	**Use**
	For fibre optic communications
Gamma rays	For communicating with a satellite
Microwaves	To see security markings
Ultraviolet	To sterilise surgical instruments

0 6 . 3 Complete the sentence.

Use an answer from the box.

[1 mark]

black body	**ionising**	**nuclear**

X-rays can be dangerous to people because X-rays

are ____________________________ radiation.

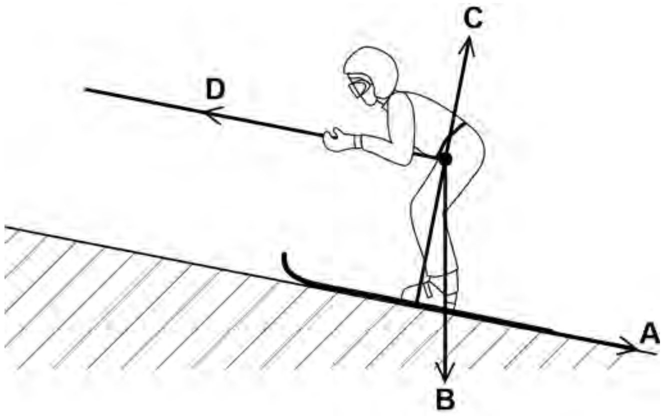
Turn over for the next question

0 7 **Figure 11** shows a skier using a drag lift.

The drag lift pulls the skier from the bottom to the top of a ski slope.

The arrows, **A**, **B**, **C** and **D** represent the forces acting on the skier and her skis.

Figure 11



0 7 . 1 Which arrow represents the force pulling the skier up the slope?

[1 mark]

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

0 7 . 2 Which arrow represents the normal contact force?

[1 mark]

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

0 7 . 3 The drag lift pulls the skier with a constant resultant force of 300N for a distance of 45 m.

Use the following equation to calculate the work done to pull the skier up the slope.

work done = force × distance

[2 marks]

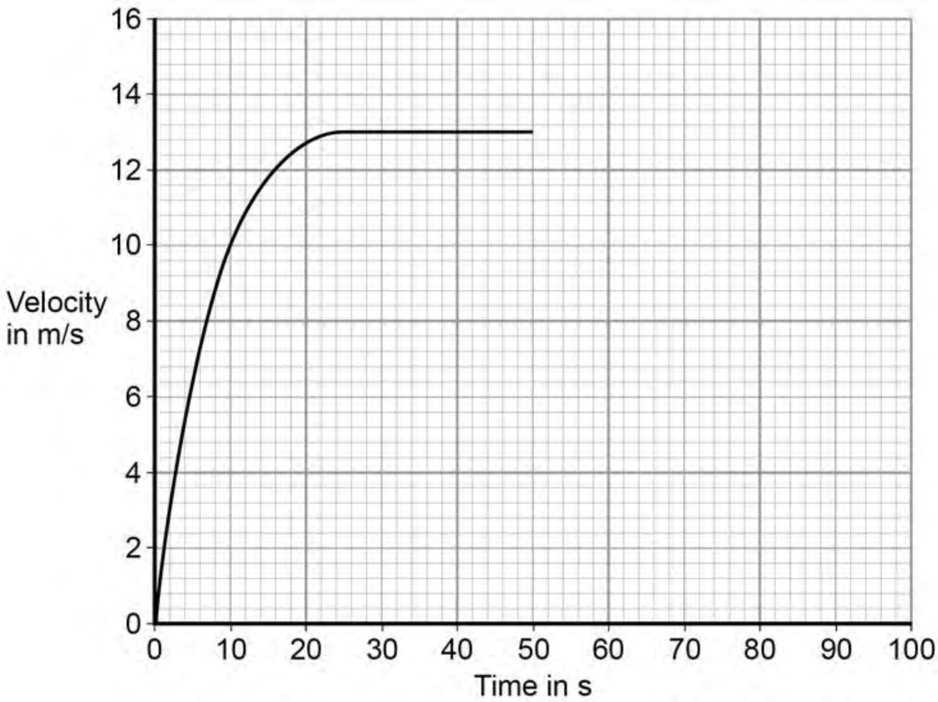
Work done = ________________ J

Question 7 continues on the next page

At the top of the slope the skier leaves the drag lift and skis back to the bottom of the slope.

Figure 13 shows how the velocity of the skier changes with time as the skier moves down the slope.

Figure 13



0 7 . 4 After 50 seconds the skier starts to slow down.

The skier decelerates at a constant rate coming to a stop in 15 seconds.

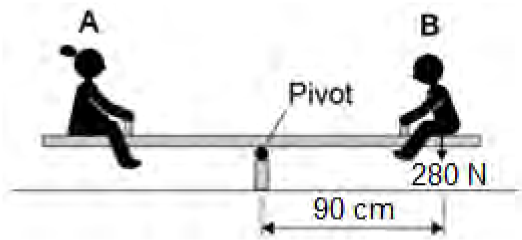
Draw a line on **Figure 13** to show the change in velocity of the skier as she slows down and comes to a stop.

[2 marks]

0 8 Two children, **A** and **B**, are sitting on a see-saw, as shown in **Figure 14**.

The see-saw is balanced.

Figure 14



0 8 . 1 Use the following equation to calculate the moment of child **B** about the pivot of the see-saw.

moment of a force = force x distance

Give your answer in newton-metres

[2 marks]

Moment = ____________________ Nm

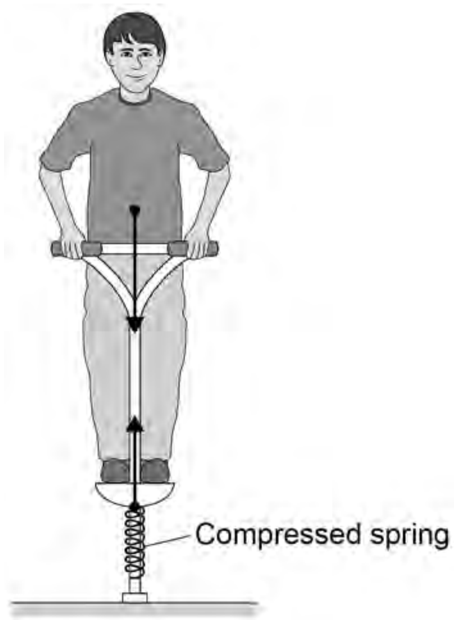
0 8 . 2 Use the idea of moments to explain what happens when child **B** moves closer to the pivot.

[3 marks]

0 9 **Figure 15** shows the forces acting on a child who is balancing on a pogo stick.

The child and pogo stick are not moving.

Figure 15



0 9 . 1 The downward force of the child on the spring is equal to the upward force of the spring on the child.

This is an example of which one of Newton's Laws of motion?

[1 mark]

Tick **one** box.

First Law ☐

Second Law ☐

Third Law ☐

0 9 . 2 Complete the sentence.

Use an answer from the box.

[1 mark]

elastic potential	**gravitational potential**	**kinetic**

The compressed spring stores __________________________ energy.

The child has a weight of 343 N.

Gravitational field strength = 9.8 N/kg

0 9 . 3 Write down the equation which links gravitational field strength, mass and weight.

[1 mark]

0 9 . 4 Calculate the mass of the child.

[3 marks]

Mass = ____________________ kg

The weight of the child causes the spring to compress elastically from a length of 30cm to a new length of 23cm.

0 9 . 5 Write down the equation which links compression, force and spring constant.

[1 mark]

0 9 . 6 Calculate the spring constant of the spring.

Give your answer in newtons per metre.

[4 marks]

Spring constant = ____________________ N/m

1 0 **Figure 16** shows the horizontal forces acting on a car.

Figure 16

1 0 . 1 Which **one** of the statements describes the motion of the car?

[1 mark]

Tick **one** box.

It will be slowing down. ☐

It will be stationary. ☐

It will have a constant speed. ☐

It will be speeding up. ☐

1 0 . 2 During part of the journey the car is driven at a constant speed for five minutes.

Which one of the equations links distance travelled, speed and time?

[1 mark]

Tick **one** box.

distance travelled = speed + time ☐

distance travelled = speed x time ☐

distance travelled = speed – time ☐

distance travelled = speed ÷ time ☐

During a different part of the journey the car accelerates from 9m/s to 18m/s in 6 s.

10.3 Use the following equation to calculate the acceleration of the car.

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

[2 marks]

acceleration = _______________ m/s^2

10.4 Which equation links acceleration, mass and resultant force?

[1 mark]

Tick **one** box.

resultant force = mass + acceleration ☐

resultant force = mass × acceleration ☐

resultant force = mass - acceleration ☐

resultant force = mass ÷ acceleration ☐

10.5 The mass of the car is 1120 kg. The mass of the driver is 80 kg.

Calculate the resultant force acting on the car and driver while accelerating.

[2 marks]

Resultant force = _______________ N

10.6 Calculate the distance travelled while the car is accelerating.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

Distance = _______________ m

10 . 7 A car driver sees a fallen tree lying across the road ahead and makes an emergency stop.

The braking distance of the car depends on the speed of the car.

For the same braking force, explain what happens to the braking distance if the speed doubles.

You should refer to kinetic energy in your answer.

[4 marks]

1 1 In 1929, the astronomer Edwin Hubble observed that the light from galaxies moving away from the Earth had longer wavelengths than expected.

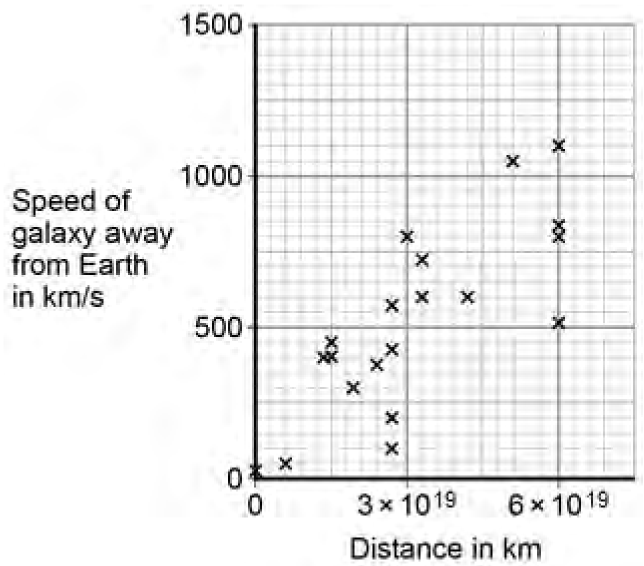
1 1 . 1 What name is given to this effect?

[1 mark]

1 1 . 2 From his observations, Hubble was able to calculate the speed of a galaxy and the distance of the galaxy from the Earth.

Figure 17 shows the results of Hubble's calculations.

Figure 17



What relationship between the speed of a galaxy and the distance is suggested by Hubble's results?

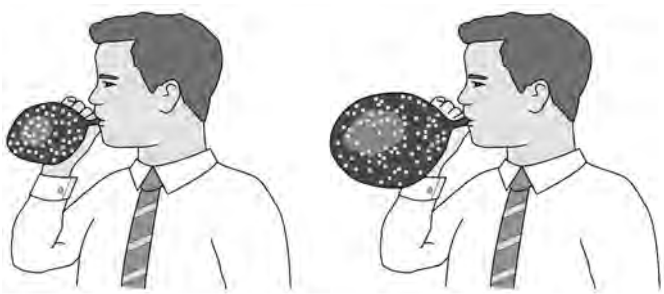
[1 mark]

The observations made by Hubble support the idea that the Universe is expanding. This means that galaxies are continually moving away from each other and from the Earth.

Figure 18 shows a student using a balloon to model the idea of an expanding Universe.

Some dots, which represent galaxies, were marked on the balloon.
The balloon was then inflated.

Figure 18



1 1 . 3 Give **one** strength and **one** weakness of this model in representing the idea of an expanding Universe.

[2 marks]

Strength ____

____

Weakness ____

____

In the 1950s there were two main theories to explain how the Universe began.

Theory 1	The Universe has always existed, it is continually expanding. New galaxies are formed as older galaxies die out.
Theory 2	The Universe began from a very small region that was extremely hot and dense. The Universe has been expanding ever since.

1 1 . 4 In what way do the observations made by Hubble support both Theory 1 and Theory 2?

[1 mark]

1 1 . 5 Most scientists now believe that Theory 2 is correct.

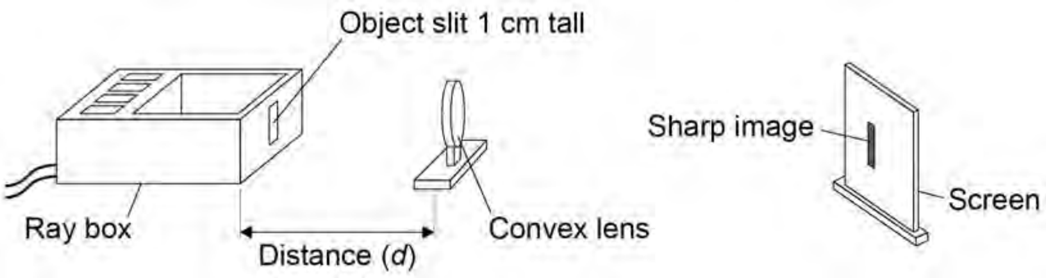
Suggest what is likely to have caused scientists to start thinking Theory 1 is wrong.

[1 mark]

1 2 A student investigated how the magnification produced by a convex lens varies with the distance (d) between the object and the lens.

The student used the apparatus shown in **Figure 19**.

Figure 19



1 2 . 1 The student measured the magnification produced by the lens by measuring the image height in centimetres.

Explain why the image height in centimetres was the same as the magnification.

[2 marks]

The data recorded by the student is given in **Table 4**.

Table 4

Distance between the object and the lens in cm	Magnification
25	4.0
30	2.0
40	1.0
50	0.7
60	0.5

1 2 . 2 It would be difficult to obtain accurate magnification values for distances greater than 60 cm.

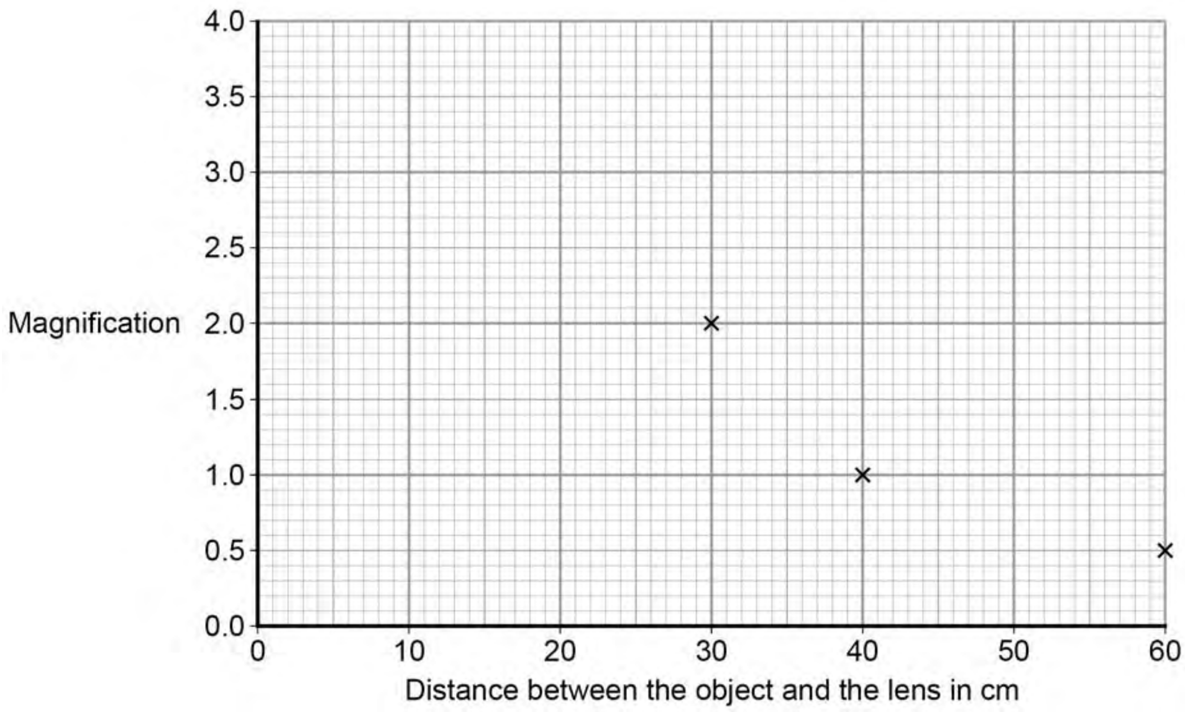
Suggest **one** change that could be made so that accurate magnification values could be obtained for distances greater than 60 cm.

[1 mark]

Question 12 continues on the next page

The graph in **Figure 20** is incomplete.

Figure 20



1 2 . 3 Complete the graph in **Figure 20** by plotting the missing data and then drawing a line of best fit.

[2 marks]

1 2 . 4 How many times bigger is the image when the object is 35 cm from the lens compared to when the object is 55 cm from the lens?

[2 marks]

1 2 . 5 During the investigation the student also measured the distance between the lens and the image.

Table 5 gives both of the distances measured and the magnification.

Table 5

Distance between the lens and the image in cm	Distance between the lens and the object in cm	Magnification
100	25	4.0
60	30	2.0
40	40	1.0
33	50	0.7
30	60	0.5

Consider the data in **Table 5**.

Give a second way that the student could have determined the magnification of the object.

Justify your answer with a calculation.

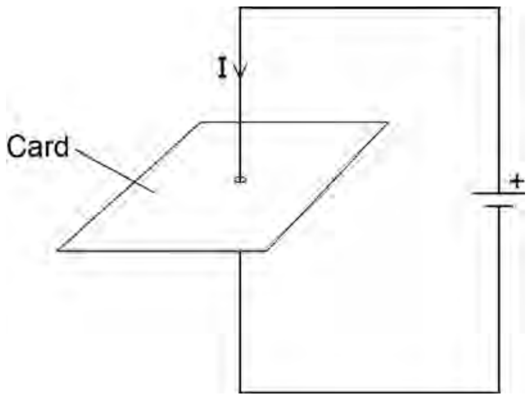
[2 marks]

Turn over for the next question

1 3 **Figure 21** shows a straight wire passing through a piece of card.

A current (I) is passing down through the wire.

Figure 21



1 3 . 1 Describe how you could show that a magnetic field has been produced around the wire.

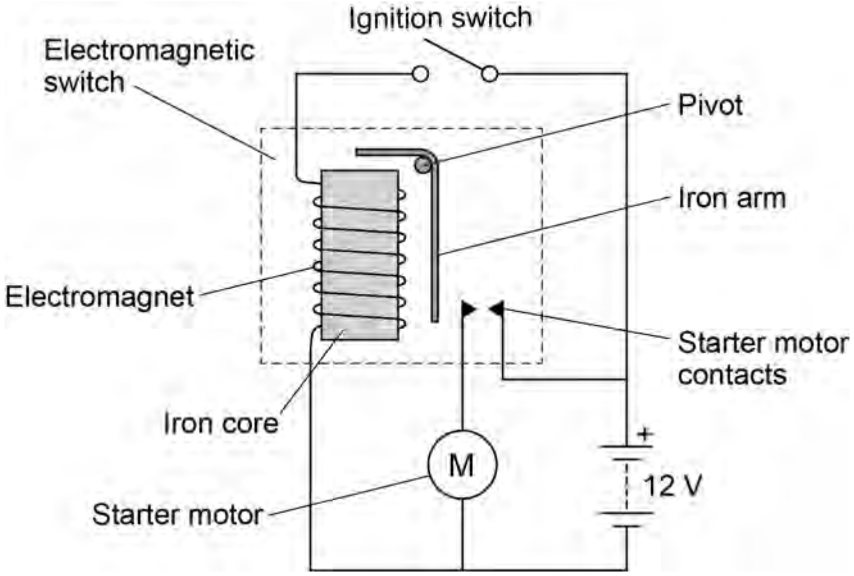
[2 marks]

.

1 3 . 2 **Figure 22** shows the ignition circuit used to switch the starter motor in a car on.

The circuit includes an electromagnetic switch.

Figure 22



Explain how the ignition circuit works.

[4 marks]

1 4 The data given in **Table 6** was obtained from an investigation into the refraction of light at an air to glass boundary.

Table 6

Angle of incidence	Angle of refraction
20°	13°
30°	19°
40°	25°
50°	30°

Describe an investigation a student could complete in order to obtain similar data to that given in **Table 6**.

Your answer should consider any cause of inaccuracy in the data.

A labelled diagram may be drawn as part of your answer.

[6 marks]

END OF QUESTIONS

AQA

SPECIMEN MATERIAL

GCSE PHYSICS

Foundation Tier Paper 1F

F

Specimen 2018 Time allowed: 1 hour 45 minutes

Materials

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

Instructions
- 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.

Information
- There are 100 marks available on this paper.
- 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.
- When answering questions 05.2, 06.1 and 10 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

Advice
- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number Candidate number

Surname

Forename(s)

Candidate signature

0 1 Energy resources can be renewable or non-renewable.

0 1 . 1 Coal is a non-renewable energy resource.

Name **two** other non-renewable energy resources.

[2 marks]

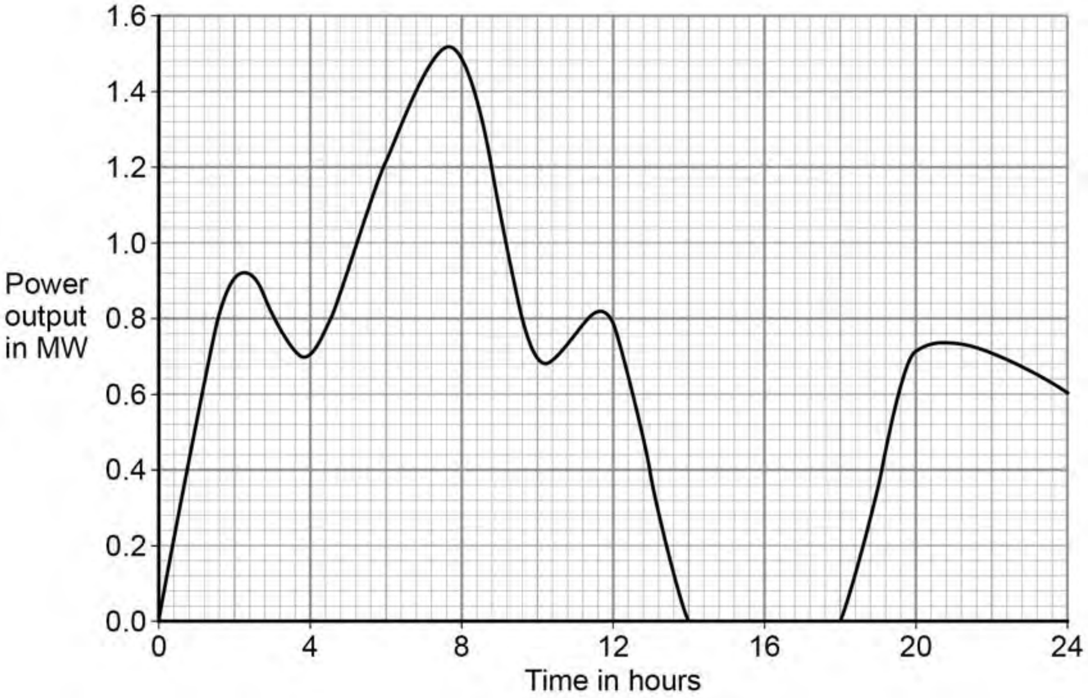
1 ____________________

2 ____________________

Wind turbines are used to generate electricity.

Figure 1 shows how the power output of a wind turbine changes over one day.

Figure 1



0 1 . 2 A wind turbine does not generate electricity constantly.

For how many hours did the wind turbine generate no electricity?

[1 mark]

Time = ____________ hours

0 1 . 3 Electrical power is transferred from power stations to the National Grid.

What is the National Grid?

Tick **one** box.

[1 mark]

a system of cables and pylons ☐

a system of cables and transformers ☐

a system of cables, transformers and power stations ☐

0 1 . 4 An island has a large number of wind turbines and a coal-fired power station.

The island needs to use the electricity generated by the coal-fired power station at certain times.

Choose **one** reason why.

[1 mark]

Tick **one** box.

Wind is a renewable energy resource. ☐

Wind turbine power output is constant. ☐

The power output of wind turbines is unpredictable. ☐

The fuel cost for wind turbines is very high. ☐

0 1 . 5 A wind turbine has an average power output of 0.60 MW.

A coal-fired power station has a continuous power output of 1500 MW.

Calculate how many wind turbines would be needed to generate the same power output as one coal-fired power station.

[2 marks]

Number of wind turbines = ____________________

0 1 . 6 It is important that scientists develop new energy resources.

Choose **one** reason why.

[1 mark]

Tick **one** box.

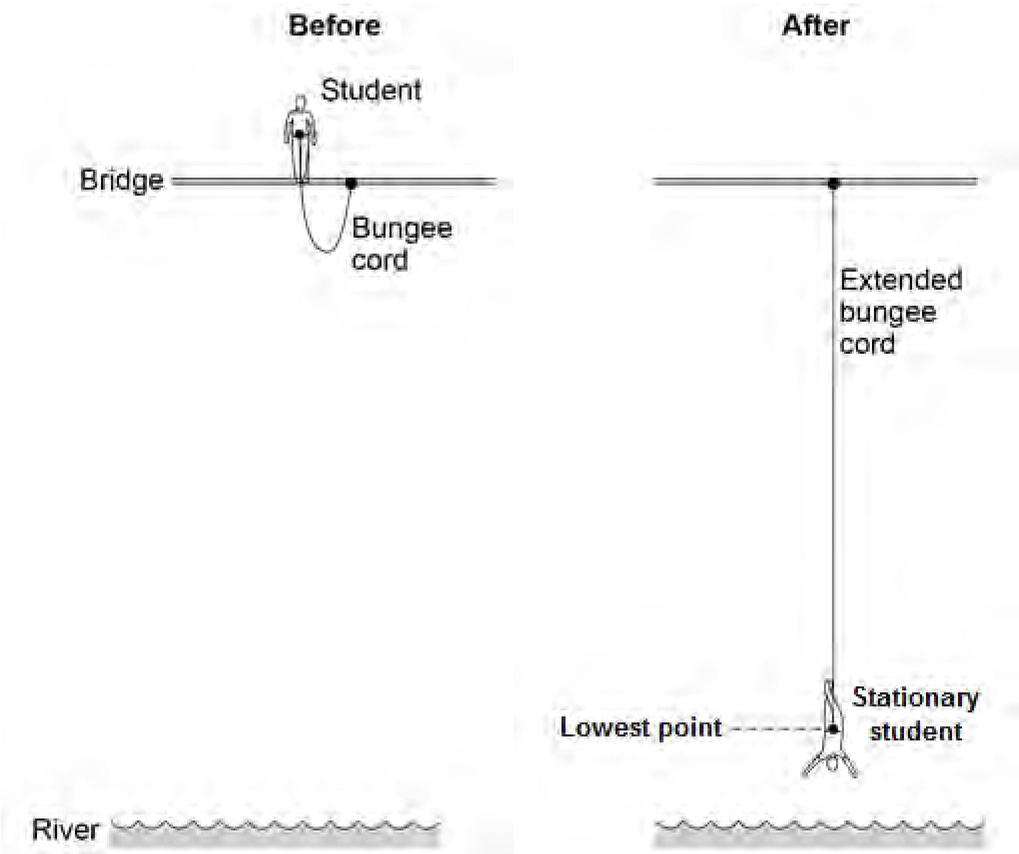
All energy resources are running out.	☐
All energy resources are used to generate electricity.	☐
Most energy resources have negative environmental effects.	☐

Turn over for the next question

0 2 **Figure 2** shows a student before and after a bungee jump.

The bungee cord has an unstretched length of 20 m.

Figure 2



0 2 . 1 For safety reasons, it is important that the bungee cord used is appropriate for the student's weight.

Give **two** reasons why.

[2 marks]

1 ____

____

2 ____

____

0 2 . 2 The student jumps off the bridge.

Complete the sentences to describe the energy transfers.

Use answers from the box.

[3 marks]

elastic potential	**gravitational potential**	**kinetic**	**sound**	**thermal**

Before the student jumps from the bridge he has a store of

____________________ energy.

When he is falling, the student's store of ____________________ energy increases.

When the bungee cord is stretched, the cord stores energy as

____________________ energy.

0 2 . 3 At the lowest point in the jump when the student is stationary, the extension of the bungee cord is 35 metres.

The bungee cord behaves like a spring with a spring constant of 40 N/m.

Calculate the energy stored in the stretched bungee cord.

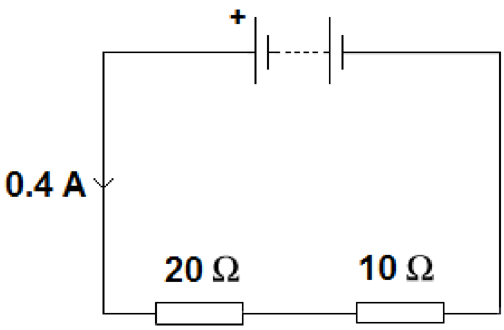
Use the correct equation from the Physics Equations Sheet.

[2 marks]

Energy = ____________________ J

0 3 An electrical circuit is shown in **Figure 3**.

Figure 3



0 3 . 1 The current in the circuit is direct current.

What is meant by direct current?

[1 mark]

Tick **one** box.

Current that continuously changes direction. ☐

Current that travels directly to the component. ☐

Current that is always in the same direction. ☐

0 3 . 2 The equation which links current, potential difference and resistance is:

potential difference = current x resistance

Calculate the potential difference across the battery in the circuit in **Figure 3**.

[3 marks]

Potential difference = ____________ V

0 3 . 3 The equation which links current, potential difference and power is:

power = current x potential difference

Calculate the power output of the battery in **Figure 3.**

Give your answer to one significant figure.

[2 marks]

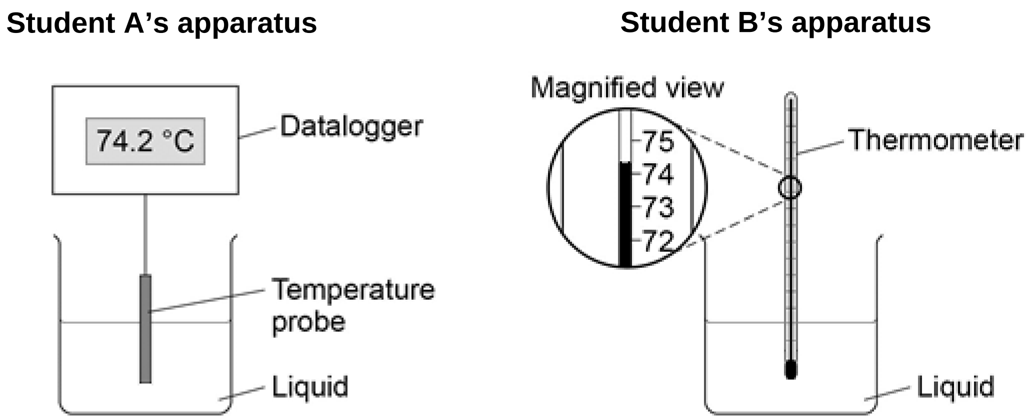
Power = ____________ W

0 4 Two students investigated the change of state of stearic acid from liquid to solid.

They measured how the temperature of stearic acid changed over 5 minutes as it changed from liquid to solid.

Figure 4 shows the different apparatus the two students used.

Figure 4



0 4 . 1 Choose **two** advantages of using student **A**'s apparatus.

[2 marks]

Tick **two** boxes.

Student **A**'s apparatus made sure the test was fair.	☐
Student **B**'s apparatus only measured categoric variables.	☐
Student **A**'s measurements had a higher resolution.	☐
Student **B** was more likely to misread the temperature.	☐

0 4 . 2 Student **B** removed the thermometer from the liquid each time he took a temperature reading.

What type of error would this cause?

[1 mark]

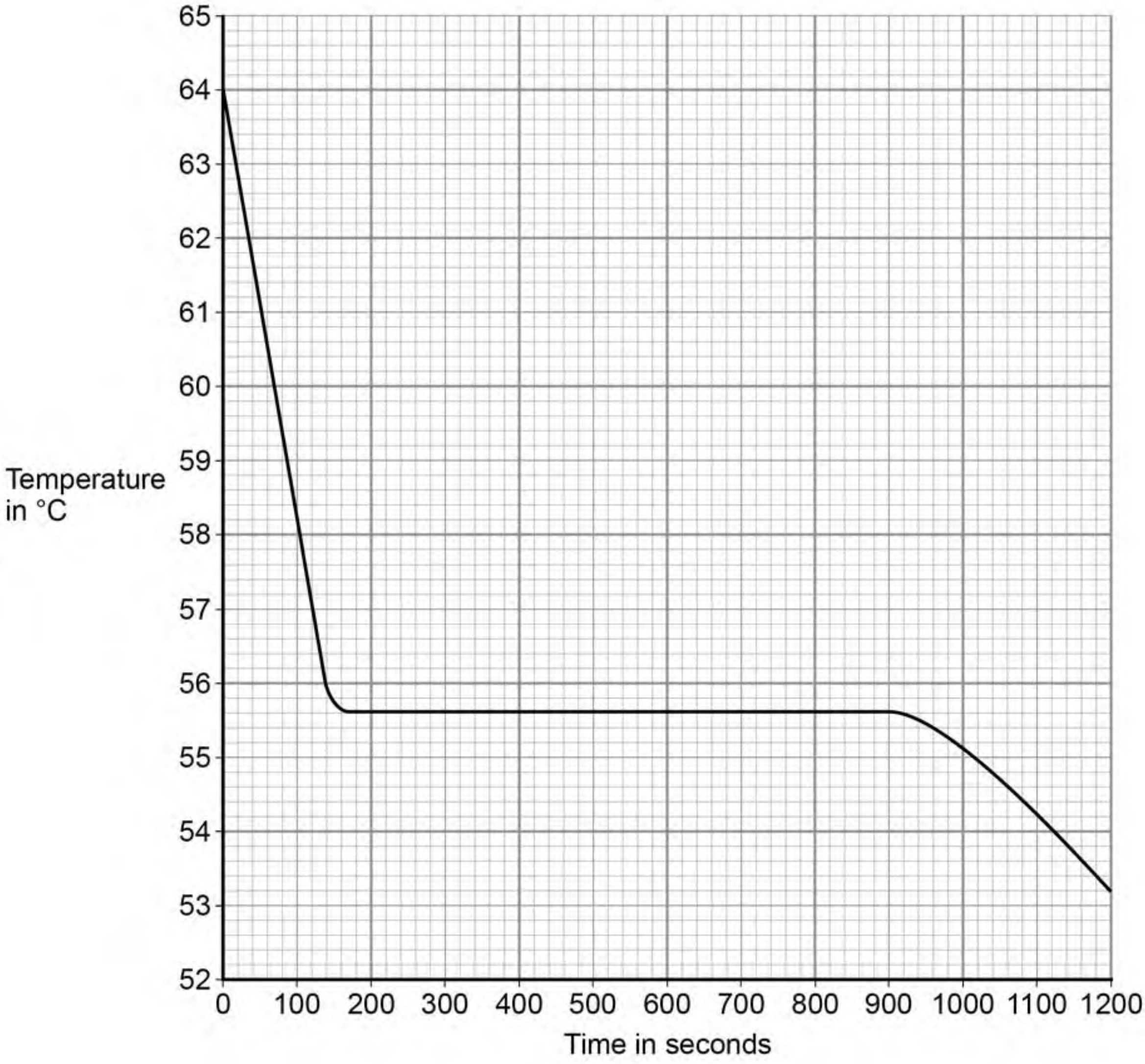
Tick **one** box.

A systematic error	☐
A random error	☐
A zero error	☐

Question 4 continues on the next page

Student **A**'s results are shown in **Figure 5**.

Figure 5



0 4 . 3 What was the decrease in temperature between 0 and 160 seconds?

[1 mark]

Tick **one** box.

8.2 °C ☐

8.4 °C ☐

53.2 °C ☐

55.6 °C ☐

0 4 . 4 Use **Figure 5** to determine the time taken for the stearic acid to change from a liquid to a solid.

[1 mark]

Time = ____________________ seconds

0 4 . 5 Calculate the energy transferred to the surroundings as 0.40 kg of stearic acid changed state from liquid to solid.

The specific latent heat of fusion of stearic acid is 199 000 J/kg.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Energy = ____________________ J

0 4 . 6 After 1200 seconds the temperature of the stearic acid continued to decrease.

Explain why.

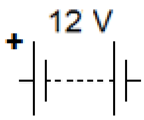
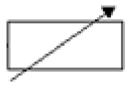
[2 marks]

Turn over for the next question

0 5 A student wants to investigate how the current through a filament lamp affects its resistance.

0 5 . 1 Use the circuit symbols in the boxes to draw a circuit diagram that she could use.

[2 marks]

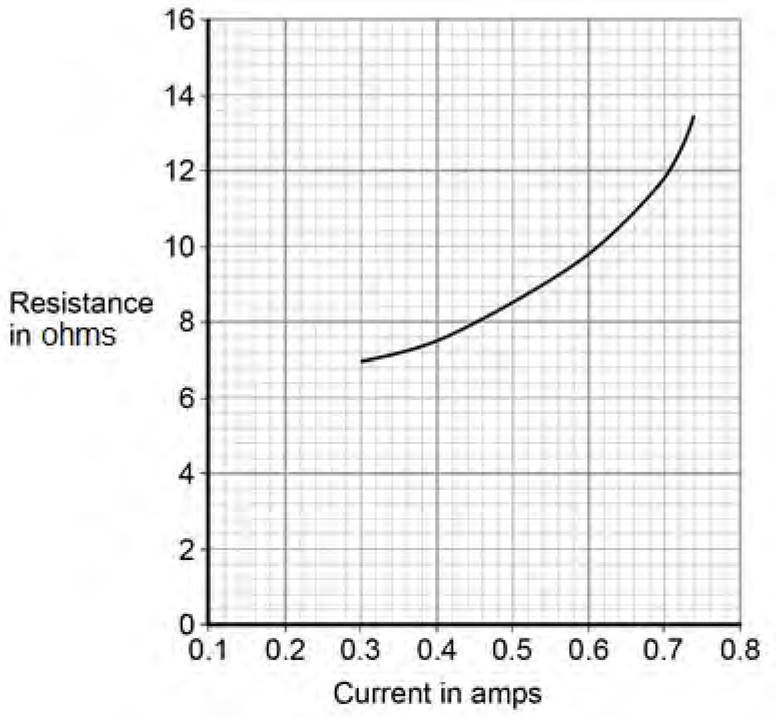
12 V battery	variable resistor	filament lamp	voltmeter	ammeter
				

0 5 . 2 Describe how the student could use her circuit to investigate how the current through a filament lamp affects its resistance.

[4 marks]

The student's results are shown in **Figure 6**.

Figure 6



0 5 . 3 Describe how the resistance of the filament lamp changes as the current through it increases.

[1 mark]

0 5 . 4 Use **Figure 6** to estimate the resistance of the filament lamp when a current of 0.10 A passes through the lamp.

[1 mark]

Resistance = ____________ Ω

The current–potential difference graphs of three components are shown in **Figure 7**.

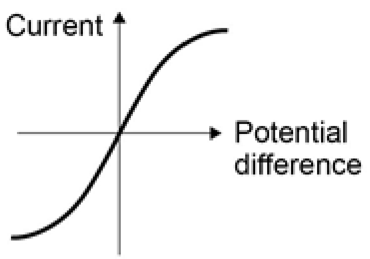
0 5 . 5 Use answers from the box to identify each component.

[3 marks]

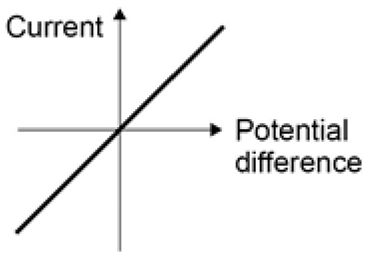
diode	**filament lamp**	**light dependent resistor**
resistor at constant temperature		**thermistor**

Figure 7

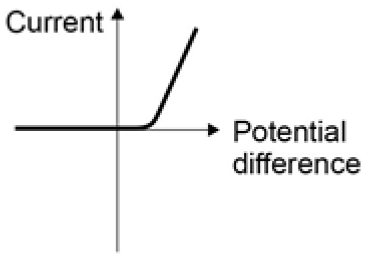
Graph A



Graph B



Graph C

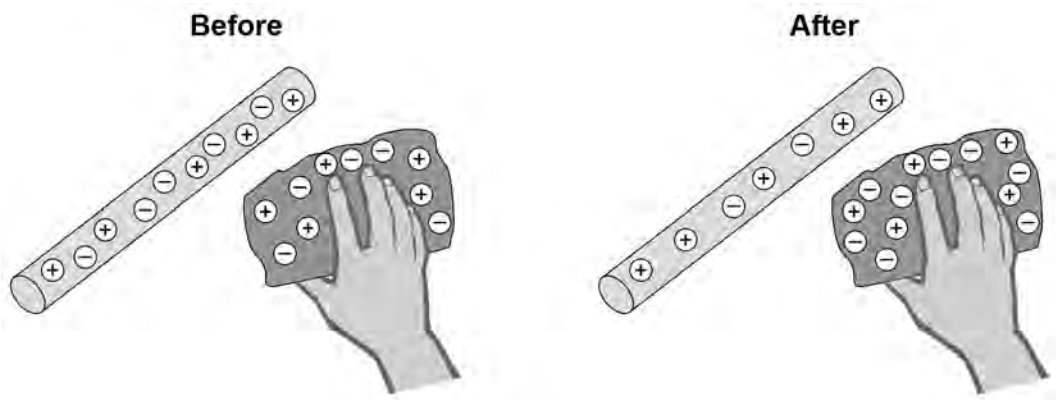


Turn over for the next question

0 6 A student rubs an acetate rod with a cloth.

Figure 8 shows the charges on the acetate rod and cloth before and after rubbing.

Figure 8



0 6 . 1 Explain how rubbing an acetate rod with a cloth causes the rod and cloth to become charged.

[4 marks]

0 6 . 2 After charging them, the student moves the acetate rod and the cloth closer together.

Which statement is correct?

Tick **one** box.

There is no force between the acetate rod and the cloth. ☐

There is a force of attraction between the acetate rod and the cloth. ☐

There is a force of repulsion between the acetate rod and the cloth. ☐

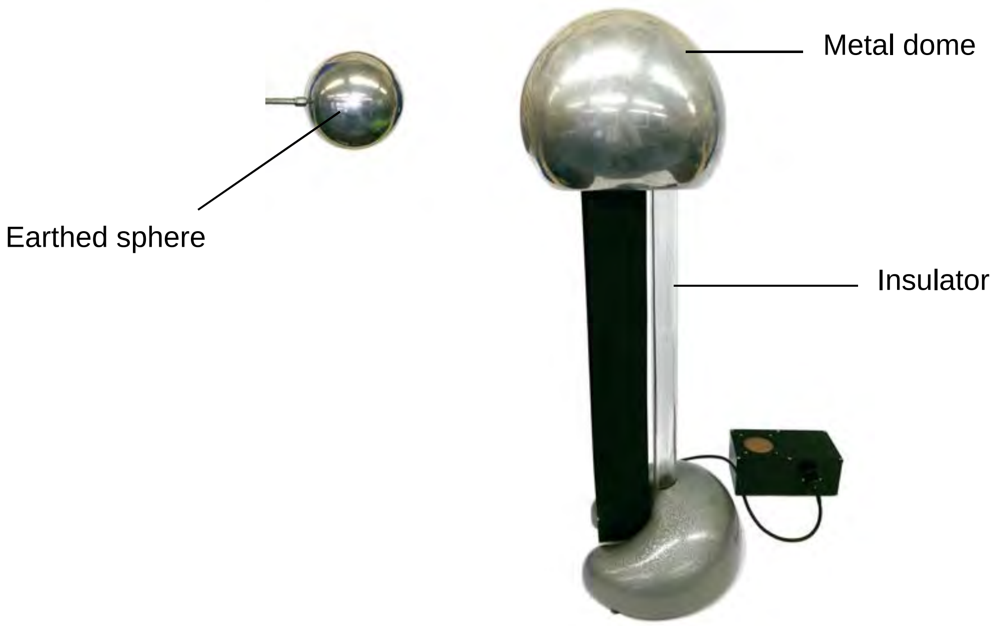
Give a reason for your answer.

[2 marks]

Question 6 continues on the next page

Figure 9 shows a Van de Graaff generator, which is used to generate static electricity.

Figure 9



0 6 . 3 The longer the Van de Graaff generator is switched on, the more charge is stored on the metal dome.

Use an answer from the box to complete the sentence.

[1 mark]

decrease	**increase**	**stay the same**

The amount of charge on the metal dome is increased, which causes the potential difference between the metal dome and the earthed sphere to ____________________ .

0 6 . 4 When the potential difference between the Van de Graaff generator and the earthed sphere is 60 kV, a spark jumps between the metal dome and the earthed sphere.

The spark transfers 0.000025 coulombs of charge to the earthed sphere.

The equation which links charge, energy and potential difference is:

$$\text{energy transferred} = \text{charge} \times \text{potential difference}$$

Calculate the energy transferred by the spark.

[2 marks]

Energy transferred = ____________ J

Turn over for the next question

0 7 Alpha, beta and gamma are types of nuclear radiation.

0 7 . 1 Draw **one** line from each type of radiation to what the radiation consists of.

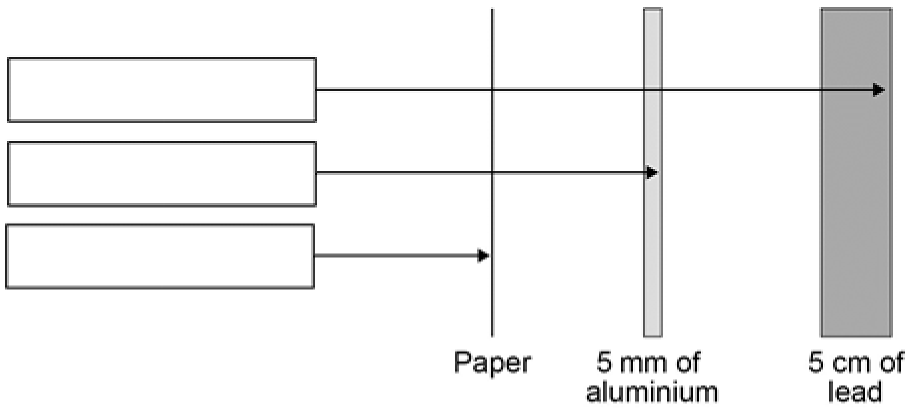
[3 marks]

Type of radiation	**What radiation consists of**
	Electron from the nucleus
Alpha	
	Two protons and two neutrons
Beta	
	Electromagnetic radiation
Gamma	
	Neutron from the nucleus

A teacher demonstrates the penetration of alpha, beta and gamma radiation through different materials.

The demonstration is shown in **Figure 10**.

Figure 10



0 7 . 2 Complete **Figure 10** by writing the name of the correct radiation in each box.

[2 marks]

0 7 . 3 Give **two** safety precautions the teacher should have taken in the demonstration.

[2 marks]

1

2

Table 1 shows how the count rate from a radioactive source changes with time.

Table 1

Time in seconds	0	40	80	120	160
Count rate in counts / second	400	283	200	141	100

0 7 . 4 Use **Table 1** to calculate the count rate after 200 seconds.

[2 marks]

0 7 . 5 The half-life of the radioactive source used was very short.

Give **one** reason why this radioactive source would be much less hazardous after 800 seconds.

[1 mark]

0 8 An electrician is replacing an old electric shower with a new one.

The inside of the old shower is shown in **Figure 11**.

Figure 11

0 8 . 1 The electrician should **not** change the shower unless he switches off the mains electricity supply.

Explain why.

[2 marks]

0 8 . 2 The new shower has a power output of 10 690 W when it is connected to the 230 V mains electricity supply.

The equation which links current, potential difference and power is:

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

Calculate the current passing through the new shower.

Give your answer to two significant figures.

[4 marks]

Current = ____________ A

0 8 . 3 The new shower has a higher power rating than the old shower.

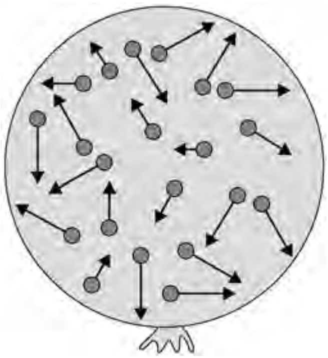
How does the power of the new shower affect the cost of using the shower?

Give a reason for your answer.

[2 marks]

0 9 **Figure 12** shows a balloon filled with helium gas.

Figure 12



0 9 . 1 Describe the movement of the particles of helium gas inside the balloon.

[2 marks]

0 9 . 2 What name is given to the total kinetic energy and potential energy of all the particles of helium gas in the balloon?

[1 mark]

Tick **one** box.

External energy ☐

Internal energy ☐

Movement energy ☐

0 9 . 3 Write down the equation which links density, mass and volume.

[1 mark]

____

0 9 . 4 The helium in the balloon has a mass of 0.00254 kg.

The balloon has a volume of 0.0141 m^3.

Calculate the density of helium. Choose the correct unit from the box.

[3 marks]

m^3 / kg	**kg / m^3**	**kg m^3**

____

____

____

____

Density = ______________________ Unit ______________

Turn over for the next question

There are no questions printed on this page

1 0 Scientists sometimes replace one scientific model with a different model.

For example, in the early 20th Century the plum pudding model of the atom was replaced by the nuclear model of the atom.

Explain what led to the plum pudding model of the atom being replaced by the nuclear model of the atom.

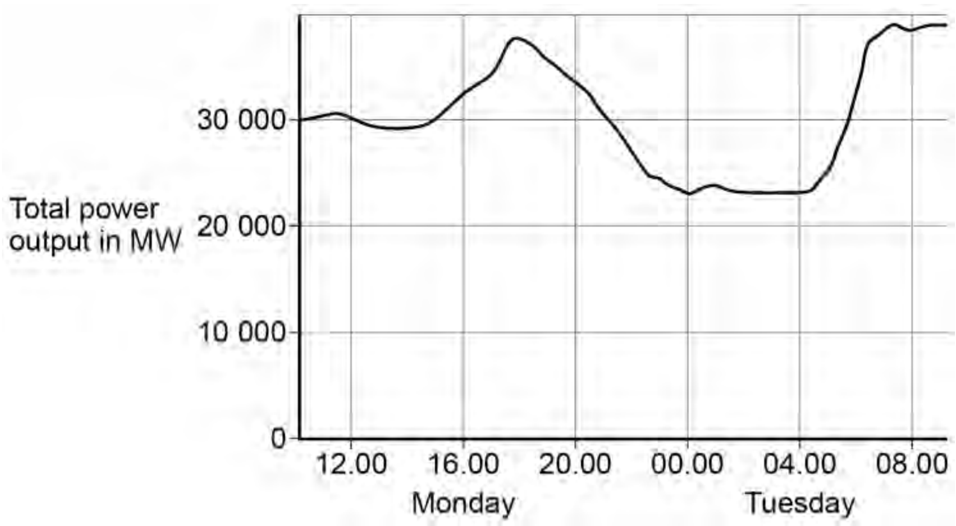
[6 marks]

Turn over for the next question

1 1 The National Grid ensures that the supply of electricity always meets the demand of the consumers.

Figure 13 shows how the output from fossil fuel power stations in the UK varied over a 24-hour period.

Figure 13



1 1 . 1 Suggest **one** reason for the shape of the graph between 15.00 and 18.00 on Monday.

[1 mark]

1 1 . 2 Gas fired power stations reduce their output when demand for electricity is low.

Suggest **one** time on **Figure 13** when the demand for electricity was low.

[1 mark]

11 . 3 The National Grid ensures that fossil fuel power stations in the UK only produce about 33% of the total electricity they could produce when operating at a maximum output.

Suggest **two** reasons why.

[2 marks]

1 ____

____

2 ____

____

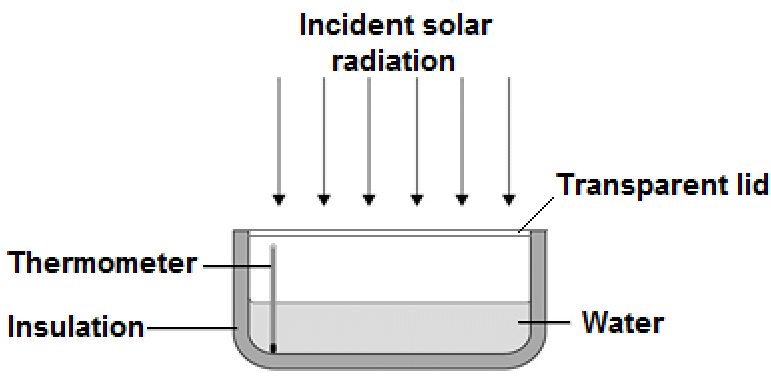
Turn over for the next question

1 2 A student investigated how much energy from the Sun was incident on the Earth's surface at her location.

She put an insulated pan of water in direct sunlight and measured the time it took for the temperature of the water to increase by 0.6 °C.

The apparatus she used is shown in **Figure 14**.

Figure 14



1 2 . 1 Choose the most appropriate resolution for the thermometer used by the student.

[1 mark]

Tick **one** box.

0.1 °C ☐

0.5 °C ☐

1.0 °C ☐

The energy transferred to the water was 1050 J.

The time taken for the water temperature to increase by 0.6 °C was 5 minutes.

The specific heat capacity of water is 4200 J/kg °C.

1 2 . 2 Write down the equation which links energy transferred, power and time.

[1 mark]

1 2 . 3 Calculate the mean power supplied by the Sun to the water in the pan.

[2 marks]

Average power = ______________ W

1 2 . 4 Calculate the mass of water the student used in her investigation.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

Mass = ______________ kg

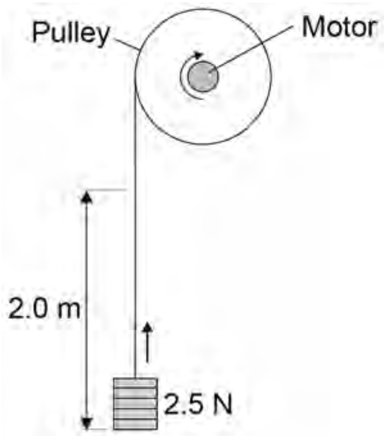
1 2 . 5 The student's results can only be used as an estimate of the mean power at her location.

Give **one** reason why.

[1 mark]

1 3 A student investigated the efficiency of a motor using the equipment in **Figure 15**.

Figure 15



He used the motor to lift a weight of 2.5 N a height of 2.0 m.

He measured the speed at which the weight was lifted and calculated the efficiency of the energy transfer.

He repeated the experiment to gain two sets of data.

1 3 . 1 Give **one** variable that the student controlled in his investigation.

[1 mark]

____

1 3 . 2 Give **two** reasons for taking repeat readings in an investigation.

[2 marks]

1 ______________________________

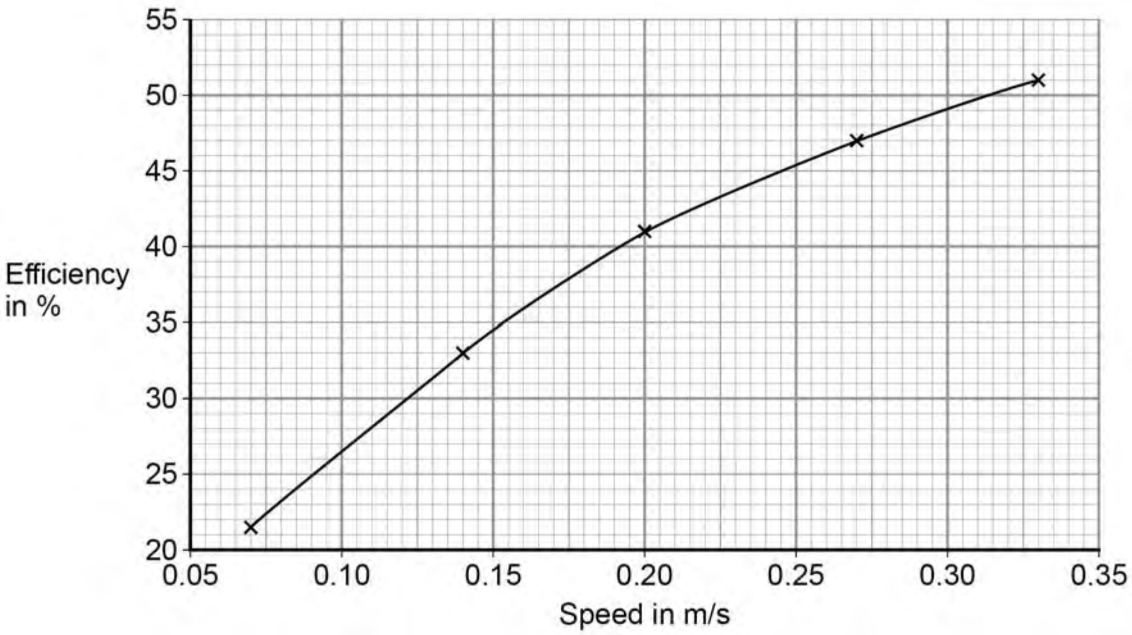
____

2 ______________________________

____

Figure 16 shows a graph of the student's results.

Figure 16



1 3 . 3 Give **two** conclusions that could be made from the data in **Figure 16**.

[2 marks]

1 3 . 4 Give the main way that the motor is likely to waste energy.

[1 mark]

1 3 . 5 When the total power input to the motor was 5 W the motor could not lift the 2.5 N weight.

State the efficiency of the motor.

[1 mark]

Efficiency = ____________ %

END OF QUESTIONS

There are no questions printed on this page

Figure 9: Photograph © Michael Priest
Figure 11: Photograph © Michael Priest

GCSE
PHYSICS
PAPER 2F

Mark scheme

Specimen 2018

Version 1.0

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Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

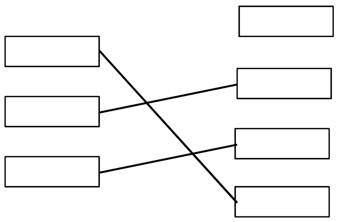
Question	Answers	Extra information	Mark	AO / Spec. Ref.
1.1	any **one** from: • Earth is at the centre (not the Sun) • there are fewer planets	accept there is no asteroid belt shown accept there are only 5 planets (and not 8) accept other planets have no moons shown	1	AO1/1 4.8.1.1 WS1.1
1.2	Shows the moon in orbit around the Earth	accept the planets have circular orbits	1	AO1/1 4.8.1.1 WS1.1
1.3	circular	accept elliptical	1	AO1/1 4.8.1.3
1.4	gravity		1	AO1/1 4.8.1.3
1.5	Mira is much more massive		1	AO1/1 4.8.1.2
Total			**5**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	induced		1	AO1/1 4.7.1.1
02.2	bar 2 (the same end) of bar 1 attracts both ends of bar 2 **or** only two magnets can repel so cannot be bar 1 or bar 3		1 1	AO2/1 4.7.1.1
02.3	so the results for each magnet can be compared **or** so there is only one independent variable	fair test is insufficient allow different thickness of paper would affect number of sheets each magnet could hold accept it is a control variable	1	AO3/1a 4.7.1 WS2.2
02.4	because the magnet with the biggest area was not the strongest	accept any correct reason that confirms the hypothesis is wrong eg smallest magnet holds more sheets than the largest	1	AO3/1b 4.7.1 WS3.6
Total			**5**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	**Level 2:** A detailed and coherent description of a plan covering all the major steps is provided. The steps are set out in a logical manner that could be followed by another person to obtain valid results.	3–4	4	AO3/3a 4.5.6.3.2
	Level 1: Simple statements relating to relevant apparatus or steps are made but they may not be in a logical order. The plan would not allow another person to obtain valid results.	1–2		
	No relevant content.	0		
	Indicative content • measure the distance the ruler falls before being stopped • the greater this distance the greater the reaction time • repeat measurements and calculate a mean • repeat several times with the student listening to music (through earphones). Calculate a mean. • a (significant) difference between the two means would show that music affects reaction time.			
03.2	reaction time decreases with practice	allow Y has a shorter reaction time allow Y has faster reaction times (than X)	1	AO3/2a 4.5.6.3.2
03.3	the stop clock was started before the computer test started the student was distracted		1 1	AO3/3a 4.5.6.3.2
Total			**7**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	from K to L		1	AO1/2 4.5.3
04.2	the same as smaller than	correct order only	1 1	AO3/3a 4.5.3 WS3.7
04.3	4 N		1	AO2/1 4.5.3 WS3.5
04.4	the limit of proportionality is reached when a weight of 7N is added to the spring	accept any number from 6.8 to 7.2 inclusive	1	AO3/2a 4.5.3
04.5	The extension is directly proportional to the weight.		1	AO3/2b 4.5.3
04.6	C		1	AO3/2b 4.5.3
TOTAL			**7**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	K		1	AO1/1 4.6.1.2
05.2	Decreases		1	AO1/1 4.6.1.2
05.3	use a metre rule/30 cm ruler to measure across 10 (projected) waves and then divide by 10	accept any practical number of waves number for 10	1 1	AO1/2 4.6.1.2
05.4	1.2 cm = 0.012 m 18.5 × 0.012 = 0.22(2) (m/s)	allow 0.22(2) with no working shown for **2** marks	1 1	AO2/1 AO2/1 4.6.1.2
	typical walking speed = 1.5m/s	accept any value e.g. in the range 0.7 to 2.0 m/s	1	AO1/1 4.5.6.1.2
	so the water waves are slower (than a typical walking speed)	this cannot score on its own	1	AO3/2a 4.5.6.1.2
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	radio		1	AO1/1 4.6.2.1
06.2		award **1** mark for each correct line if more than one line is drawn from any em wave then none of those lines gain credit	3	AO1/1 4.6.2.4
06.3	ionising		1	AO1/1 4.6.2.3
Total			**5**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	D		1	AO1/1 4.5.1.2
07.2	C		1	AO1/1 4.5.1.2
07.3	W = 300 × 45 W = 13 500	allow 13 500 with no working shown for **2** marks	1 1	AO2/1 4.5.2
07.4	straight line drawn from 13 m/s to 0 m/s finishing on x-axis at 65 s		1 1	AO2/2 4.5.6.1.5
Total			**6**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	moment = 280 × 0.9 moment = 252	allow 252 with no working shown for **2** marks allow 25200 with no working shown for **1** mark	1 1	AO2/1 4.5.4
08.2	the clockwise moment (of child B) decreases making it is less than the anticlockwise moment (of child A) so child A moves downwards **or** so child B moves upwards	accept so moments are no longer balanced	1 1 1	AO2/2 4.5.4
Total			**5**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	Third Law		1	AO1/1 4.5.6.2.3
09.2	elastic potential		1	AO1/1 4.5.3
09.3	weight = mass x gravitational field strength	accept gravity for gravitational field strength accept W = mg accept correct rearrangement ie mass = weight / gravitational field strength **or** m = W/g	1	AO1/1 4.5.1.3
09.4	343 = m x 9.8 m = $\frac{343}{9.8}$ m = 35	allow 35 with no working shown for **3** marks	1 1 1	AO2/1 AO2/1 AO2/1 4.5.1.3
09.5	force = spring constant × compression	accept force = spring constant × extension accept F = k e accept correct rearrangement ie constant = force / extension **or** k = F/e	1	AO1/1 4.5.3
09.6	compression = 0.07m 343 = k × 0.07 k = 343 ÷ 0.07 k = 4900	allow 4900 with no working shown for **4** marks allow 49 with no working shown for **3** marks	1 1 1 1	AO2/1 AO2/1 AO2/1 AO2/1 4.5.3
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	It will have a constant speed.		1	AO1/1 4.5.6.2.1
10.2	distance travelled = speed x time		1	AO1/1 4.5.6.1.2
10.3	$a = \frac{18 - 9}{6}$ a = 1.5	 allow 1.5 with no working shown for **2** marks	1 1	AO2/1 4.5.6.1.5
10.4	resultant force = mass x acceleration		1	AO1/1 4.5.6.2.2
10.5	F = (1120+80) × 1.5 F = 1800 (N)	 allow 1800 with no working shown for **2** marks accept their 10.3 × 1200 correctly calculated for **2** marks	1 1	AO2/1 4.5.6.1.5
10.6	$18^2 - 9^2 = 2 \times 1.5 \times s$ $s = 18^2 - 9^2 / 2 \times 1.5$ s = 81 (m)	allow 81 (m) with no working shown for **3** marks accept answer using their 10.3 (if not 1.5) correctly calculated for **3** marks	1 1 1	AO2/1 4.5.6.2.2

Question	Answers	Extra information		Mark	AO / Spec. Ref.
10.7	**Level 2:** A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that include references to the numerical factor.		3–4	4	AO2/1 4.1.1.2 4.5.6.3
	Level 1: Simple statements are made. The response may fail to make logical links between the points raised.		1–2		
	No relevant content		0		
	Indicative content • doubling speed increase the kinetic energy • kinetic energy increases by a factor of 4 • work done (by brakes) to stop the car increases • work done increases by a factor of 4 • work done is force x distance and braking force is constant • so if work done increases by 4 then the braking distance must increase by 4				
Total				**14**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	red–shift		1	AO1/1 4.8.2
11.2	the further away from the Earth, the faster a galaxy is moving		1	AO3/1a 4.8.2 WS3.5
11.3	**strength** as the balloon expands the dots get further apart, representing the galaxies moving apart **weakness** dots are only on the surface of the balloon, galaxies are throughout the universe **or** there is a limit to how far the balloon can expand		1 1	AO3/1b 4.8.2 WS1.2
11.4	both theories suggest that the Universe is expanding		1	AO1/2 4.8.2
11.5	new evidence / observations that cannot be explained by Theory 1	accept specific example of new evidence ie CMBR	1	AO1/1 4.8.2 WS1.1
Total			**6**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12.1	$\text{magnification} = \dfrac{\text{image height}}{\text{object height}}$		1	AO3/1b 4.6.2.5
	dividing by an object height of 1 cm gives the same (numerical) value		1	
12.2	accept anything practical that would work eg: use a taller object use a (travelling) microscope attach a scale to the screen and used a magnifying glass		1	AO3/3b 4.6.2.5 WS2.3/7
12.3	both points plotted correctly		1	AO2/2 4.6.2.5 WS3.1/2
	correct line of best fit drawn	a curve passing through all points (within ½ square), judge by eye	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12.4	values of 1.4 and 0.6 extracted from the graph		1	AO2/2 4.6.2.5 WS3.5
	2.33 times bigger	accept any number between 2.3 and 2.5 inclusive	1	
12.5	by dividing the distance between the lens and the image by the distance between the lens and the object		1	AO3/1a
	at least one correct calculation and comparison eg 100÷25 = 4 which is the same as the measured magnification		1	AO2/2 4.6.2.5 WS3.5
Total			**9**	

<table>
<tr><th>Question</th><th colspan="2">Answers</th><th>Extra information</th><th>Mark</th><th>AO /
Spec. Ref.</th></tr>
<tr><td>13.1</td><td colspan="2">move a (magnetic/plotting) compass around the wire

the changing direction of the compass needle shows a magnetic field has been produced

OR

sprinkle iron filings onto the card (1)

tapping the card will move the filings to show the magnetic field (pattern) (1)</td><td></td><td>1

1</td><td>AO1/2
4.7.2.1</td></tr>
<tr><td rowspan="4">13.2</td><td colspan="2">Level 2: A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that explain how the ignition circuit works.</td><td>3–4</td><td rowspan="4">4</td><td rowspan="4">AO2/1
4.7.2.1</td></tr>
<tr><td colspan="2">Level 1: Simple statements are made. The response may fail to make logical links between the points raised.</td><td>1–2</td></tr>
<tr><td colspan="2">No relevant content</td><td>0</td></tr>
<tr><td colspan="3">Indicative content
closing the (ignition) switch causes a current to pass through the electromagnet
the iron core (of the electromagnet) becomes magnetised
the electromagnet/iron core attracts the (short side of the) iron arm
the iron arm pushes the (starter motor) contacts (inside the electromagnetic switch) together
the starter motor circuit is complete
a current flows through the starter motor (which then turns)</td></tr>
<tr><td>Total</td><td colspan="3"></td><td>6</td><td></td></tr>
</table>

Question	Answers		Extra information	Mark	AO / Spec. Ref.
14	**Level 3:** A detailed and coherent plan covering all the major steps is provided. The steps in the method are logically ordered. The method would lead to the production of valid results. A source of inaccuracy is provided.	5–6		6	AO1/2 4.6.2.2
	Level 2: The bulk of a method is described with mostly relevant detail. The method may not be in a completely logical sequence and may be missing some detail.	3–4			
	Level 1: Simple statements are made. The response may lack a logical structure and would not lead to the production of valid results.	1–2			
	No relevant content	0			
	Indicative content place a glass block on a piece of paper draw around the glass block and then remove from the paper draw a line at 90° to one side of the block (the normal) use a protractor to measure and then draw a line at an angle of 20° to the normal replace the glass block using a ray box and slit point the ray of light down the drawn line mark the ray of light emerging from the block remove the block and draw in the refracted ray measure the angle of refraction with a protractor repeat the procedure for a range of values of the angle of incidence **possible source of inaccuracy** the width of the light ray which makes it difficult to judge where the centre of the ray is				
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SPECIMEN MATERIAL

GCSE
PHYSICS

PAPER 1F

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Do **not** allow means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any **two** from: • nuclear • oil • (natural) gas		2	AO1/1 4.1.3
01.2	4 (hours)		1	AO2/2 4.1.3 WS2
01.3	a system of cables and transformers		1	AO1/1 4.2.3
01.4	The power output of wind turbines is unpredictable		1	AO2/1 4.1.3
01.5	1500 / 0.6 2500 (wind turbines)	allow 2500 with no working shown for **2** marks	1 1	AO2/1 4.1.3
01.6	Most energy resources have negative environmental effects.		1	AO1/1 4.1.3
Total			**8**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any **two** from: • bungee rope may snap • rope may extend too much • student may land in the river		2	AO2/1 4.1.1 WS1
02.2	gravitational potential kinetic elastic potential	correct order only	1 1 1	AO1/1 4.1.1.1
02.3	$\frac{1}{2} \times 40 \times 35^2$ 24 500 (J)	accept 25 000 (J) (2 significant figures) allow 24 500 (J) with no working shown for **2** marks	1 1	AO2/2 4.1.1.2
Total			**7**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	current that is always in the same direction		1	AO1/1 4.2.3.1
03.2	total resistance = 30 (Ω) V = 0.4 × 30 12 (V)	allow 12 (V) with no working shown for **3** marks an answer of 8 (V) or 4 (V) gains **2** marks only	1 1 1	AO2/1 AO2/1 AO2/1 4.2.1.3
03.3	P = 0.4 x 12 = 4.8 5 (W)	allow 5 (W) with no working shown for **2** marks allow 4.8 (W) with no working shown for **1** mark	1 1	AO2/1 AO2/1 4.2.4.1
Total			**6**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	Student A's measurements had a higher resolution Student B was more likely to misread the temperature		1 1	AO3/1b 4.3.1.3 WS3
04.2	a random error		1	AO3/3a 4.3.1.3 WS3
04.3	8.4 ˚C		1	AO3/2a 4.3.2.3
04.4	740 (seconds)	allow answers in the range 730 – 780	1	AO3/2a 4.3.2.3
04.5	0.40 x 199 000 79 600 (J)	accept 79 600 (J) with no working shown for **2** marks	1 1	AO2/1 4.3.2.3
04.6	stearic acid has a higher temperature than the surroundings temperature will decrease until stearic acid is the same as the room temperature / surroundings	accept stearic acid is hotter than the surroundings	1 1	AO3/2b 4.3.2.3
Total			**9**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	battery, lamp and ammeter connected in series with variable resistor voltmeter in parallel with (filament) lamp		1 1	AO1/2 4.2.1.3
05.2	**Level 2:** A detailed and coherent description of a plan covering all the major steps is provided. The steps are set out in a logical manner that could be followed by another person to obtain valid results.	3–4	4	AO1/2 4.2.5.1
	Level 1: Simple statements relating to relevant apparatus or steps are made but they may not be in a logical order. The plan would not allow another person to obtain valid results.	1–2		
	No relevant content	0		
	Indicative content • ammeter used to measure current • voltmeter used to measure potential difference • resistance of variable resistor altered to change current in circuit **or** change potential difference (across filament lamp) • resistance (of filament lamp) calculated **or** R=V/I statement • resistance calculated for a large enough range of different currents that would allow a valid conclusion about the relationship to be made			
05.3	(as current increases) resistance increases (at an increasing rate)		1	AO2/2 4.2.1.4 WS3
05.4	any value between 6.3 and 6.9 (Ω)		1	AO2/2 4.2.1.4 WS3
05.5	**A**: Filament lamp **B**: Resistor at constant temperature **C**: Diode		1 1 1	AO1/1 4.2.1.4
Total			**11**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	**Level 2:** A detailed and coherent explanation is provided. The student makes logical links between clearly identified, relevant points.	3–4	4	AO1/1 4.2.5.1
	Level 1: Simple statements are made, but not precisely. The logic is unclear.	1–2		
	No relevant content	0		
	Indicative content • friction (between cloth and rod) causes • electrons (to) move • from the acetate rod **or** to the cloth • (net) charge on cloth is now negative • (net) charge on rod is now positive			
06.2	there is a force of attraction between the acetate rod and the cloth (reason) unlike charges attract **or** negative charges attract positive charges		1 1	AO2/1 AO1/1 4.2.5.1
06.3	increase		1	AO1/1 4.2.5.1
06.4	0.000025 × 60 000 1.5 (J)	accept 1.5 (J) with no working shown for **2** marks	1 1	AO2/1 4.2.5.2 4.2.4.2
Total			**9**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	Alpha – two protons and two neutrons Beta – electron from the nucleus Gamma – electromagnetic radiation		1 1 1	AO1/1 4.4.2.1
07.2	Gamma Beta Alpha	allow **1** mark for 1 or 2 correct	2	AO1/1 4.4.2.1
07.3	any **two** from: • (radioactive) source not pointed at students • (radioactive) source outside the box for minimum time necessary • safety glasses **or** eye protection **or** do not look at source • gloves • (radioactive) source held away from body • (radioactive) source held with tongs / forceps	accept any other sensible and practical suggestion	2	AO3/3a 4.4.2.4 WS1
07.4	half-life = 80 s counts/s after 200 s = 71	 accept an answer of 70	1 1	AO2/2 4.4.2.3
07.5	very small amount of radiation emitted	accept similar / same level as background radiation	1	AO2/1 4.4.3.2
Total			**10**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	he may receive an electric shock **or** he may be electrocuted		1	AO1/1 4.2.3.1
	if he touches the live wire		1	
08.2	10 690 = I x 230 I = 10 690 / 230 46.478(260) (A) 46	allow 46 (A) with no working shown for **4** marks	1 1 1 1	AO2/1 4.2.3.1
08.3	cost is higher more energy is used (per second)		1 1	AO1/1 AO2/1 4.2.4.2
Total			**8**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	range of speeds moving in different directions	 accept random motion	1 1	AO1/1 4.3.3.1
09.2	internal energy		1	AO1/1 4.3.2.1
09.3	density = mass / volume		1	AO1/1 4.3.1.1
09.4	0.00254 / 0.0141 0.18 kg/m^3	accept 0.18 with no working shown for the **2** calculation marks	1 1 1	AO2/1 AO2/1 AO1/1 4.3.1.1
Total			**7**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10	**Level 3:** A detailed and coherent explanation is provided. The student gives examples that argue a strong case and demonstrate deep knowledge. The student makes logical links between clearly identified, relevant points.	5–6	6	2xAO2/2
	Level 2: An attempt to link the description of the experiment and the results with differences between the two models. The student gives examples of where the plum pudding model does not explain observations. The logic used may not be clear.	3–4		1xAO1/1 1xAO2/2
	Level 1: Simple statements are made that the nuclear model is a better model. The response may fail to make logical links between the points raised.	1–2		2x AO1/1 4.4.1.3
	No relevant content	0		
	Indicative content • alpha particle scattering experiment • alpha particles directed at gold foil • most alpha particles pass straight through • (so) most of atom is empty space • a few alpha particles deflected through large angles • (so) mass is concentrated at centre of atom • (and) nucleus is (positively) charged • plum pudding model has mass spread throughout atom • plum pudding model has charge spread throughout atom			
Total			**6**	

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	power output increases (to meet demand) due to people returning home from work / school	accept many electrical appliances are switched on (which increases demand) accept other sensible suggestions	1	AO3/1a 4.1.3
11.2	00.00	accept midnight allow answers between 00.00 and 04.00	1	AO3/1a 4.1.3 WS3
11.3	any **two** from: • conserves fuel reserves • spare capacity to compensate for unreliable renewable resources • provides spare capacity in case of power station emergency shut-down • so as to not make unnecessary environmental impact		2	AO2/1 4.1.3
Total			**4**	

Question 12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
12.1	0.1 (ºC)		1	AO3/3a 4.1.1.3 WS2.3
12.2	power = energy transferred / time	allow P = E / t allow E = P x t	1	AO1/1 4.1.1.4
12.3	1050 / 300 3.5 (W)	accept 3.5 (W) with no working shown for **2** marks	1 1	AO2/1 4.1.1.4
12.4	1050 = m x 4200 x 0.6 m = 1050 / (4200 x 0.6) m = 0.417 (kg)	accept 0.417 (kg) with no working shown for **3** marks	1 1 1	AO2/2 4.1.1.3
12.5	any **one** from: • energy used to heat metal pan (as well as the water) • energy transfer to the surroundings (through the insulation) • angle of solar radiation will have changed during investigation • intensity of solar radiation may have varied during investigation		1	AO3/3a 4.1.1.3 WS3
Total			**8**	

Question 13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
13.1	weight (lifted) **or** height (lifted)		1	AO3/3a 4.1.2.2 WS2
13.2	any **two** from: • calculate a mean • spot anomalies • reduce the effect of random errors		2	AO3/3a 4.1.2.2 WS3
13.3	as speed increases, the efficiency increases (but) graph tends towards a constant value **or** appears to reach a limit	accept efficiency cannot be greater than 100%	1 1	AO3/2b 4.1.2.1
13.4	heating the surroundings		1	AO1/1 4.1.2.1
13.5	0 (%)		1	AO1/1 4.1.2.2
Total			**7**	

AQA

Please write clearly in block capitals.

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

Surname ____________________

Forename(s) ____________________

Candidate signature ____________________

GCSE COMBINED SCIENCE: TRILOGY

H

Higher Tier
Physics Paper 2H

Friday 14 June 2019 Morning Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a protractor
- a ruler
- 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 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 70.
- 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.

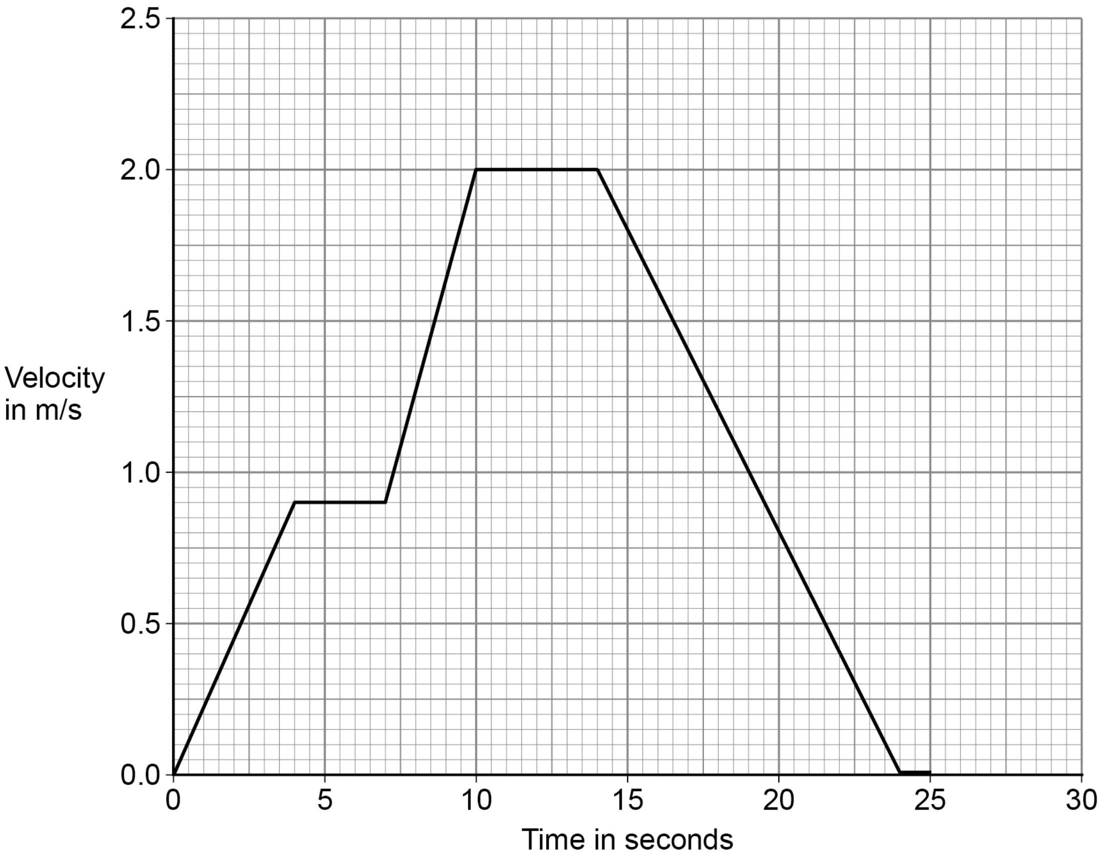
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

0 1 **Figure 1** shows a runner using a smart watch and a mobile phone to monitor her run.

Figure 1

Figure 2 is a velocity–time graph for part of the runner's warm-up.

Figure 2



0 1 . 1 Determine the total time for which the velocity of the runner was increasing.

[2 marks]

Time = ____________________ s

0 1 . 2 Determine the deceleration of the runner.

[2 marks]

Deceleration = ____________________ m/s^2

Question 1 continues on the next page

Do not write outside the box

The smart watch and mobile phone are connected to each other by a system called Bluetooth.

Bluetooth is wireless and uses electromagnetic waves for communication.

0 1 . 3 Suggest why the phone and watch being connected by a wireless system is an advantage when running.

[1 mark]

____

____

0 1 . 4 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

____

0 1 . 5 The electromagnetic waves have a frequency of 2 400 000 000 Hz

The speed of electromagnetic waves is 300 000 000 m/s

Calculate the wavelength of the electromagnetic waves.

[3 marks]

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Wavelength = ____________________ m

Do not write outside the box

0 1 . 6 **Table 1** shows some information about four types of Bluetooth.

Table 1

Type	**Power in milliwatts**	**Range in metres**
1	100	100
2	2.50	10.0
3	1.00	1.00
4	0.50	0.50

Mobile phones use type **2** Bluetooth to communicate with other devices.

Suggest **two** reasons why.

[2 marks]

1 ____

____

2 ____

____

11

Turn over for the next question

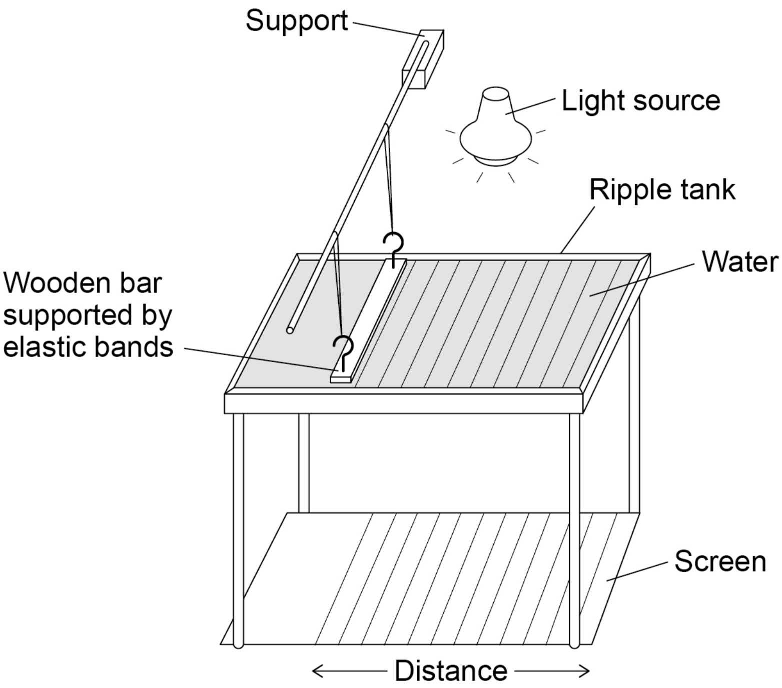
Do not write outside the box

0 2 **Figure 3** shows the equipment a teacher used to determine the speed of a water wave.

The equipment includes:

- a ripple tank filled with water
- a wooden bar that creates ripples on the surface of the water
- a light source which causes a shadow of the ripples on the screen.

Figure 3



0 2 . 1 Describe how equipment in **Figure 3** can be used to measure the wavelength, frequency and speed of a water wave.

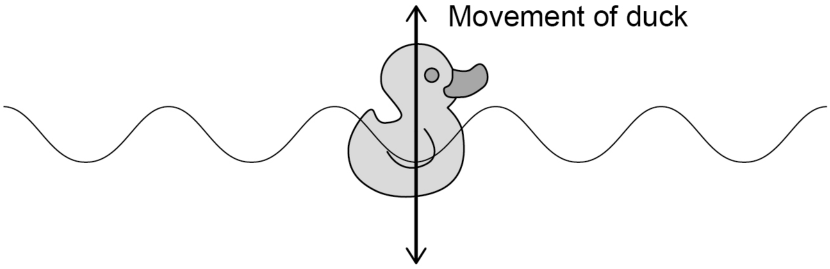
[6 marks]

Do not write outside the box

The teacher put a plastic duck in the ripple tank as shown in **Figure 4**.

The plastic duck moved up and down as the waves in the water passed.

Figure 4



0 2 . 2 How does the movement of the plastic duck in **Figure 4** demonstrate that water waves are transverse?

[1 mark]

Question 2 continues on the next page

Do not write outside the box

0 2 . 3 The teacher measured the maximum height and the minimum height of the plastic duck above the screen as the wave passed.

The teacher repeated his measurements.

Table 2 shows the teacher's measurements.

Table 2

Maximum height in mm	509	513	511
Minimum height in mm	503	498	499

Calculate the mean amplitude of the water wave.

[3 marks]

Mean amplitude = ______________________ mm

10

Do not write outside the box

0 3 Some quantities are scalars and some are vectors.

0 3 . 1 Which of the following quantities are scalars?

[2 marks]

Tick (✓) **two** boxes.

Displacement ☐

Distance ☐

Force ☐

Speed ☐

Velocity ☐

0 3 . 2 Give the difference between a vector quantity and a scalar quantity.

[1 mark]

____

____

Question 3 continues on the next page

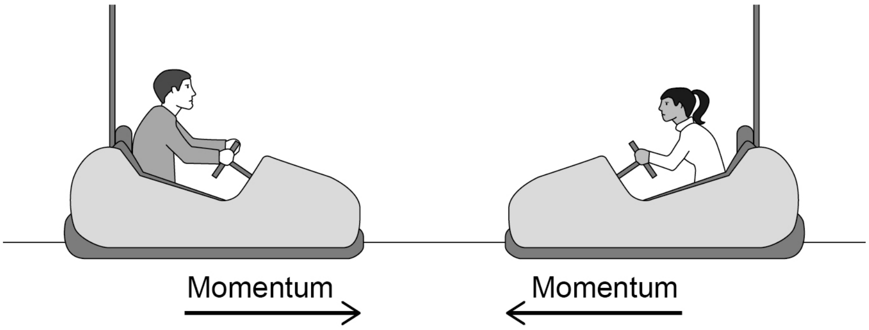
Do not write outside the box

Bumper cars are a fairground ride and are designed to bump into each other.

Figure 5 shows two bumper cars moving towards each other.

The momentum of each bumper car is shown by an arrow.

Figure 5



0 3 . 3 Give **two** factors that affect the momentum of each bumper car.

[2 marks]

1 ____

2 ____

0 3 . 4 The bumper cars crash into each other and stop.

Explain why both bumper cars stop after the crash.

[4 marks]

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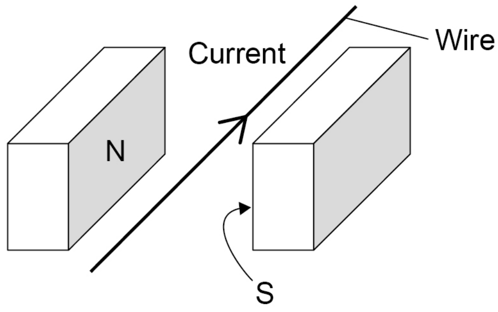
9

Do not write outside the box

0 4 **Figure 6** shows a wire in a magnetic field.

The direction of the current in the wire is shown.

Figure 6

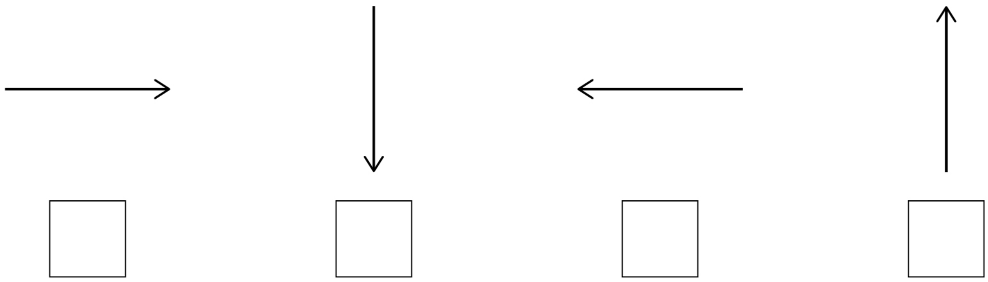


0 4 . 1 There is a force on the wire due to the current in the magnetic field.

In which direction is the force on the wire?

[1 mark]

Tick (✓) **one** box.



0 4 . 2 Give **two** ways that the direction of the force on the wire could be reversed.

[2 marks]

1 ____

2 ____

Question 4 continues on the next page

Do not write outside the box

0 4 . 3 The length of the wire in the magnetic field is 0.050 m

The force on the wire is 0.072 N

magnetic flux density = 360 mT

Calculate the current in the wire.

Use the Physics Equations Sheet.

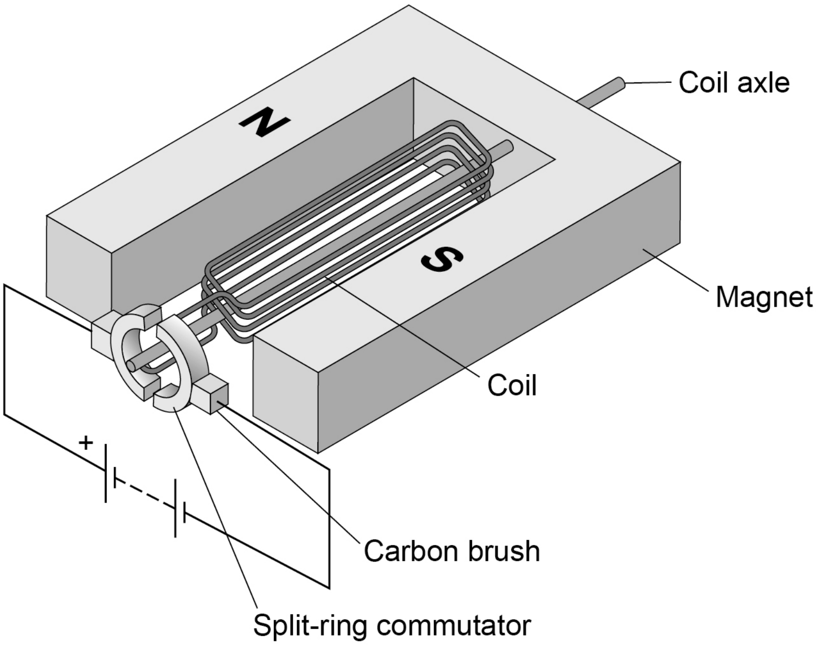
[4 marks]

Current = ____________________ A

Do not write outside the box

0 4 . 4 **Figure 7** shows a simple motor.

Figure 7



Explain why the coil rotates when there is a current in the coil.

[4 marks]

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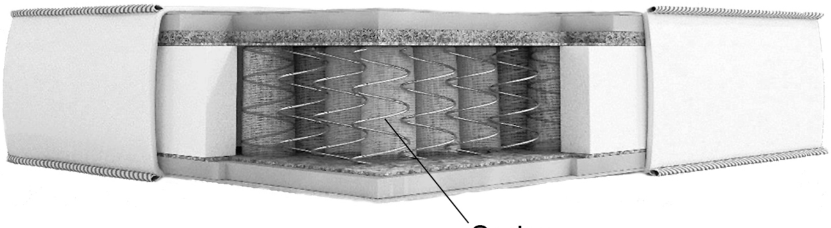
11

Turn over for the next question

Do not write outside the box

0 5 **Figure 8** shows some springs inside a mattress.

Figure 8



0 5 . 1 Which proportionality is true when a force is applied to a spring?

[1 mark]

Tick (✓) **one** box.

Force ∝ energy stored ☐

Force ∝ extension ☐

Force ∝ length ☐

Force ∝ spring constant ☐

Do not write outside the box

A mattress contains 1200 identical springs.

A person lies on the mattress and the springs compress.

The mean force on each spring in the mattress is 0.49 N

0 5 . 2 Calculate the mass of the person.

gravitational field strength = 9.8 N/kg

[4 marks]

Mass = ____________________ kg

Question 5 continues on the next page

Do not write outside the box

0 5 . 3 The mean compression of each spring is 3.5×10^{-3} m

Calculate the spring constant of each spring in the mattress.

Give the unit.

[4 marks]

Spring constant = ____________________

Unit = ____________________

0 5 . 4 For a given force, different springs compress by different amounts.

Explain what property of the springs would make the mattress soft.

[2 marks]

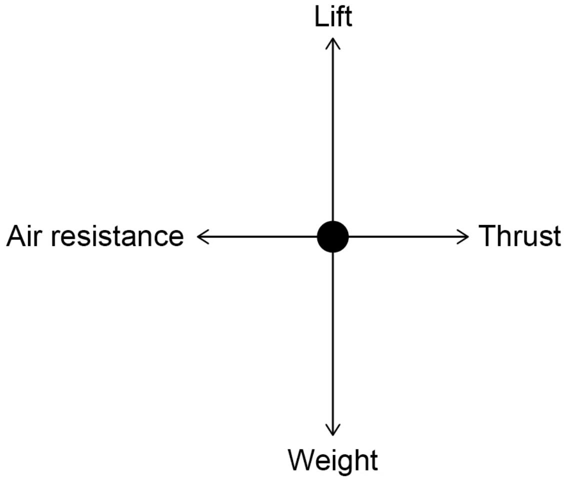
11

Do not write outside the box

0 6 **Figure 9** shows a free body diagram for an aeroplane flying at a constant speed and at a constant height.

The speed of the aeroplane is much greater than the speed at which the aeroplane lands.

Figure 9



0 6 . 1 Explain how the forces need to change so the aeroplane can land.

[4 marks]

Question 6 continues on the next page

Do not write outside the box

0 6 . 2 The aeroplane lands at a speed of 80 m/s

After landing, the aeroplane takes 28 s to decelerate to a speed of 10 m/s

The mean resultant force on the aeroplane as it decelerates is 750 000 N

Calculate the mass of the aeroplane.

[5 marks]

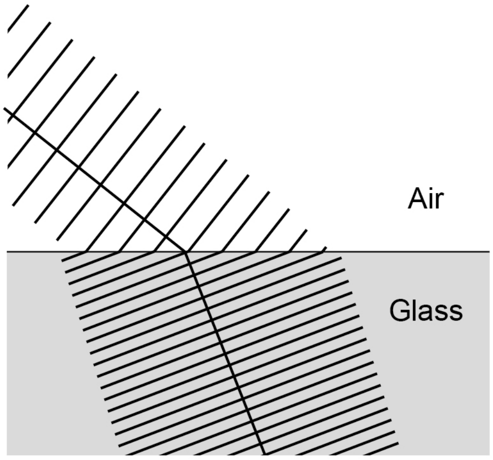
Mass = ____________________ kg

9

Do not write outside the box

0 7 Wave front diagrams are used to explain why light refracts when it passes from air into glass.

Figure 10



0 7 . 1 Explain why the light refracts as it passes from air into glass.

[3 marks]

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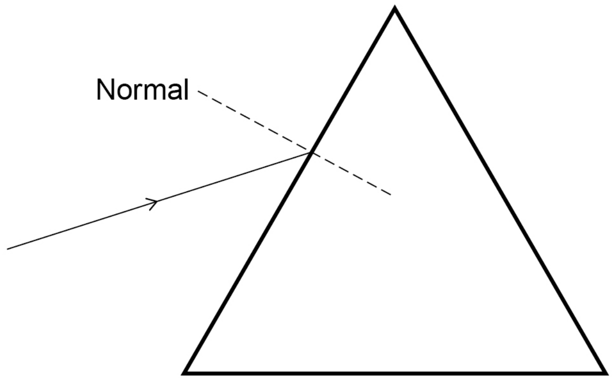
Question 7 continues on the next page

Do not write outside the box

0 7 . 2 **Figure 11** shows a ray of red light entering a glass prism.

Figure 11



Complete the ray diagram to show the ray emerging from the glass prism.

[3 marks]

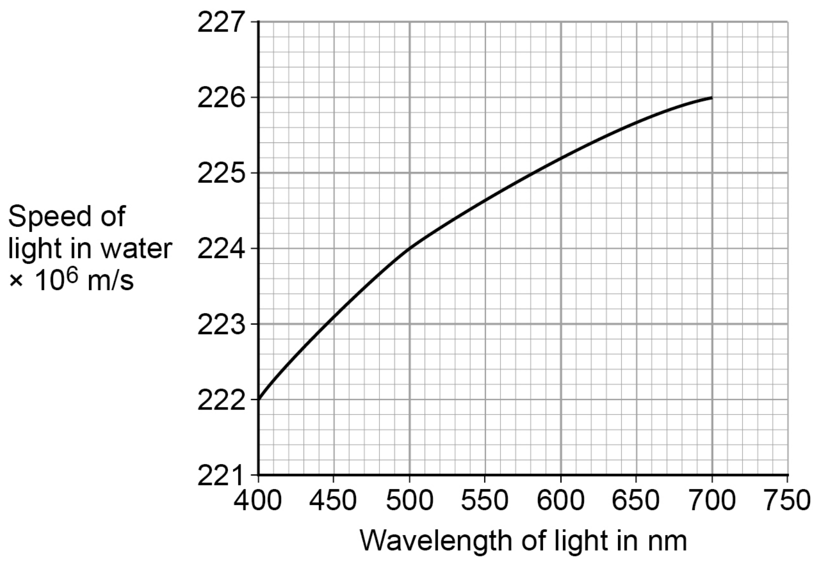
Do not write outside the box

0 7 . 3 White light is made up of a continuous spectrum of different wavelengths that all travel at 3×10^8 m/s in air.

Rainbows are produced because different wavelengths of light travel at different speeds in water.

Figure 12 shows the speed of different wavelengths of light in water.

Figure 12



Explain why violet light is refracted the most as it enters water.

[3 marks]

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9

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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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	
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9	
10	
11	
TOTAL	

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]

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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]

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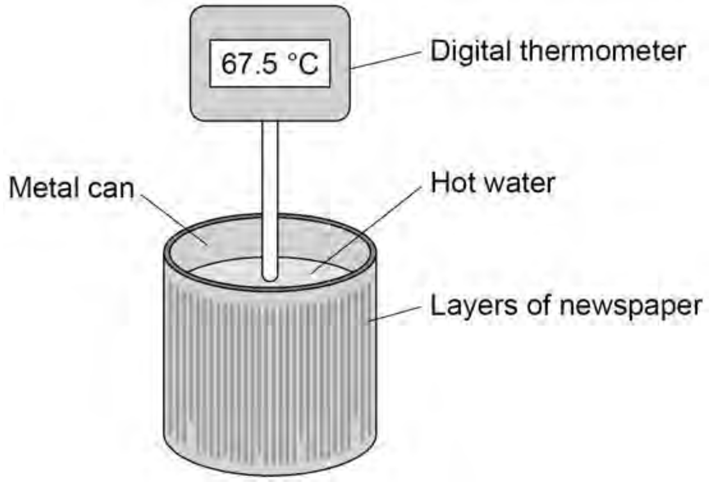
11

Do not write outside the box

0 2 A student investigated the insulating properties of newspaper.

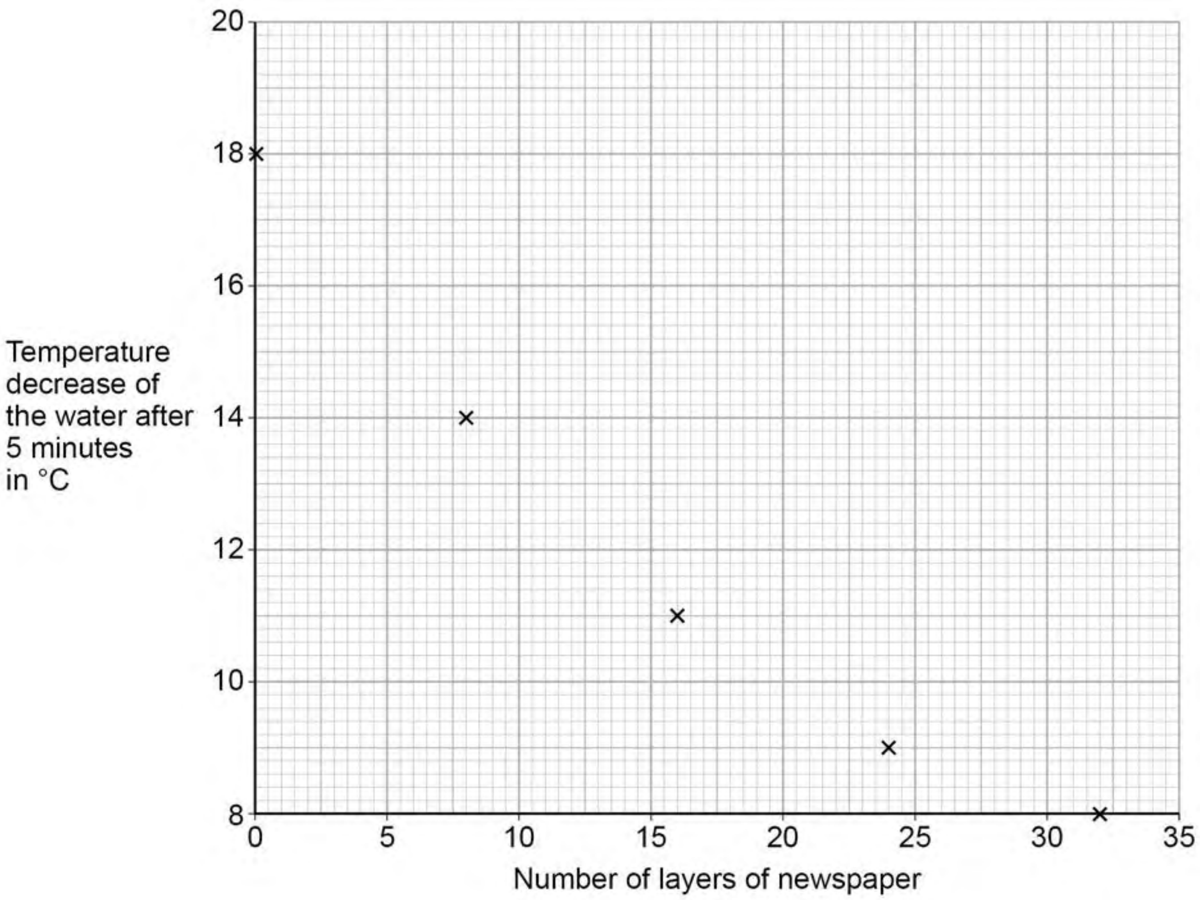
Figure 1 shows the apparatus the student used.

Figure 1



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

Figure 2



Do not write outside the box

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

[6 marks]

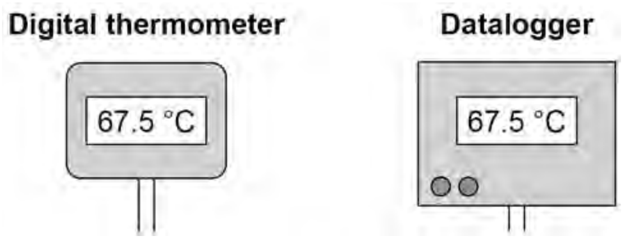
Question 2 continues on the next page

Do not write outside the box

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]

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8

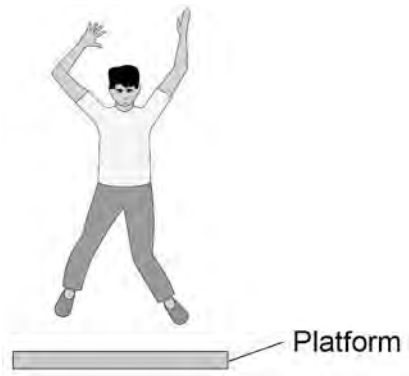
Do not write outside the box

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

Turn over ►

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]

____

____

____

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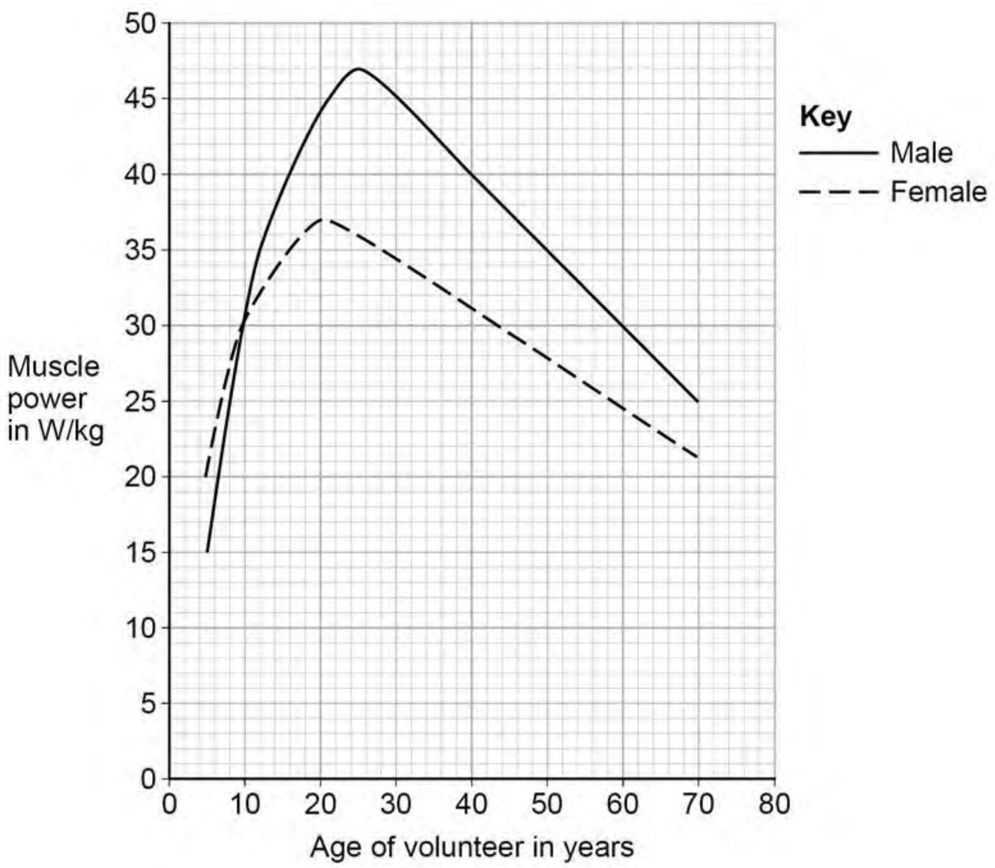
____

Mass = ____________________ kg

Figure 5 shows the scientist's results.

Figure 5



Do not write outside the box

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

Do not write outside the box

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]

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

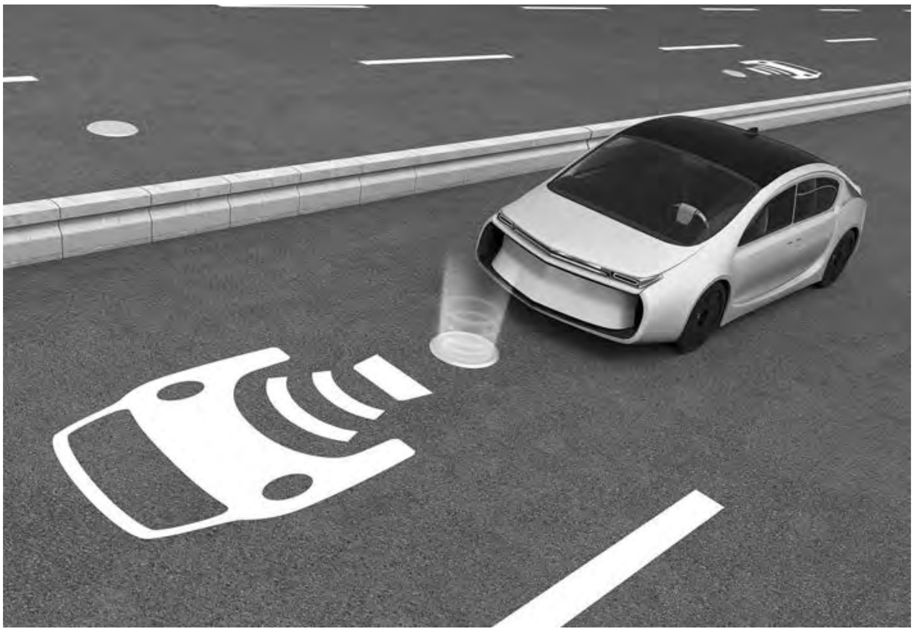
Do not write outside the box

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 ____

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____

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2 ____

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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]

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9

Turn over for the next question

Do not write outside the box

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

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

[2 marks]

$$^{210}_{84}\text{Po} \longrightarrow {}^{\square}_{\square}\text{Pb} + {}^{4}_{2}\text{He}$$

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]

Do not write outside the box

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

Do not write outside the box

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]

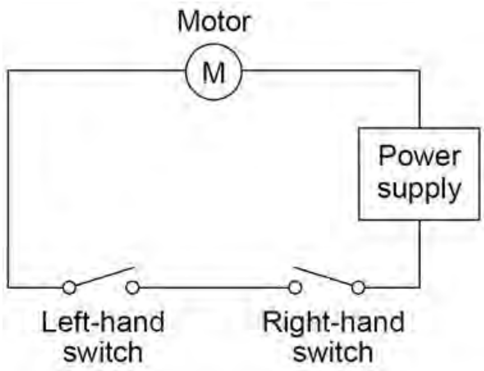
Frequency = ____________ Unit ____________

Do not write outside the box

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]

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____

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]

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____

____

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

Do not write outside the box

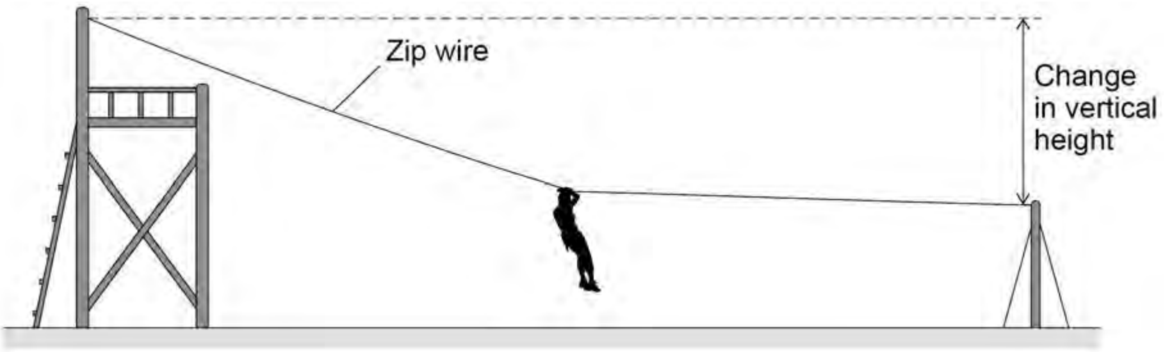
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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]

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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

Do not write outside the box

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

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]

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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

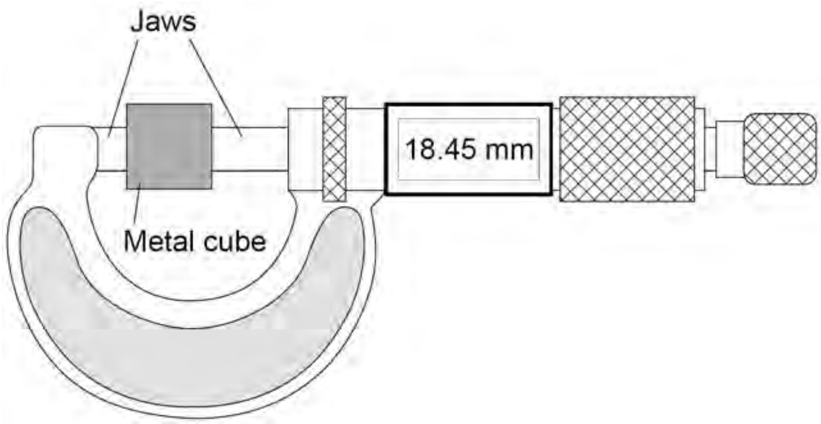
9

Do not write outside the box

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]

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Question 9 continues on the next page

Do not write outside the box

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]

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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]

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Mass = ____________________ kg

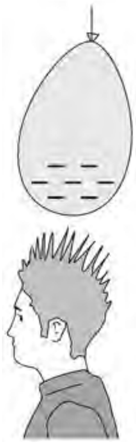
9

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]

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____

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]

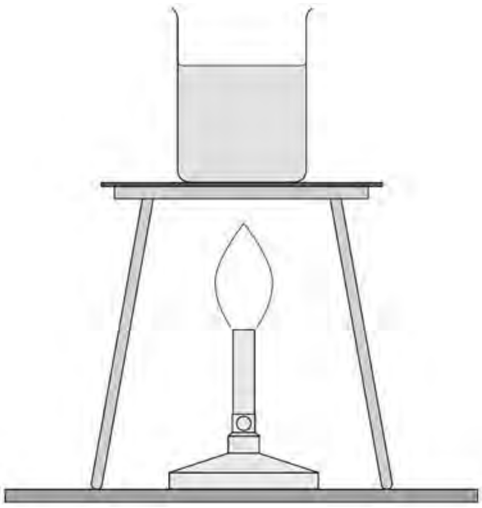
Resistance = ____________________ Ω

10

Do not write outside the box

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. ☐

Turn over ►

Do not write outside the box

11.3 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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GCSE
COMBINED SCIENCE: TRILOGY
8464/P/2H

Physics Paper 2H

Mark scheme

June 2019

Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, ‘allow’ is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student’s answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student’s answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	(4 - 0) + (10 - 7) **or** 4 + 3 **or** 10 - 3 7 (s)	an answer of 7 (s) gains **2** marks	1 1	AO2 6.5.4.1.5	E
01.2	gradient = $\frac{0-2}{24-14}$ (-)0.2 (m/s^2)	an answer of 0.2 (m/s^2) gains **2** marks allow readings from any two points correctly substituted allow correct use of $a = \frac{\Delta v}{t}$	1 1	AO2 6.5.4.1.5	E
01.3	(there are no wires) to get tangled / disconnected	allow easier to move arms allow wires are inconvenient allow easier to transfer data	1	AO3 6.6.2.4	E
01.4	wave speed = frequency × wavelength	allow v = f λ allow any correct re-arrangement	1	AO1 6.6.1.2	E
01.5	300 000 000 = 2 400 000 000 × λ λ = $\frac{300\ 000\ 000}{2\ 400\ 000\ 000}$ λ = 0.125 (m)	an answer of 0.125 (m) or 0.13 (m) scores **3** marks allow λ = 0.13 (m)	1 1 1	AO2 6.6.1.2	E
01.6	range is far enough (for most uses) power is not too great so the battery will not drain quickly	allow power not too great so the phone will not overheat allow the range per milliwatt is greatest or 4 metres	1 1	AO3 6.6.2.4	E

Total			**11**		

Question	Answers	Mark	AO / Spec. Ref.	ID
02.1	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.6.1.2	E
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4		
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2		
	No relevant content.	0		
	Indicative content • If two quantities have been determined, v = f λ can be used to find the third. **Frequency** • use a stopclock • count the number of waves passing a point in a fixed time period • divide the time by the number of waves to determine the time for one wave, T • f = 1/T • read the frequency off the oscillator **Wavelength** • use a camera to freeze the image • use a metre rule to measure the distance between two wavefronts • count the number of waves between the wavefronts • divide distance by the number of waves to determine λ **Velocity** • determine a mean value of frequency • determine a mean value of wavelength • measure the time it takes one wavefront to travel the length of the screen • measure the length of the screen • speed = distance / time to access Level 3 there must be a description of how frequency, wavelength and velocity can be determined			

02.2	(the duck) moves perpendicular to the direction of wave travel	duck moves up and down is insufficient	1	AO2 6.6.1.1	E
02.3	mean maximum height = 511 **and** mean minimum height = 500	an answer of 5.5 gains **3** (mm) marks	1	AO2 6.6.1.2	E
	511 – 500 = 11	allow a calculated difference from incorrect means	1		
	11 / 2 = 5.5 (mm)	allow their difference divided by 2 any correct method of determining the mean amplitude can score **3** marks	1		
Total			**10**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	distance speed		1 1	AO1 6.5.4.1.3	A
03.2	(both have magnitude) only a vector has direction	allow scalar does not have a direction	1	AO1 6.5.1.1	E
03.3	any **two** from: • mass • velocity • friction • power of the motor	 allow weight allow speed or direction allow air resistance or drag	2	AO1 6.5.5.2	E

03.4	total momentum is zero after the collision (because the bumper cars are stationary) because the momentum of each car before the collision was equal (in magnitude) and opposite (in direction) so the total momentum of the bumper cars was zero before the collision and momentum is conserved **OR** total momentum is zero after the collision (because the bumper cars are stationary) (1) because the momentum of each car before the collision was equal (in magnitude) and opposite (in direction) (1) both cars exert an equal and opposite force on each other (for equal periods of time) (1) so the cars accelerate (in opposite directions) (1)		1 1 1 1	AO3 5.5.5.2	E
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	$\downarrow$		1	AO1 6.7.2.2	A
04.2	reverse the direction of the current		1	AO1 6.7.2.2	E
	reverse the direction of the magnetic field		1		
04.3		an answer of 4.0 (A) scores **4** marks		AO2 6.7.2.2	E
	B = 0.360 (T)		1		
	0.072 = 0.360 × I × 0.050	allow a correct substitution using an incorrectly / not converted value of B	1		
	$I = \frac{0.072}{(0.360 \times 0.050)}$	allow a correct rearrangement using an incorrectly / not converted value of B	1		
	I = 4.0 (A)	allow a correct calculation using an incorrectly / not converted value of B	1		

04.4	there is a magnetic field (due to the permanent magnet) **and** current in a wire causes a magnetic field current is in opposite directions in each side of the coil so forces act in opposite directions on either side of the coil (the split ring ensures that) the current in the left / right side of the coil is always in the same direction	 allow (the split ring ensures that) the force in the left / right side of the coil is always in the same direction allow the current reverses each half rotation	1 1 1 1	AO1 6.7.2.3	E

Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	force ∝ extension		1	AO1 6.5.3	A
05.2		an answer of 60 (kg) scores **4** marks		AO2 6.5.1.3	E
	$F = 0.49 \times 1\,200$		1		
	or				
	F = 588 (N)				
	$588 = m \times 9.8$	allow a correct substitution using an incorrectly calculated value of F	1		
	$m = \frac{588}{9.8}$	allow a correct rearrangement using an incorrectly calculated value of F	1		
	m = 60 (kg)	allow a correct calculation using an incorrectly calculated value of F	1		
	OR				
	0.49 = mean mass per spring × 9.8 (1)				
	mean mass per spring = $\frac{0.49}{9.8}$ (1)				
	mean mass per spring = 0.050 (1)				
	m = 0.050 × 1200 = 60 (kg) (1)				
05.3		an answer of 140 scores **3** calculation marks		3 x AO2 1 x AO1 6.5.3	E
	$0.49 = k \times 3.5 \times 10^{-3}$		1		
	$k = \frac{0.49}{3.5 \times 10^{-3}}$		1		
	140		1		
	N/m		1		

05.4	springs with a low spring constant because they can compress by a larger amount (for a given force)	 allow they can compress by the same amount for a smaller force allow low stiffness	1 1	AO3 6.5.3	E
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	thrust decreases	allow air resistance or drag increases ignore air resistance decreases as speed decreases	1	1xAO1 1xAO2 2xAO3 6.5.4.2.1	E
	so there is a resultant force in opposite direction	allow so air resistance or drag is greater than thrust	1		
	lift must decrease (because weight stays the same)		1		
	so there is a resultant downwards force	allow so weight is greater than lift the last two marking points cannot be awarded if there is a reference to the weight increasing	1		
06.2		an answer of 300 000 (kg) scores **5** marks		AO2 6.5.4.1.5 6.5.4.2.2	E
	$a = \frac{(10\text{-}80)}{28}$	allow $a = \frac{(80\text{-}10)}{28}$	1		
	a = (–)2.5 (m/s^2)	a valid equation must have been used to calculate a to score subsequent marks	1		
	(–) 750 000 = m × (–)2.5	allow a correct substitution using their calculated value of a	1		
	$m = \frac{(\text{-})750\ 000}{(\text{-})2.5}$	allow a correct rearrangement using their calculated value of a	1		
	m = 300 000 (kg)	allow a correct calculation using their calculated value of a	1		
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
7.1	speed / velocity in the glass is lower	speed / velocity changes is insufficient allow the refractive index of glass is higher than that of air allow glass has a higher optical density than air	1	AO1 6.6.2.2	E
	so the edge of the wave(front) entering the glass slows down		1		
	but the part of the wave(front) in the air continues at the higher speed / velocity (causing a change in direction)		1		
7.2	correct ray in the prism bent towards the normal		1	AO1 6.2.2.2	E
	second normal at 90° at the point the ray emerges		1		
	correct emergent ray bent away from the normal	this mark can be awarded without a normal line drawn	1		
7.3	violet has the shortest wavelength (400 nm)		1	AO3 6.2.2.2	E
	violet light travels the slowest in water		1		
	violet light undergoes the greatest change in speed (and direction)		1		
Total			**9**		

GCSE
PHYSICS
8463/1H

Paper 1 Higher Tier

Mark scheme

June 2019

Version: 1.0 Final

196G8463/1H/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1.1	The energy transferred each second to the bulb.		1	4.1.1.4 AO1
1.2	power = potential difference × current **or** $P = VI$		1	4.2.4.1 AO1
1.3	$40 = I \times 230$ $I = \frac{40}{230}$ I = 0.17 (A)	an answer of 0.17 (A) scores **3** marks a correct answer that rounds to 0.17 (A) scores **3** marks	1 1 1	4.2.4.1 AO2
1.4	$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$		1	4.1.2.2 AO1
1.5	$0.30 = \frac{\text{useful power output}}{9.0}$ useful power output = 0.30 × 9.0 useful power output = 2.7 (W)	an answer of 2.7 (W) scores **3** marks	1 1 1	4.1.2.2 AO2
1.6	bulbs also transfer thermal energy the efficiency of the light bulb also needs to be considered	allow light bulbs emit infrared radiation as well as visible light ignore so people know how bright the bulb is allow the cost to power the light bulb depends on the efficiency allow to see how much energy is wasted	1 1	4.1.2.2 4.1.1.4 AO1 AO3
Total			**11**	

Question 2

Question	Answers		Mark	AO/ Spec. Ref.
2.1	**Level 3**: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		5–6	RP2 WS2.2 4.1.2.1 AO1
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.		3–4	
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.		1–2	
	No relevant content		0	
	Indicative content • Wrap N layers of newspaper around the metal can • Heated water in a kettle **or** Using a Bunsen burner • Put hot water in the metal can • Use a measuring cylinder to measure the volume of water • Measure initial and final temperature with the digital thermometer • Use a stopclock / stopwatch to measure a time of 5 minutes • Calculate temperature decrease • Repeat with different number of layers of newspaper • Repeat with no layers of newspaper • Use same initial temperature of hot water • Use same volume of water each time Level 3: Workable method which includes changing the number of layers and includes at least one control variable (same volume of water or same starting temperature)			
2.2	the digital thermometer and the datalogger have the same resolution	allow both measure to 1 d.p. ignore accuracy ignore precision they give the same result is insufficient	1	RP2 WS2.3 4.1.2.1 AO3
	only need to measure the start and end temperature **or** only need 2 readings **or** only need to calculate the temperature change		1	
Total			**8**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3.1	$41 = \frac{9.8 \times h}{0.12}$ $h = \frac{41 \times 0.12}{9.8}$ h = 0.50 (m)	an answer of 0.50 scores **3** marks allow a correct answer that rounds to 0.50 for **3** marks	1 1 1	4.1.1.2 AO2
3.2	kinetic energy = 0.5 × mass × (speed)^2 ***or*** $E_k = ½ mv^2$		1	4.1.1.2 AO1
3.3	270 = ½ × m × 3^2 $m = \frac{270}{(½ \times 3^2)}$ **or** $m = \frac{270}{4.5}$ m = 60 (kg)	an answer of 60 (kg) scores **3** marks	1 1 1	4.1.1.2 AO2

3.4	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear.		3–4	WS3.5 4.1.1.2 AO3
	Level 1: Relevant features are identified and differences noted.		1–2	
	No relevant content		0	
	Indicative content • males have a greater muscle power than females for most of their lives • males have a greater muscle power than females above 9/10 years old • males have a lower muscle power than females below 9/10 years old • there is a similar pattern for males and females as age increases • males have a peak muscle power at 25 years old whereas females have a peak muscle power at 20/21 years old • at 9/10 years old males have the same muscle power as females • peak muscle power for males (47 W/kg) is greater than peak muscle power for females (37 W/kg) • the rate of increase of muscle power is greater for males than females (between 5 and 25 years old) • the rate of decrease of muscle power is greater for males than females. Ignore comments relating to strength			
3.5	any **1** from: • maximum height reached is a better indicator of maximum muscle power • maximum / peak muscle power was being investigated, not mean / average muscle power • volunteer may not use maximum effort on the first try • performance may improve with practise • performance may get worse with tiredness	allow maximum time in the air for maximum height reached / jumped	1	WS3.7 4.1.1.4 AO3
Total			**12**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4.1	electric car journey will take a (much) longer time (because) battery will need recharging **or** (because) the car will need to stop for 40 minutes	allow diesel car journey will take a shorter time allow diesel car will not need to be refuelled	1 1	4.1.3 AO3
4.2	energy stored in diesel = 45 × 51 = 2295 (MJ) energy stored in batteries = 0.95 × 280 = 266 (MJ) (so) the diesel stores more energy than the battery (and the diesel car has a higher range)	 this mark is dependent on correct calculations of energy stored	1 1 1	4.1.3 1AO1 1AO2 1AO3
4.3	any **2** from: • recharging is a continuous process • fewer cells needed in the car • more cars can be charged at the same time	allow cars do not need to stop to recharge allow shorter journey times allow don't have to wait for battery to recharge allow longer time between recharges allow the range of the electric car is increased allow smaller battery needed in the car allow do not need to find a charging point allow fewer charging stations needed ignore it is quicker ignore cost of charging ignore methods of electricity generation	2	4.1.3 AO1

4.4	when cars are plugged in the energy from car batteries could be transferred back to the National Grid	 allow mains supply for National Grid allow energy from car batteries could be used to power household appliances	1 1	4.1.3 AO1
Total			**9**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5.1	$^{206}_{82}\text{Pb}$		1 1	4.4.2.2 AO1
5.2	alpha radiation is highly ionising causing an increased risk of cancer **or** organ failure **or** radiation sickness / poisoning **or** mutation of genes / DNA **or** damage to cells / tissues / organs until the radioactive material is removed / excreted **or** activity of radioactive material reaches / approaches background radiation levels	allow kill cells allow all the alpha radiation is absorbed by the body ignore references to half-life	1 1 1	4.4.2.4 AO1
5.3	$\frac{414}{138} = 3$ (half-lives) $1.45 \times 10^{-4} \times 2 \times 2 \times 2$ $= 1.16 \times 10^{-3}$ (g) **or** $= 0.00116$ (g)	an answer of 1.16×10^{-3} (g) scores **3** marks	1 1 1	4.4.2.3 AO2
Total			**8**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6.1	50 Hz / hertz	 allow Hertz	1 1	4.2.3.1 AO1
6.2	(both) switches need to be closed / on to complete the <u>series</u> circuit **or** to allow charge to flow **or** so there is a current in the circuit		1 1	4.2.2 AO1
6.3	 $1800 = I^2 \times 32$ $I^2 = \frac{1800}{32}$ **or** $I^2 = 56.25$ I = 7.5 (A)	an answer of 7.5 (A) scores **3** marks an answer of 0.237(A) scores **2** marks this mark may be awarded if P is incorrectly or not converted this mark may be awarded if P is incorrectly or not converted this answer only	 1 1 1	4.2.4.1 AO2
6.4	 $1500 = \frac{450\ 000}{t}$ $t = \frac{450\ 000}{1500}$ t = 300 (s)	an answer of 300 (s) scores **3** marks an answer of 300 000 (s) scores **2** marks this mark may be awarded if P is incorrectly or not converted this mark may be awarded if P is incorrectly or not converted this answer only	 1 1 1	4.1.1.4 AO2
Total			**10**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7.1		an answer of 2.5 (m) scores **3** marks		4.1.1.2 AO2
	$1470 = 60 \times 9.8 \times h$	this mark may be awarded if E_p is incorrectly/not converted	1	
	$h = \frac{1470}{60\times9.8}$ **or** $h = \frac{1470}{588}$	this mark may be awarded if E_p is incorrectly/not converted	1	
	h = 2.5 (m)	this answer only	1	
7.2	(work done against) air resistance **or** (work done against) friction (between zip line and pulley)		1	4.1.1.1 AO1
	causes thermal energy to be transferred to surroundings	ignore sound energy	1	
7.3	different people have different surface areas	allow streamlining allow body position body size is insufficient	1	4.1.1.1 4.1.1.2 AO1
	so would be affected by air resistance differently **OR** initial speed may not be zero (1) which would add to the total energy (of the system) (1)	allow people have different masses / weights (1) so people have different terminal velocities (1) reference to mass changing the kinetic energy or gravitational potential energy negates both these marks	1	
Total			**7**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8.1	Initial temperature was a control variable		1	WS3.7 4.3.2.2 AO3
8.2	copper greater change in mass (than the other metals)	this mark is dependent on scoring the first mark allow more ice melted (than the other metals) allow the ice melted faster (than the other metals)	1 1	4.1.2.1 AO3
8.3	variation in initial mass of ice cube **or** surface area of the ice cube touching the metal	allow variation in initial volume of ice cube allow melting of ice while handling allow variation in room temperature allow initial temperature of metal block	1	WS3.7 4.1.2.1 AO3

8.4	$E = m \times 2100 \times 15$ $E = m \times 334\ 000$ $5848 = 31\ 500\ m + 334\ 000\ m$ **or** $5848 = 365\ 500\ m$ $m = \frac{5848}{(31\ 500 + 334\ 000)}$ **or** $m = \frac{5848}{(365\ 500)}$ $m = 0.016$ (kg)	an answer of 0.016 (kg) scores **5** marks allow **2** marks for an answer that rounds to 0.186 or 0.0175 if no other mark scored allow **1** mark for either 5848 = m × 2100 × 15 **or** 5848 = m × 334 000	1 1 1 1 1	4.3.2.2 4.3.2.3 AO2
Total			**9**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9.1	metre rule has a lower resolution so is less accurate (than the micrometer screw gauge)	allow metre rule has a resolution of 1mm / 1cm fewer decimal places is insufficient	1 1	WS2.3 RP5 4.3.1.1 AO1
9.2	record the value of the zero error when there is no object on the balance subtract / add the value of the zero error		1 1	RP5 4.3.1.1 AO3
9.3		an answer of 0.0502 (kg) scores **5** marks		RP5 4.3.1.1 AO2
	$V = (18.45 \times 10^{-3})^3$ **or** $V = 0.01845^3$	this mark may be awarded if width is incorrectly / not converted	1	
	$V = 6.28 \times 10^{-6}$ (m^3)	this answer only	1	
	$8.0 \times 10^3 = \dfrac{m}{6.28 \times 10^{-6}}$	allow $8.0 \times 10^3 = \dfrac{m}{\text{their calculated V}}$	1	
	$m = 8.0 \times 10^3 \times 6.28 \times 10^{-6}$	allow $m = 8.0 \times 10^3 \times$ their calculated V	1	
	m = 0.0502 (kg)	allow an answer consistent with their calculated V	1	
Total			**9**	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	non-contact (force)	allow electrostatic (force)	1	4.2.5.2 AO1
	attraction (between hair and balloon)	allow repulsion between the hairs on the head	1	
10.2		an answer of 2.0×10^{-6} (C) scores **3** marks an answer of 2×10^{-3} (C) scores **2** marks		4.2.4.2 AO2
	$0.0050 = Q \times 2500$	this mark may be awarded if pd is incorrectly or not converted	1	
	$Q = \frac{0.0050}{2500}$	this mark may be awarded if pd is incorrectly or not converted	1	
	$Q = 2.0 \times 10^{-6}$ (C) **or** $Q = 0.0000020$ (C)	these answers only	1	
10.3		an answer of 120 (Ω) scores **5** marks		4.2.1.2 4.2.1.3 AO2
	$0.16 = I \times 4.0 \times 10^{-3}$ **or** $I = \frac{0.16}{4.0 \times 10^{-3}}$	this mark may be awarded if time is incorrectly / not converted	1	
	$I = 40$ (A)	this value only	1	
	$4800 = 40 \times R$	allow 4800 = their calculated I × R	1	
	$R = \frac{4800}{40}$	allow R = 4800 / their calculated I	1	
	$R = 120$ (Ω)	allow an answer consistent with their calculated I	1	
Total			**10**	

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	the (mean) kinetic energy of the particles increases	allow the (mean) speed of the particles increases 'kinetic energy increases' is insufficient by itself do not accept particles vibrating	1	4.3.2.1 AO1
	which increases the (internal) energy of the water	ignore description of evaporation	1	
11.2	Particles in a gas have more potential energy than particles in a liquid.		1	4.3.1.1 AO1
11.3	Energy given to water E = mL with quantities defined		1	4.3.3.1 AO1
	power output (of Bunsen burner) $= \frac{\text{energy transferred (to water)}}{\text{time}}$	allow $P = \frac{E}{t}$ with quantities defined	1	
	power output $= \frac{\text{change in mass} \times \text{specific latent heat}}{\text{time}}$	allow E = Pt equated with E = mL or stated in words **or** $P = \frac{mL}{t}$ with quantities defined	1	
	time should be converted to seconds **or** use a time of 300 seconds		1	
Total			**7**	