Questions are for both separate science and combined science students

Q1.

Figure 1 shows a student putting a coin into a vending machine that sells food.

Figure 1

(a) The vending machine is connected to the mains electricity supply.

What is the frequency and the potential difference of the mains electricity supply in the UK?

Frequency = _____ Hz

Potential difference = _____ V

(2)

The vending machine identifies the value of the coin by measuring the resistance of the coin.

(b) The power dissipated by the coin is 340 mW when the current in the coin is 0.75 A.

Calculate the resistance of the coin.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

_____

Resistance = _____ Ω

(4)

(c) Coins that are dirty are **not** recognised by the vending machine.

Suggest **one** reason why.

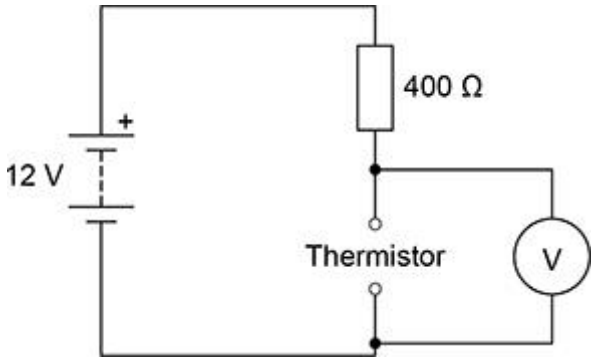
_____

_____

(1)

Figure 2 shows part of a different circuit that is used to monitor the temperature inside the vending machine.

Figure 2



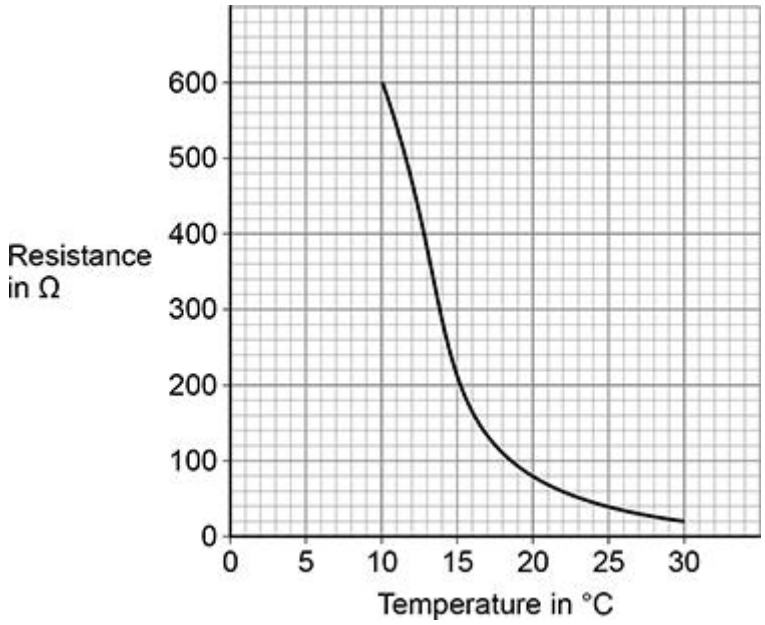
(d) The circuit symbol for a thermistor has not been included.

Draw the circuit symbol for a thermistor in the box below.

(1)

Figure 3 shows how the resistance of the thermistor varies with temperature.

Figure 3



(e) The cooling system inside the vending machine turns on when the temperature of the thermistor is above 20 °C.

Determine the potential difference across the thermistor when the temperature is 20 °C.

Use the Physics Equations Sheet.

Potential difference = _____ V

(5)

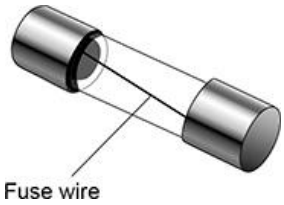
(Total 13 marks)

Q2.

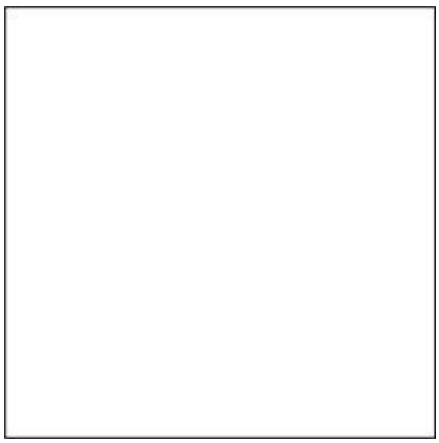
The live wire in a three-core cable is connected to a fuse inside a plug.

A fuse contains a wire that is designed to melt when the current gets too great.

The figure below shows a fuse.



(a) Draw the circuit symbol for a fuse in the box below.



(1)

(b) The fuse wire melts when there is a charge flow of 2.0 C for 400 ms.

Calculate the current in the fuse wire.

Use the Physics Equations Sheet.

Current = _____ A

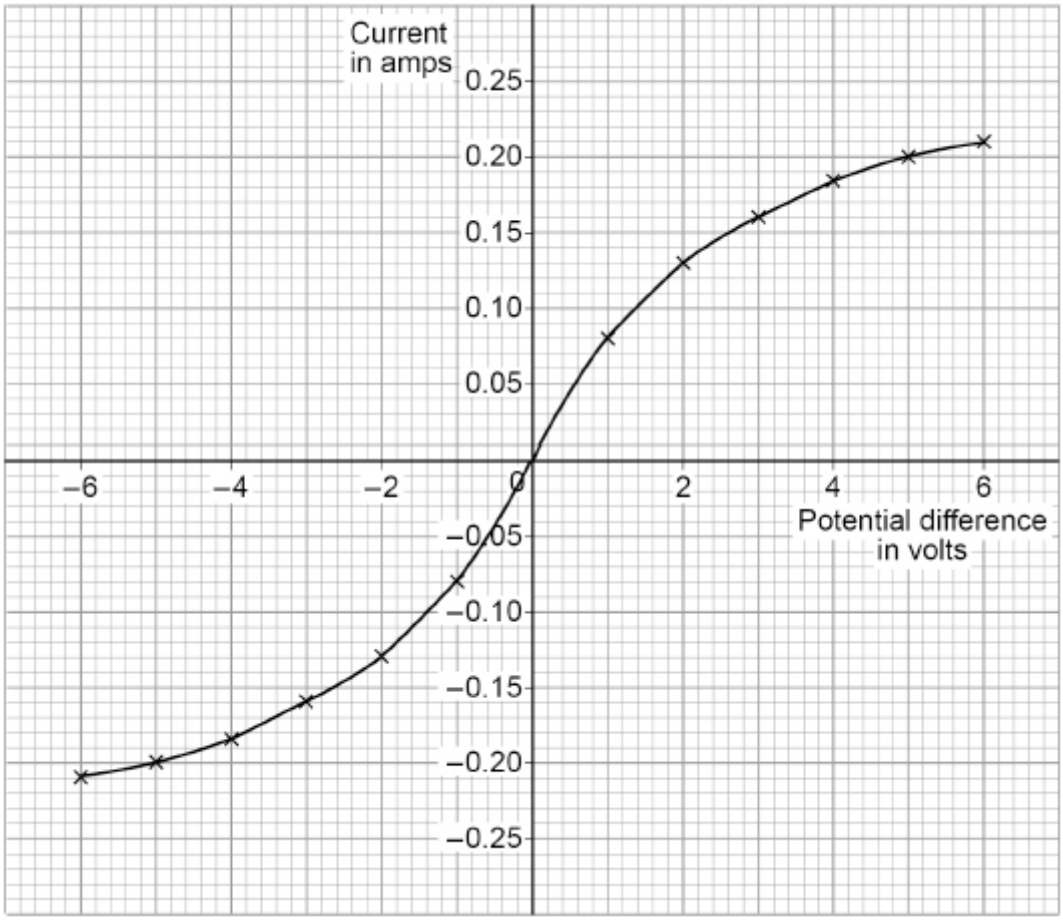
(4)

(Total 5 marks)

Q3.

A student investigated how the current in a filament lamp varies with the potential difference across the filament lamp.

The figure below shows the results.



(a) Describe a method the student could use to obtain these results.

You should include a circuit diagram.

(6)

(b) Determine the resistance of the filament lamp when the potential difference across it is +3.0 V.

Use the Physics Equations Sheet.

Use the figure above.

Resistance = _____ Ω

(3)

(c) The current in the lamp is 0.21 A when the potential difference across the lamp is 6.0 V.

Calculate the energy transferred by the filament lamp in 30 minutes.

Use the Physics Equations Sheet.

Energy transferred = _____ J

(5)

(d) The power output of the lamp is 1.0 W when the potential difference across the lamp is 5.0 V.

A student predicts that the power output would be 4.0 W if the potential difference was doubled.

Explain why the student is **not** correct.

(2)

(Total 16 marks)

Q4.

Figure 1 shows some hair straighteners.

Hair straighteners contain heating elements.

Figure 1

(a) When the hair straighteners reach normal operating temperature, an LED turns on.

Draw the circuit symbol for an LED in the box.

(1)

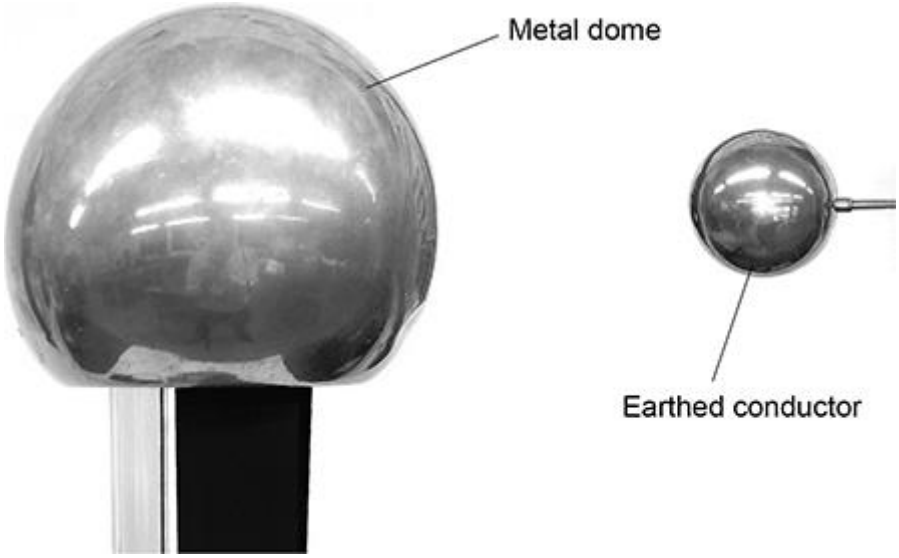
(Total 1 marks)

Questions are for both separate science and combined science students

Q1.

Figure 3 shows the negatively charged metal dome and an earthed conductor.

Figure 3



When the earthed conductor is moved towards the metal dome, there is a spark between the dome and the earthed conductor.

(a) The spark transfers 0.60 J of energy, and 2.0 μC of charge is transferred from the dome to the earthed conductor.

Calculate the potential difference between the metal dome and the earthed conductor.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

Potential difference = _____ V

(4)

(Total 4 marks)

Q4.

(a) The town of Hornsdale in Australia has electricity supplied by a huge battery.

On one day the battery transferred 3.24×10^{11} J of energy to the town.

The potential difference of the town s electricity supply is 230 V.

Calculate the charge flow to the town on this day.

Use the Physics Equations Sheet.

Give your answer to **3** significant figures.

_____

_____

_____

_____

_____

Charge flow (3 significant figures) = _____ C

(4)

(Total 4 marks)

Q5.

Figure 1 shows some hair straighteners.

Hair straighteners contain heating elements.

Figure 1

(a) The hair straighteners have a maximum power output of 120 W.

The energy transferred to the hair straighteners to reach normal operating temperature is 3.6 kJ.

Calculate the time taken for the hair straighteners to reach normal operating temperature when operating at maximum power.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

_____

Time = _____ seconds

(4)

(Total 4 marks)

Questions are for both separate science and combined science students

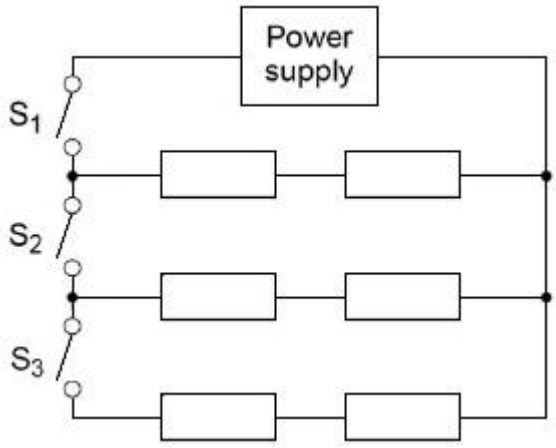
Q1.

Figure 2 shows the circuit diagram for the hair straighteners.

Each resistor represents a heating element.

The power output of the hair straighteners can be changed by closing different switches.

Figure 2



(a) Why do the hair straighteners **not** turn on when only switch S_2 is closed?

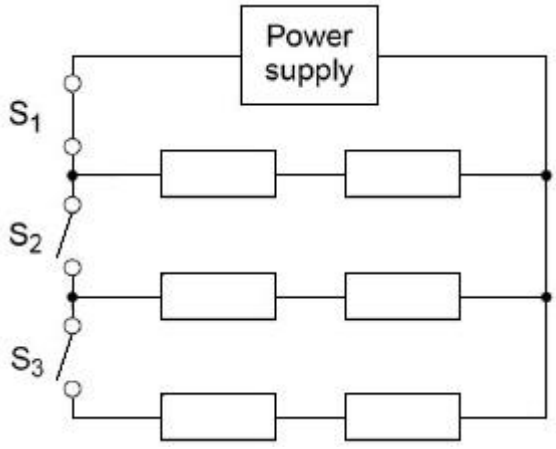
_____

_____

(1)

(b) **Figure 3** shows the hair straighteners circuit with switch S_1 closed.

Figure 3



Switch S_2 and switch S_3 are then closed at the same time.

Explain what happens to the power output of the power supply.

(3)

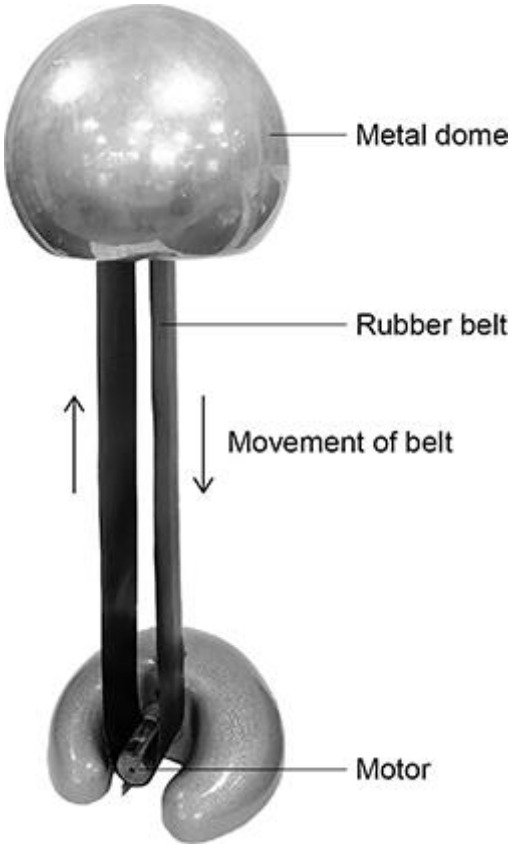
(Total 4 marks)

Questions are for separate science students only

Q1.

Figure 1 shows a static electricity generator. **(Physics only)**

Figure 1



The rubber belt is turned by a motor.

As the rubber belt moves, charge is transferred from the rubber belt to the metal dome.

(a) **Figure 2** shows a student touching the metal dome of the static electricity generator.

The dome is negatively charged.

Figure 2

Explain why the student s hair stands up on end.

_____

_____

_____

_____

_____

_____

(3)

The charged metal dome creates an electric field.

(b) What is an electric field?

_____

_____

_____

(1)

(c) How does the electric field strength vary as the distance from the charged metal dome increases?

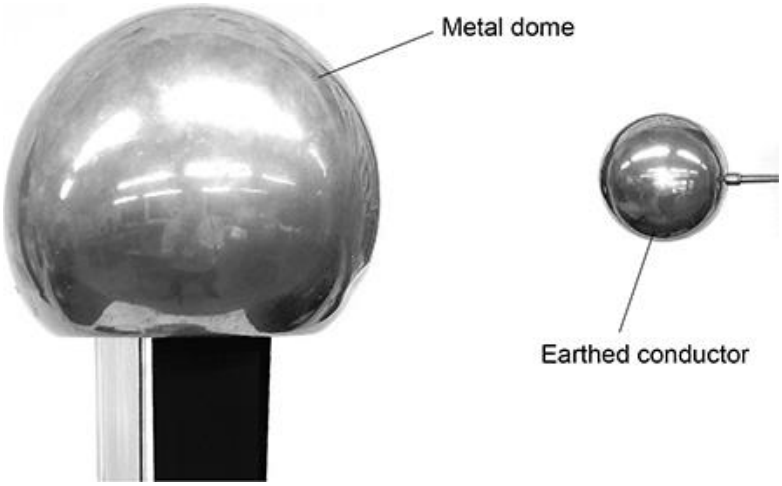
_____

_____

(1)

Figure 3 shows the negatively charged metal dome and an earthed conductor.

Figure 3



When the earthed conductor is moved towards the metal dome, there is a spark between the dome and the earthed conductor.

(d) The spark transfers 0.60 J of energy, and 2.0 μC of charge is transferred from the dome to the earthed conductor.

Calculate the potential difference between the metal dome and the earthed conductor.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

_____

_____

Potential difference = _____ V

(4)

(e) Which of the following changes would increase the distance a spark can jump between the dome and the earthed conductor?

Tick (✓) **one** box.

Decreased charge on the metal dome ☐

Decreased electric field strength ☐

Decreased electrical resistance of air ☐

Decreased potential difference ☐

(1)

(Total 10 marks)

Q2.

A student rubbed a plastic rod with a cloth. **(Physics only)**

The rod became negatively charged and the cloth became positively charged.

(a) Explain why the cloth became positively charged.

_____

_____

_____

_____

_____

_____

(3)

Figure 1 shows the negatively charged rod on a balance.

Figure 1

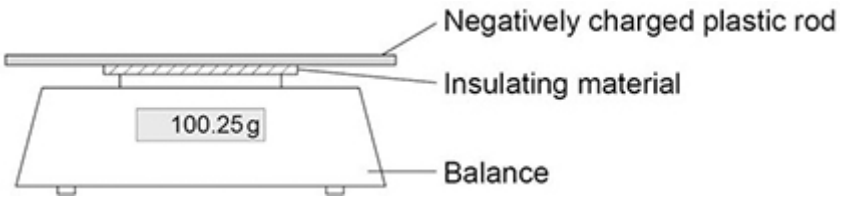
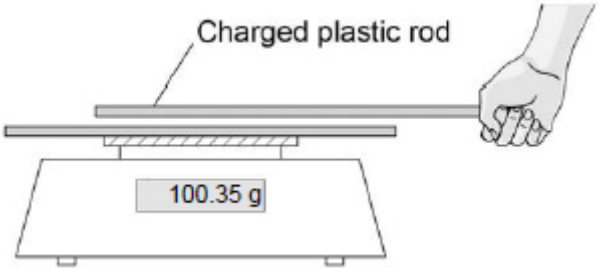


Figure 2 shows another charged rod being held stationary above the rod on the balance.

The rods do not touch each other.

Figure 2



(b) Explain why the reading on the balance increases.

_____

_____

_____

_____

_____

_____

(3)

(c) The balance had a zero error.

The zero error is not important in this experiment.

Give the reason why.

_____

_____

(1)

(d) A negatively charged rod is held near an earthed conductor.

Explain why a spark jumps between the negatively charged rod and the earthed conductor.

_____

_____

_____

_____

_____

_____

(3)

(Total 10 marks)