

- 4 (a) Figure 8 shows an airport worker refuelling an aircraft.



(Source: © Stanisław Tokarski/123RF)

Figure 8

- (i) Pumping fuel into an aircraft can be dangerous.

The worker connects an earth wire to the aircraft before pumping fuel.

Give **one** reason why earthing reduces the risk of fire.

(1)

- (ii) Explain how an aircraft can become electrically charged as it flies through the air.

(2)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) Fuel weighing 230 000 N is pumped into the aircraft.

This fuel moves upwards through a vertical height of 4.7 m.

The power developed by the pump is 1600 W.

Calculate the time needed to refuel the aircraft.

(3)

time = s

(c) Figure 9 shows an electrostatic method for spray-painting a car door.

The car door has a negative charge.

The droplets of paint receive a positive charge as they leave the spray gun.



(Source: © Jens Brüggemann/123RF)

Figure 9

Explain how charging the door helps the paint to form an even coating on both sides of the door.

You should use ideas of forces and fields in your answer.

(2)

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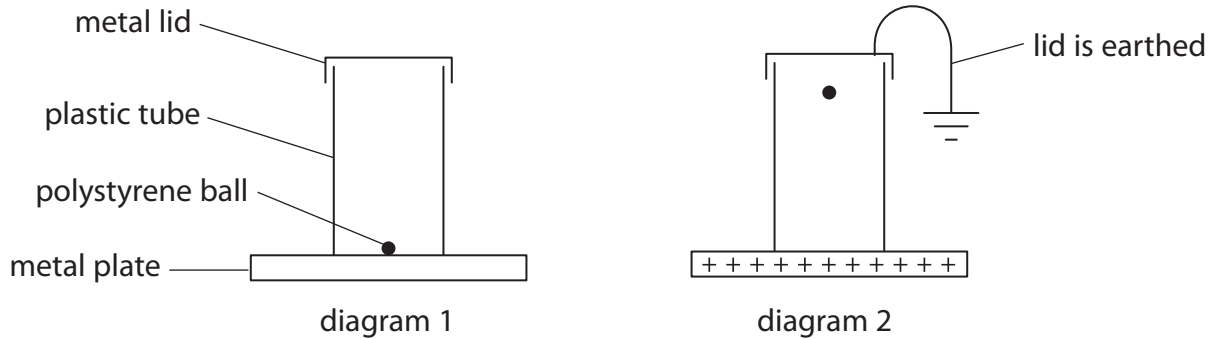
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(Total for Question 4 = 8 marks)

Electrostatics

- 2 A light, polystyrene ball is coated with a thin layer of metal.
Diagram 1 shows the ball on a metal plate.
In diagram 2, the plate has been charged and the ball is rising to hit the earthed lid.



- (a) (i) State the sign of the charge on the ball as it moves upwards.

(1)

- (ii) Explain why the ball moves upwards.

(2)

- (b) The ball discharges when it hits the earthed lid.

Explain how the ball loses its charge.

(2)



(c) The ball continues to move up and down between the charged plate and the earthed lid.

Explain why the ball continues to move up and down.

(2)

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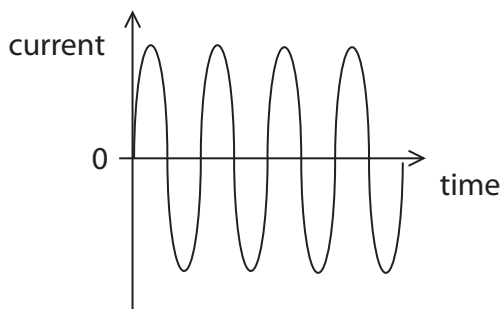
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(d) The current in the wire connected to earth may be described by a graph.

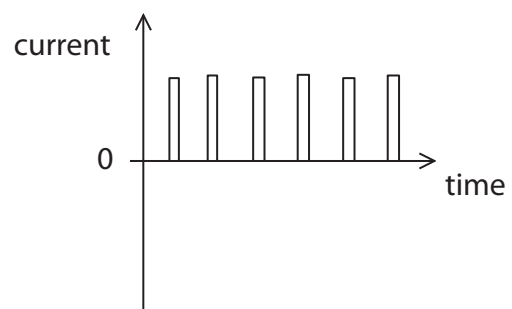
Which of these graphs best shows the current in the earth wire?

Put a cross (☒) in the box next to your answer.

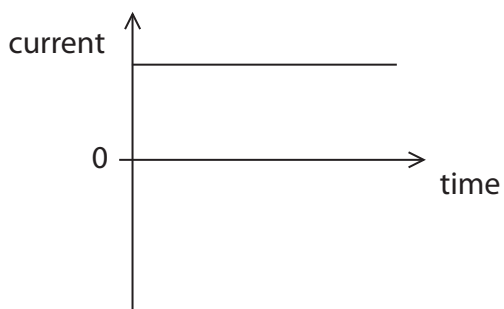
(1)



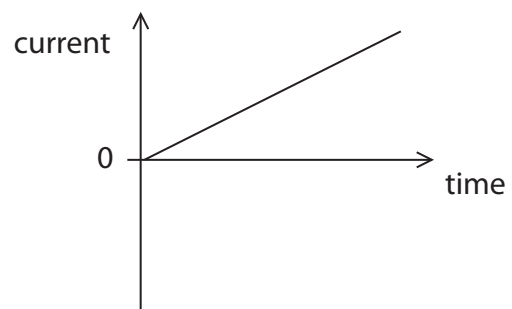
A



B



C



D

(Total for Question 2 = 8 marks)



Static electricity

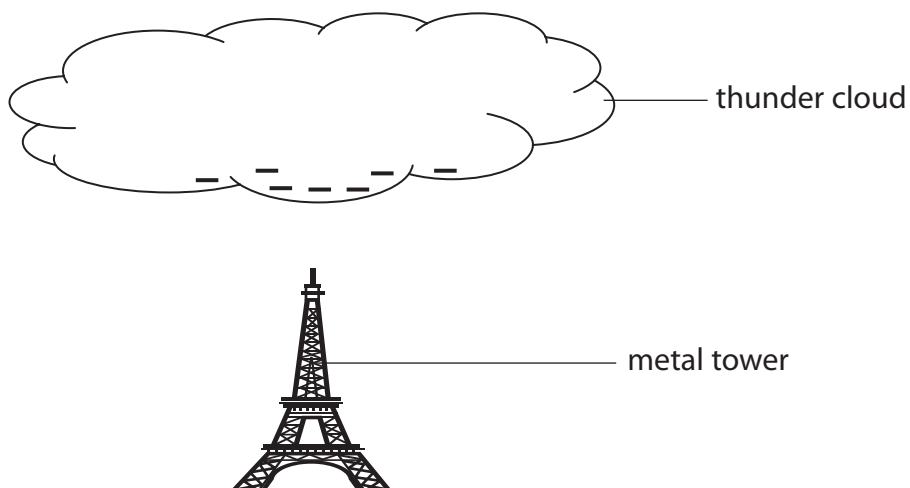
- 4 (a) A lightning strike on a metal tower can be described as follows.

In the cloud.

A thunder cloud contains moving ice particles.

Some of these ice particles are negatively charged and some are positively charged.

The negatively charged particles move to the bottom of the cloud.



When the charged cloud is over the metal tower.

A charge builds up on the top of the metal tower as the cloud passes over.

During the lightning flash.

Eventually a flash of lightning travels between the cloud and the tower.

- (i) Which row of this table is correct when the cloud is over the top of the tower before the lightning flash?

Put a cross (☒) in the box next to your answer.

(1)

	charge on top of the cloud is	charge on top of the tower is
<input checked="" type="checkbox"/> A	negative	negative
<input checked="" type="checkbox"/> B	negative	positive
<input checked="" type="checkbox"/> C	positive	positive
<input checked="" type="checkbox"/> D	positive	negative



- (ii) Here are **four** statements.
Three of these are a reason for what happens at each stage.

- 1: opposite charges attract each other
- 2: like charges repel each other
- 3: ice particles gain electrons
- 4: ice particles lose protons

Choose the best reason for each of the stages listed below by writing its number in the box next to the description of what happens.
One has been done for you.
A reason can only be used **once**.

(2)

in the cloud	reason
the bottom of the cloud becomes negatively charged	

when the charged cloud is over the metal tower	reason
the top of the tower becomes charged	

during the lightning flash	reason
electrons move through the air	1

- (iii) Explain what happens to the charge on the metal tower as a result of the lightning flash.

(2)

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- (b) During the lightning flash a total charge of 52 C flows.
The average current is 2600 A.

Calculate the duration of the flash in seconds.

(3)

duration of flash = s

- (c) When fuel tanks on an aircraft are being filled, the aircraft, fuel pipes and tanker are connected by a metal wire to the ground.

Explain why this greatly reduces the chance of a spark.

(2)

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(Total for Question 4 = 10 marks)



Answer ALL questions.

Some questions must be answered with a cross in a box . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Charge and Current

1 A battery sends a current through a metal wire.

(a) (i) Complete the sentence by putting a cross () in the box next to your answer.

Direct current is movement of charge

(1)

- A** backwards and forwards
- B** in many directions
- C** in one direction
- D** up and down

(ii) Complete the sentence by putting a cross () in the box next to your answer.

The particles that flow in the metal wire are

(1)

- A** atoms
- B** electrons
- C** protons
- D** neutrons

(b) The current in a wire is 3.7 A.

Calculate the charge that flows into the wire in 13 s.

(2)

charge = C



(c) Plastic is an insulator.

A student rubs a piece of plastic with a cloth.

This gives the plastic a negative charge.

(i) Explain how the plastic is charged by the rubbing.

(2)

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(ii) The cloth is also charged when it rubs against the plastic.

Describe the charge on the cloth.

(2)

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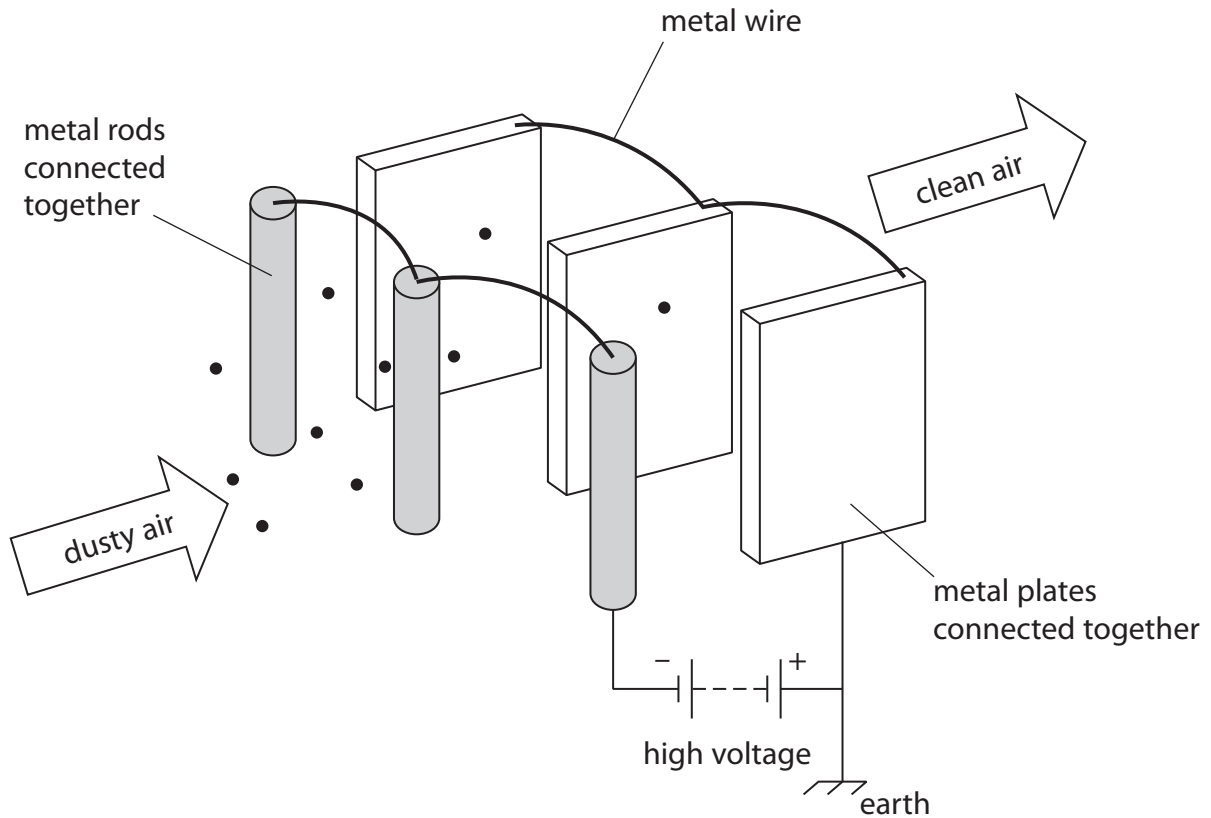
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(Total for Question 1 = 8 marks)



Electrostatic air filters

- 2 An electrostatic air filter is designed to remove dust particles from the air in a room. A fan blows dusty air past several metal rods and metal plates. There is a large potential difference (voltage) between the metal rods and the metal plates.



- (a) Complete the sentence by putting a cross (☒) in the box next to your answer.

When dusty air goes past the metal rods, the dust particles become negatively charged.

This is because the dust particles

(1)

- A lose electrons
- B lose protons
- C gain electrons
- D gain protons



(b) When the dusty air flows past the metal plates, the dust particles settle on the metal plates.

Explain why the dust particles settle on the metal plates.

(2)

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(c) (i) State what happens to the charge on the dust particles when they settle on the metal plates.

(1)

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(ii) Explain why the charge does not build up on the metal plates.

(2)

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(d) There is a current of 1.2 mA in the circuit.

Calculate the charge transferred by this current in 40 s.

State the unit.

(3)

charge transferred = unit:

(Total for Question 2 = 9 marks)



Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Static electricity

1 (a) A student rubs a plastic rod with a dry cloth. The cloth becomes positively charged.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The cloth becomes positively charged because

(1)

- A negative charge has moved from the cloth to the rod
- B negative charge has moved from the rod to the cloth
- C positive charge has moved from the cloth to the rod
- D positive charge has moved from the rod to the cloth.

(ii) Two plastic strips are joined at the top and are hanging by a thread.

The student rubs both strips with another dry cloth.

The diagram shows the two plastic strips before and after the student rubs them.

before



after



Explain why the strips behave in this way after they are rubbed with the cloth.

(2)

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(b) The student reads an article about the possible build-up of static electricity during the refuelling of an aircraft.

(i) Explain why this build-up could be dangerous.

(2)

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(ii) The article also states that the aircraft is connected by a metal cable to the ground. The aircraft is also connected by a metal cable to the refuelling tanker.

Explain how these cables reduce the dangers when refuelling the aircraft.

(3)

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(Total for Question 1 = 8 marks)

