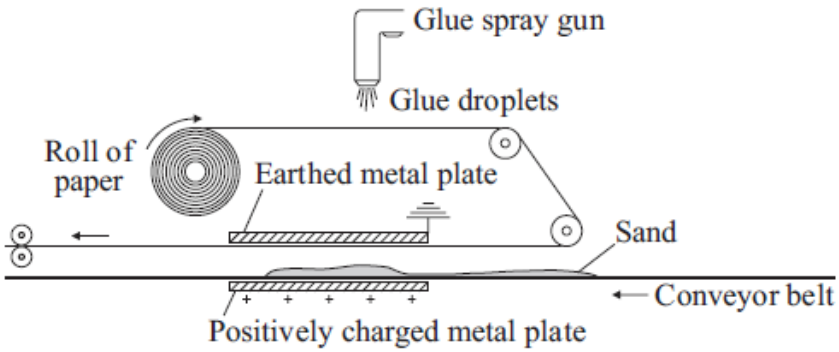
Static Electricity

1.

Static electricity can be both useful and a nuisance.

(a) The diagram shows a method of producing sandpaper using static electricity.



Glue is sprayed onto a moving strip of paper. As the glue leaves the spray gun, the glue breaks up into tiny negatively charged droplets which coat the paper. The sticky paper passes between two metal plates. Sand moving on a conveyor belt also passes between the metal plates.

(a) (i) Explain the advantage of having all the droplets of glue negatively charged.

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(2 marks)

(a) (ii) Explain why the sand moves towards the sticky paper.

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(2 marks)

(b) People often experience an electric shock when getting out of a car.
This happens because charge is generated as they move around on the car seats.

On a warm dry day, the potential difference between a driver and the car increases to 10 000 volts. As the driver goes to touch the car door, a spark jumps the air gap, transferring 20 joules of energy between the driver and the car.

Use the equation in the box to calculate the initial charge on the driver.

energy transformed = potential difference × charge

Show clearly how you work out your answer and give the unit.

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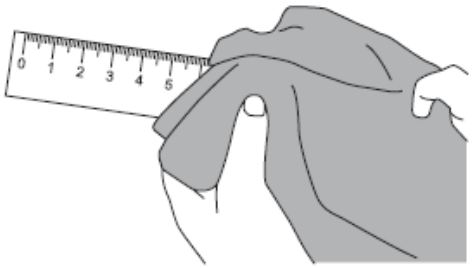
Charge = ...

(3 marks)

2.

(a) A plastic ruler is rubbed with a cloth.



The ruler becomes negatively charged.

(a) (i) Complete the following sentence by drawing a ring around the correct line in the box.

The ruler becomes negatively charged because it has

gained electrons
lost neutrons
lost protons

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(1 mark)

(a) (ii) How could you show that the ruler is charged?

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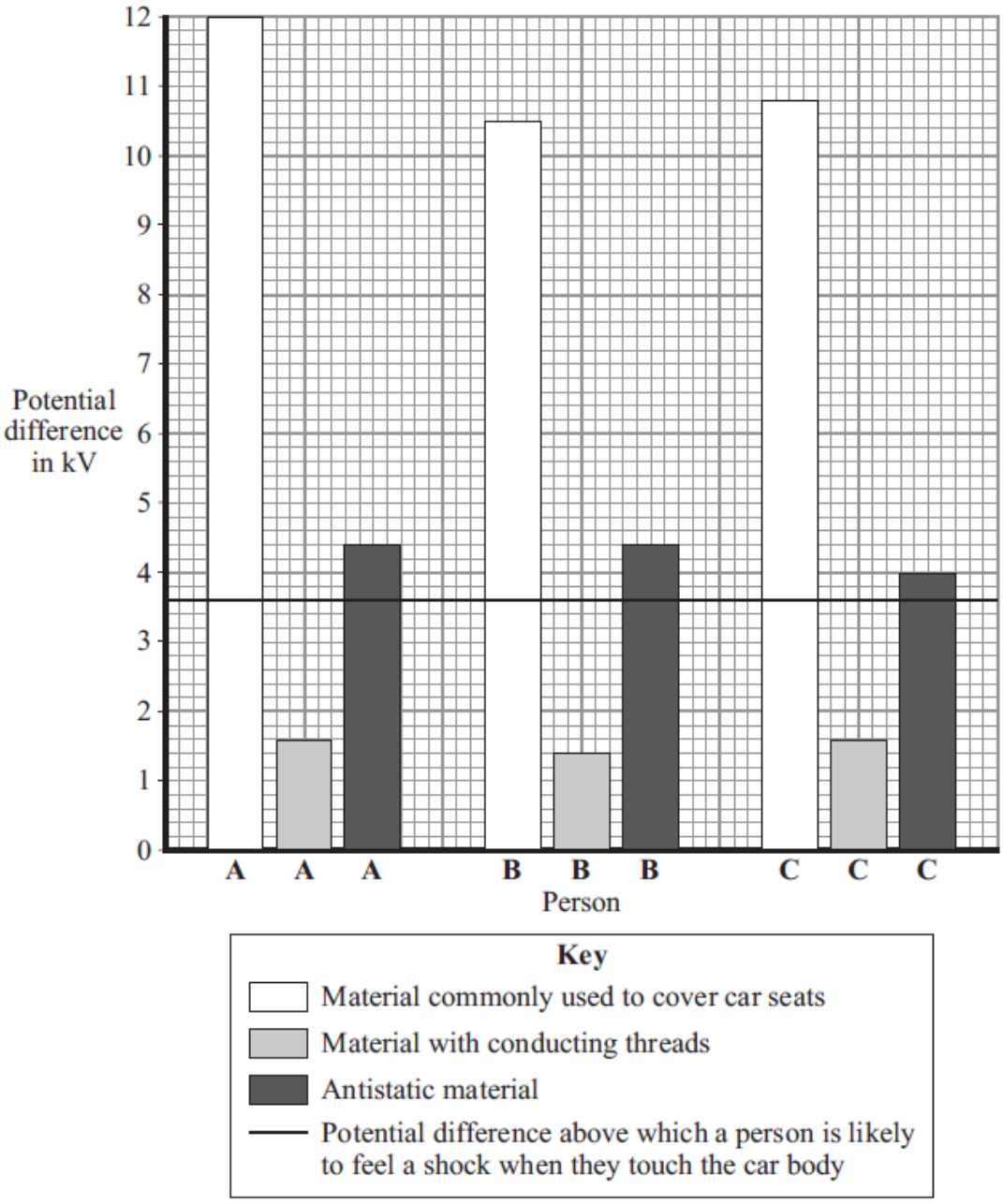
(1 mark)

(b) People often become electrostatically charged as they get out of a car.
This happens because their clothing rubs against the car seat.

A scientist was asked to find out whether the amount of charge on a person depended on the type of material which covered the car seat.
Three people, **A**, **B** and **C**, were used to test three different types of seat covering.

In each test, the person got out of the car and stood on a thick sheet of plastic.
The scientist then measured the potential difference between the person and the car body.
The results of the investigation are displayed in the bar chart.



Question 2 continues on the next page

(b) (i) Explain why the measurement was made with the person standing on a thick sheet of plastic.

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(2 marks)

(b) (ii) To make this a fair test, the three people, **A**, **B** and **C**, each wore the same type of clothing.

Suggest a reason why this was important.

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(1 mark)

(b) (iii) The smallest scale division on the voltmeter was 0.1 kV.

Suggest why, from the data, it was **not** necessary to increase the precision of the potential difference measurements.

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(1 mark)

(b) (iv) Explain why this investigation may cause a manufacturer to change the material used to cover car seats.

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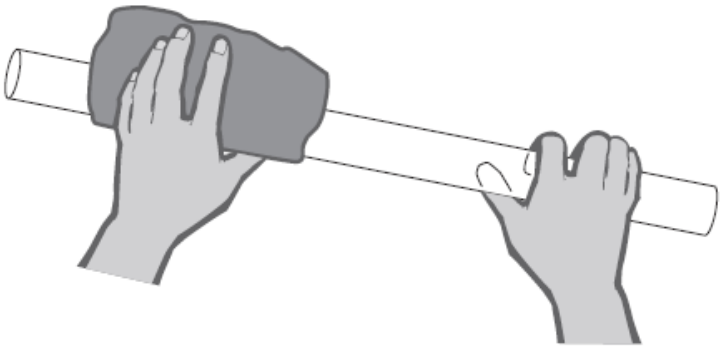
(2 marks)

3.

(a) When a glass rod is rubbed with a woollen cloth, the rod becomes positively charged.



(a) (i) Explain why the glass becomes positively charged.

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(2 marks)

(a) (ii) A glass TV screen, polished with a dry cloth on a dry day, soon becomes dusty again.

Explain why.

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(2 marks)

(b) Many devices use electrostatic charge to work.
The following sentences describe how a photocopier works using electrostatic charge.
The sentences are in the wrong order.

J A strong light is used to form an image of the page to be copied on the roller.

K The charged areas of the roller attract particles of black toner powder.

L The charge left on the roller has the same pattern as the dark parts of the original page.

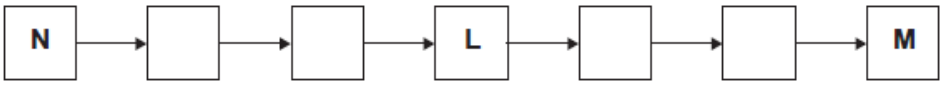
M The toner melts and sticks to the paper. This is now a photocopy of the original.

N A roller coated with a photoconducting material is given a charge.

O Where light hits the roller, the charge leaks away.

P A blank piece of paper is heated and pressed against the roller.

(b) (i) Arrange the sentences in the correct order.
Three of the sentences have been put into the correct places.



(3 marks)

(b) (ii) Why is it important that the blank piece of paper is heated?

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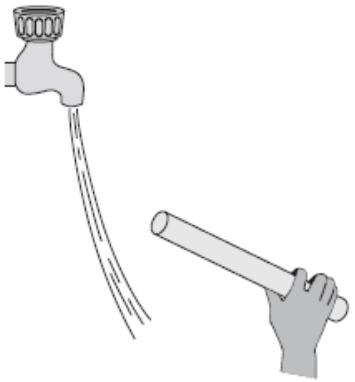
(1 mark)

4.

(a) The diagram shows a negatively charged plastic rod held close to a thin stream of water. The water is attracted towards the rod.



Which **one** of the following statements explains what is happening to the charge in the water?

Tick (✓) **one** box.

The positive and the negative charges in the water are attracted to the rod. ☐

The positive and the negative charges in the water are repelled by the rod. ☐

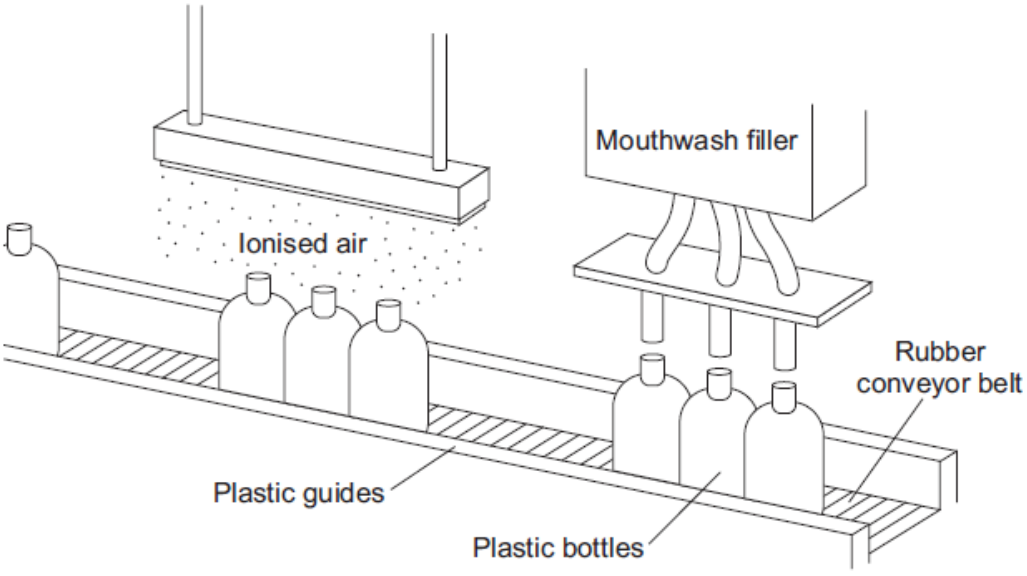
The negative charge in the water is repelled by the rod and the positive charge is attracted. ☐

The negative charge in the water is attracted by the rod and the positive charge is repelled. ☐

(1 mark)

(b) A company that produces bottles of mouthwash found a problem with the automatic filling system.

As the bottles go towards the filler, they move around on the conveyer belt and become electrostatically charged. This causes the stream of mouthwash to move sideways, missing the open top of the bottle.



The company came up with a solution to the problem. Before the bottles reach the filler, they pass through a stream of ionised air. The ions in the air neutralise the charge on the bottles.

(b) (i) Explain why the plastic bottles become charged.

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(2 marks)

(b) (ii) What is an ion?

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(1 mark)

(b) (iii) Earthing the conveyor belt with a conducting wire would not have solved this problem.

Give a reason why.

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(1 mark)