1. **Figure 1** shows a student walking on a carpet.

Figure 1

(a) The student becomes negatively charged because of the friction between her socks and the carpet.

Explain why the friction causes the student to become charged.

_____

_____

_____

_____

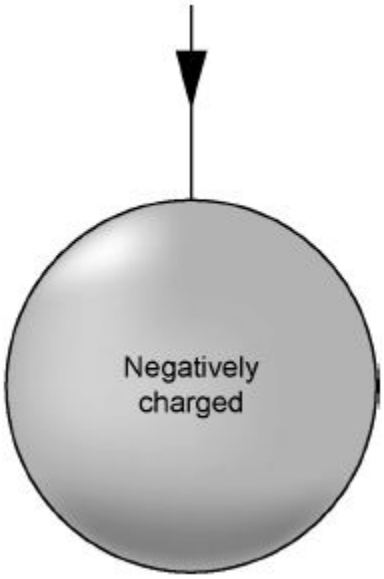
(2)

(b) The student's head is represented by the sphere in **Figure 2**.

The student is negatively charged. The arrow shows part of the electric field around the student's head.

Draw **three** more arrows on **Figure 2** to complete the electric field pattern.

Figure 2



(1)

(c) The negatively charged student touches a metal tap and receives an electric shock.

Explain why.

_____

_____

_____

_____

_____

_____

(3)

(d) Some carpets have thin copper wires running through them. The student is less likely to receive an electric shock after walking on this type of carpet.

Suggest why.

_____

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

2. **Figure 1** 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 1

© Michael Priest

(a) Explain how an uncharged object may become positively charged.

(3)

(b) **Figure 2** 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.

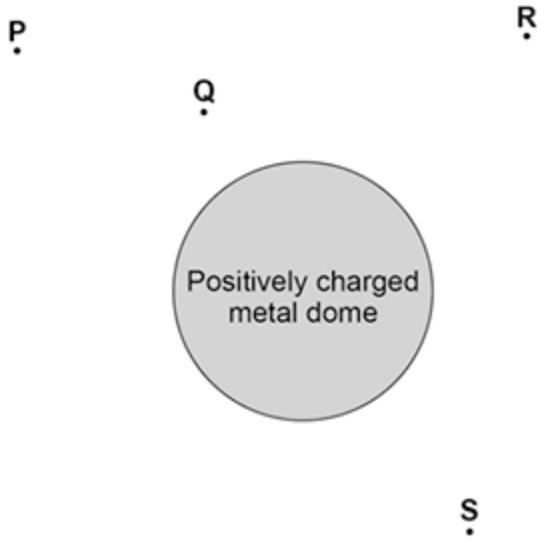
Figure 2

(2)

(c) Another positively charged object is placed in the electric field.

Look at **Figure 3**.

Figure 3



In which position would the object experience the greatest force?

Tick **one** box.

P ☐

Q ☐

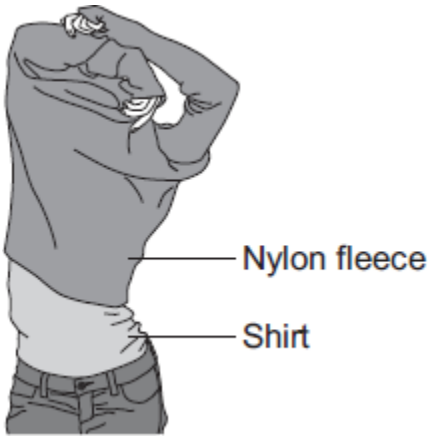
R ☐

S ☐

(1)

(Total 6 marks)

3. (a) A student takes off his nylon fleece and feels a small electric shock.
He realises that this happens because his fleece becomes charged.



Explain why the fleece becomes charged.

_____

_____

_____

_____

_____

(2)

(b) Only **two** of the following statements are correct.

Put a tick (✓) in the boxes next to the **two** correct statements.

Positively charged objects repel negatively charged objects. ☐

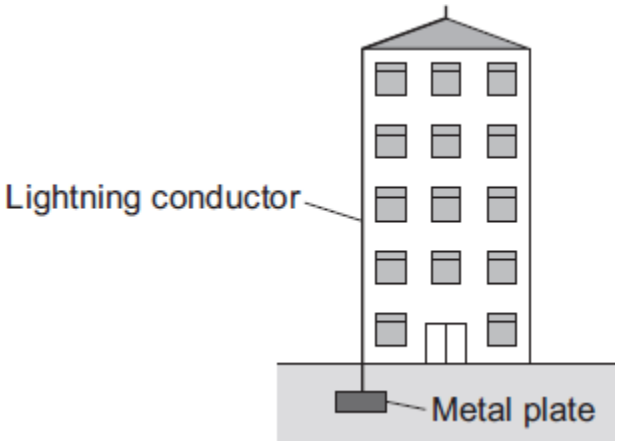
Electrical charges move easily through metals. ☐

Static electricity is safe; it never causes any danger. ☐

An electric current is a flow of electrical charge. ☐

(2)

(c) The diagram shows a lightning conductor attached to the side of a tall building.



If the building is struck by lightning, charge flows to earth through the lightning conductor.

(i) Which of the materials in the list is used to make the lightning conductor?

Draw a ring around your answer.

copper **glass** **plastic**

Give a reason for your answer.

_____

_____

_____

(2)

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

The resistance of the lightning conductor is

higher than
the same as
lower than

the resistance of the building.

(1)

(iii) It is almost impossible to test different designs of lightning conductor in controlled experiments during a lightning storm.

Suggest a reason why.

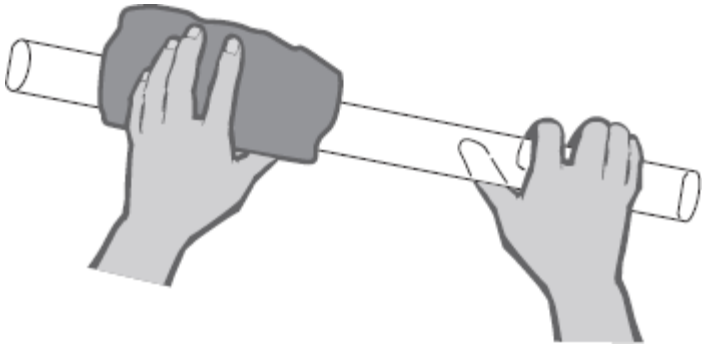
_____

_____

(1)

(Total 8 marks)

4. (a) The diagram shows a polythene rod being rubbed with a woollen cloth.



The polythene rod becomes negatively charged.

Explain how this happens.

_____

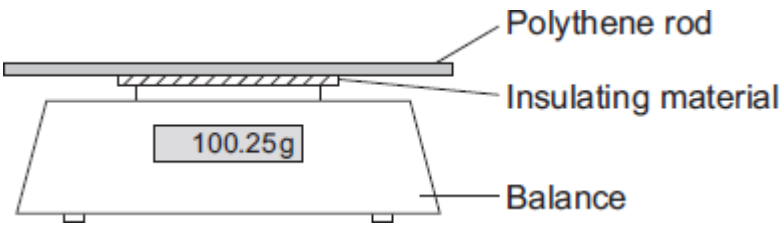
_____

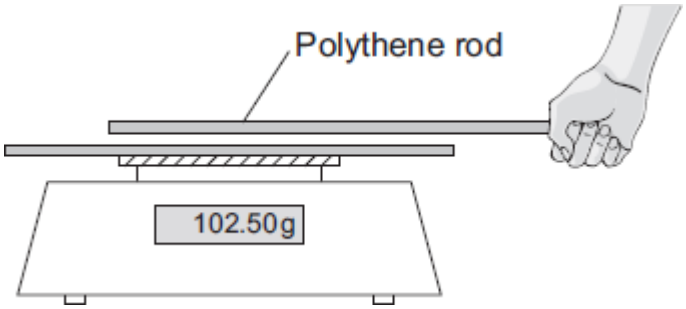
_____

_____

(2)

(b) A student put the charged polythene rod on to a balance. The rod was separated from the metal pan of the balance by a thin block of insulating material.
The student then held a second charged polythene rod above, but **not** touching, the first rod. The reading on the balance increased.





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

_____

_____

_____

_____

(2)

(ii) The student observed that the nearer the two rods are to each other, the bigger the increase in the balance reading.

What should the student conclude from this observation?

_____

_____

_____

_____

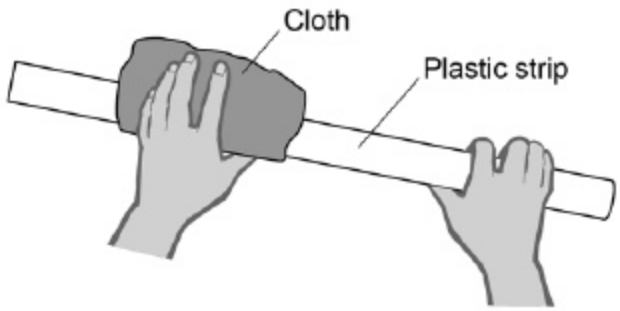
(2)

(Total 6 marks)

5. A student used some everyday items to investigate static electricity.

Figure 1 shows a flexible plastic strip being rubbed with a cloth.

Figure 1



(a) Complete the sentence.

Choose the answer from the box.

electrons	**neutrons**	**protons**

Rubbing the plastic strip with the cloth causes the strip to become negatively charged because _____ move from the cloth onto the plastic strip.

(1)

(b) Complete the sentence.

Choose the answer from the box.

a negative	**a positive**	**zero**

The cloth is left with _____ charge.

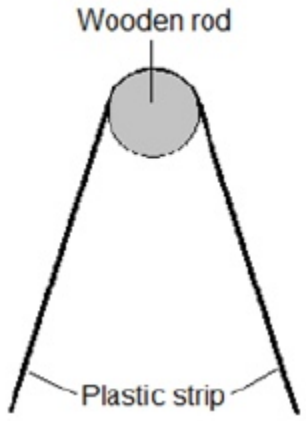
(1)

(c) The student hung the plastic strip over a wooden rod.

The ends of the strip moved away from each other.

Figure 2 shows the position of the plastic strip on the wooden rod.

Figure 2



What **two** conclusions should the student make about the forces acting on the two halves of the plastic strip?

1. _____

_____

2. _____

_____

(2)

(d) Another student repeated the experiment using the same method and found the plastic strip moved in the same way.

Complete the sentence.

Choose the answer from the box.

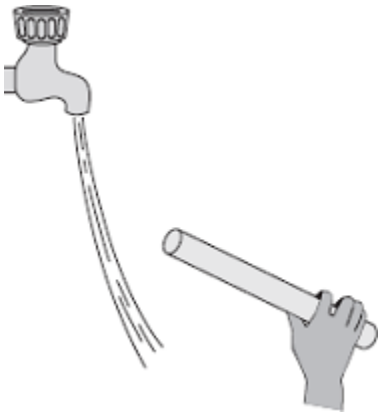
an anomaly	**repeatable**	**reproducible**

The investigation was _____ .

(1)

(Total 5 marks)

6. (a) The diagram shows a negatively charged plastic rod held near 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. ☐

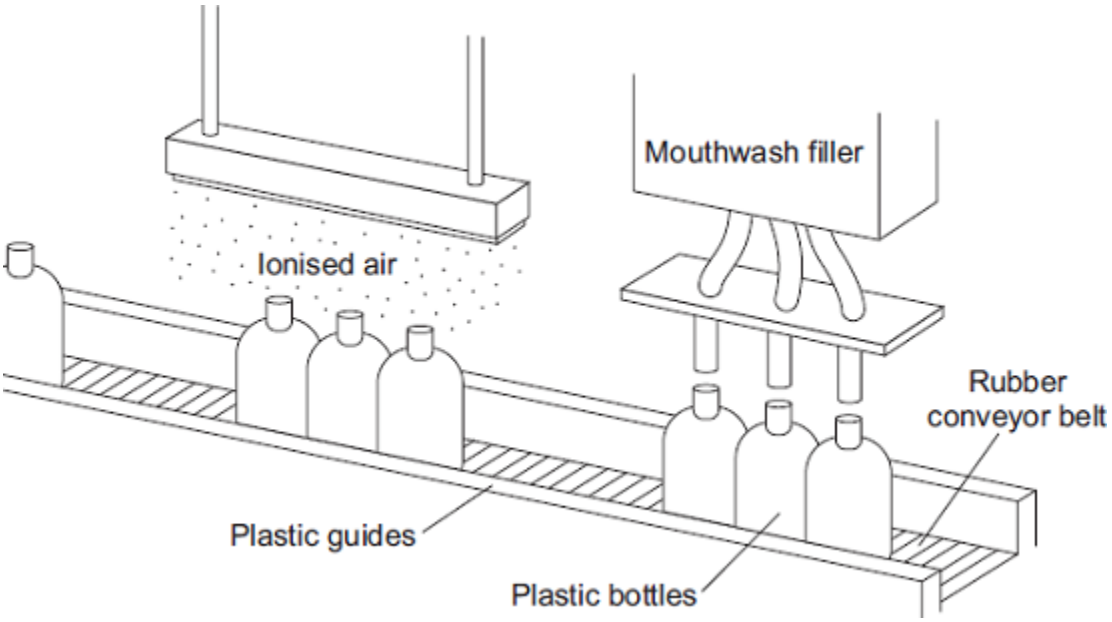
The negative charge in the water is repelled by the rod and the positive charge is attracted to the rod. ☐

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

(1)

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

As the bottles go towards the filler, the bottles move around on the conveyor 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 an answer to the problem. Before the bottles reach the dfiller, the bottles pass through a stream of ionised air. The ions in the air neutralise the charge on the bottles.

(i) Explain why the plastic bottles became charged.

_____

_____

_____

_____

(2)

(ii) What happens to the structure of an atom to change the atom into an ion?

_____

_____

(1)

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

_____

_____

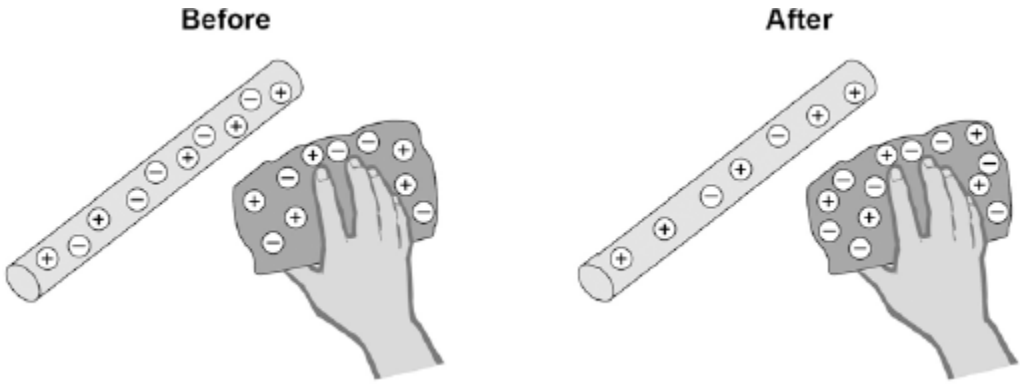
(1)

(Total 5 marks)

7. A student rubs an acetate rod with a cloth.

Figure 1 shows the charges on the acetate rod and cloth before and after rubbing.

Figure 1



(a) Explain how rubbing an acetate rod with a cloth causes the rod and cloth to become charged.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) 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.

_____

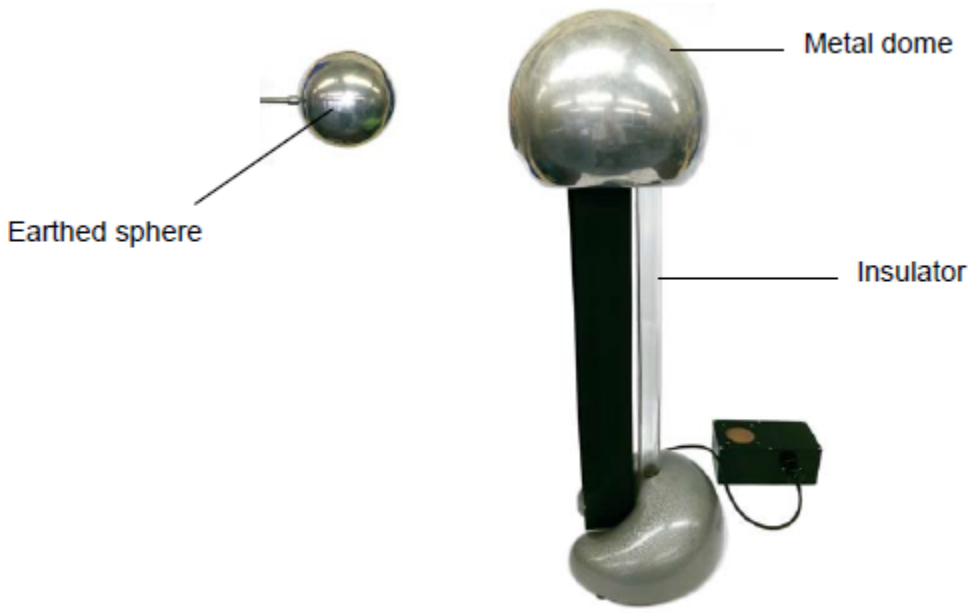
_____

_____

(2)

(c) **Figure 2** shows a Van de Graaff generator, which is used to generate static electricity.

Figure 2



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.

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 _____ .

(1)

(d) 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:

energy transferred = charge × potential difference

Calculate the energy transferred by the spark.

_____

_____

_____

Energy transferred = _____ J

(2)

(Total 9 marks)