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IGCSE PHYSICS 0625 · TOPICAL PAST PAPERS

Electric Charge

Paper 2 — Theory / Structured Questions (topical compilation)

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For Examiner's Use

5 Electrostatic charges can be placed on objects by friction.

(a) State the name of the charged particle that is transferred from one object to another in this process.

.....[1]

(b) Fig. 5.1 shows petrol (gasolene) being pumped into a can. Electrostatic charges build up on the petrol and the pipe.

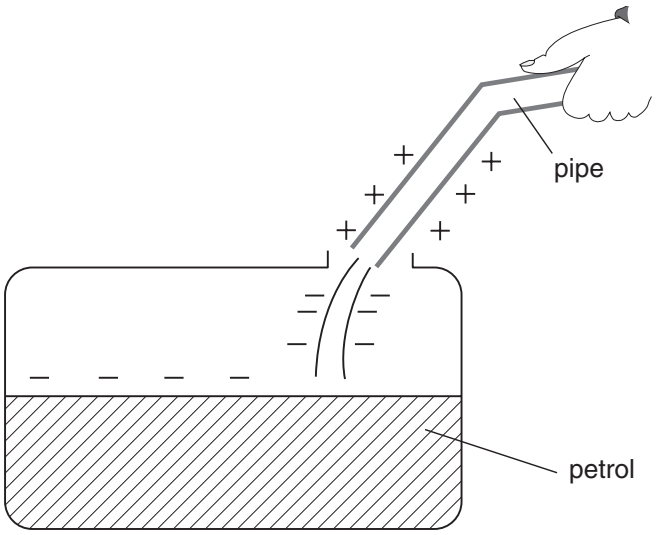

Fig. 5.1

(i) Explain why this is dangerous.

.....

.....

.....

.....[2]

(ii) State what can be done to stop the electrostatic charge building up in this way.

.....

.....[1]

For Examiner's Use

5 Two conducting spheres are rubbed and become charged, as shown in Fig. 5.1.

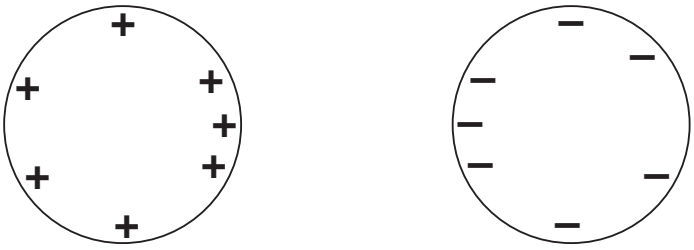

Fig. 5.1

(a) The spheres are uncharged before they are rubbed.

Explain, in terms of the movement of electrons, how they become charged.

.....

.....

.....

..... [1]

(b) On Fig. 5.1, draw the electric field pattern between the spheres. Show the direction of the field lines. [2]

(c) A metal wire is used to connect the two spheres together. In a time of 2.0×10^{-3} s, a charge of 1.8×10^{-13} C passes through the wire.

Calculate the current in the wire.

current = ... [2]

11 A plastic rod is rubbed with a cloth and becomes negatively charged.

(a) Explain how the rod becomes negatively charged when rubbed with a cloth. [2]

(b) An uncharged metal-coated sphere hangs from an insulating thread. The sphere is brought near to the rod. The sphere is attracted to the rod, as shown in Fig. 11.1.

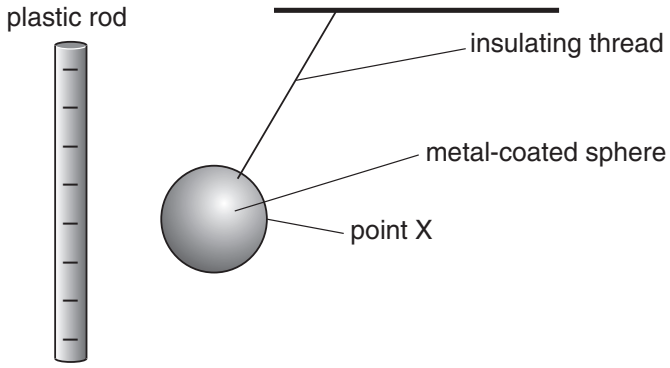

Fig. 11.1

(i) Describe and explain what happens to the free electrons in the metal-coated sphere as it approaches the rod. [2]

(ii) Draw a diagram to show how charge is distributed on the sphere. [1]

(iii) Explain why the uncharged sphere is attracted to the negatively-charged rod. [2]

(c) With the charged rod still close, point X on the metal-coated sphere is earthed.

(i) State what is meant by *earthing* the sphere. [1]

(ii) Describe and explain what happens to the free electrons in the metal-coated sphere as it is earthed. [2]

(iii) Draw a diagram to show how the charge is now distributed on the sphere. [1]

(d) Describe **one** device where electrostatic charging is used. In your answer include a diagram and explain how and why the charge is produced. [4]

[Turn over

6 **(a)** An aeroplane becomes positively-charged as it flies through the air, because it loses particles from its metal surface.

For Examiner's Use

(i) State the name of the particles lost from the metal surface.

.....[1]

(ii) The tyres of the aeroplane are made from an electrical conductor.

Explain what happens to the charge on the aeroplane when it lands.

.....

.....[2]

(b) Suggest why it is necessary to keep an aeroplane connected electrically to earth during refuelling.

.....

.....[2]

[Turn over

7 Fig. 7.1 shows two charged metal spheres.

One sphere has a positive charge and the other sphere has a negative charge.

Fig. 7.1

(a) On Fig. 7.1, draw the electric field between the two spheres. [2]

(b) The negative charge on the sphere is removed and a wire is used to connect the positive sphere to earth. The charge on the positive sphere decreases from 4.8×10^{-9} C to zero in a time of 2.0×10^{-6} s.

Calculate the average current in the wire.

current = ...[2]

5 A student rubs a polythene rod with a dry cloth. The polythene rod becomes negatively charged and the cloth becomes positively charged.

For Examiner's Use

(a) Describe, in terms of the movement of electrons, what happens during the charging process.

.....

..... [2]

(b) There is an electric field around the charged rod.

Explain what is meant by an *electric field*.

.....

..... [1]

(c) The charged rod is placed near a stream of water from a tap, as shown in Fig. 5.1.

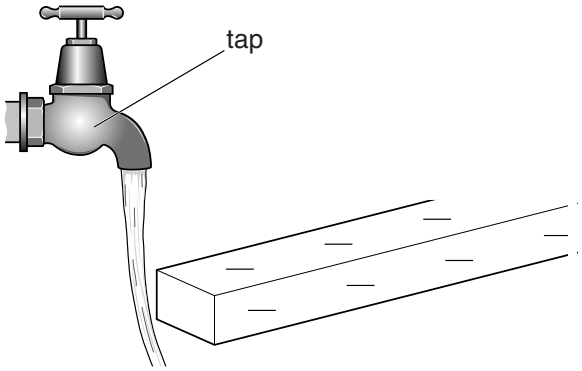

Fig. 5.1

The stream of water bends because the rod is charged.

(i) Explain how the charge on the rod causes positive and negative particles in the water to move.

.....

.....

..... [2]

(ii) On Fig. 5.1, draw the charge present on the stream of water. [1]

[Turn over

5 A positively charged sphere C is brought close to a small, uncharged metal sphere U. Sphere U is suspended from an insulating thread, as shown in Fig. 5.1.

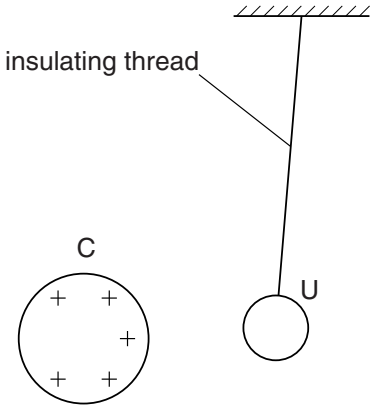

Fig. 5.1

(a) On Fig. 5.1, draw the induced charges on sphere U. [1]

(b) Sphere C is moved towards sphere U until the spheres touch. Sphere U is then repelled by sphere C, as shown in Fig. 5.2. The charges on C and U are not shown.

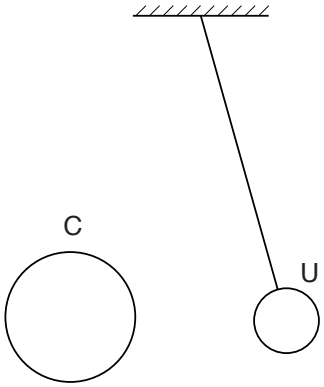

Fig. 5.2

(i) State and explain what happens to the charge on the two spheres as they touch.

charge on C: .....

.....

charge on U: .....

.....
[3]

(ii) Explain why U is repelled by C.

.....

..... [1]

5 When a balloon is rubbed on hair, the balloon becomes negatively charged. The balloon is shown in Fig. 5.1.

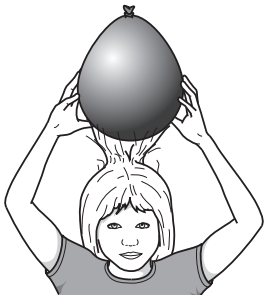

Fig. 5.1

(a) Explain how rubbing causes the balloon to become negatively charged.

.....

.....

..... [2]

(b) Explain why the hair is pulled towards the balloon.

.....

.....

.....

..... [2]

(c) Explain why it is important that the balloon is made from an electrical insulator.

.....

..... [1]

(d) State one example where static electricity is useful.

.....

..... [1]

[Turn over

7 An uncharged piece of metal P rests on an insulator. A positively charged rod is placed close to P, as shown in Fig. 7.1.

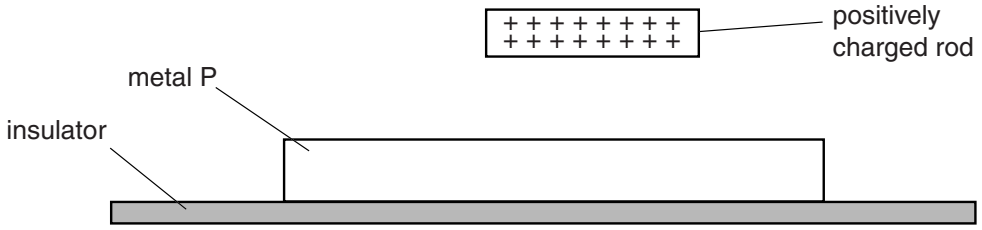

Fig. 7.1

(a) State a material that is an electrical insulator.

.....[1]

(b) On Fig. 7.1, draw the distribution of charges on P. [2]

(c) P is then connected to earth by a wire, as shown in Fig. 7.2.

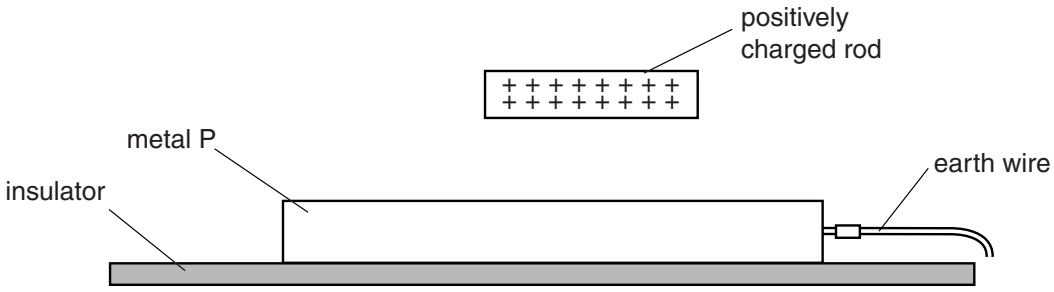

Fig. 7.2

(i) On Fig. 7.2, show the distribution of charges on P with the earth wire connected. [1]

(ii) State what happens to the charges on P if the positively charged rod is removed

1. with the earth wire still connected to P,

.....

.....[1]

2. after the earth wire is disconnected from P.

.....

.....[1]

8 Fig. 8.1 shows charges on a rod and on a cloth.

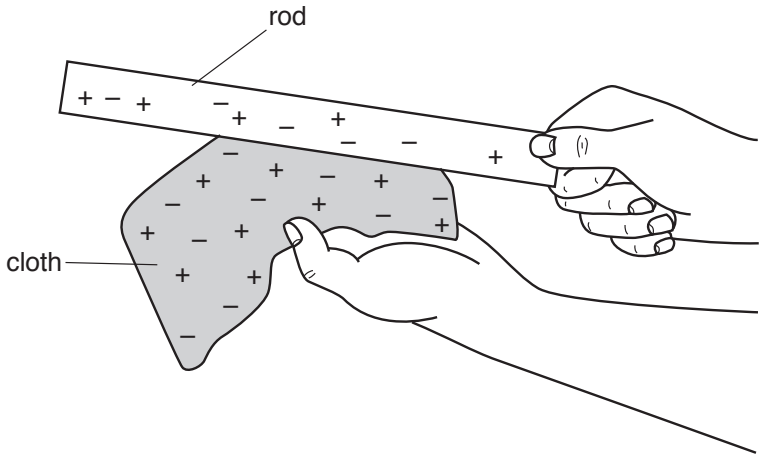

Fig. 8.1

(a) State how Fig. 8.1 shows that the rod and the cloth are uncharged.

.....

.....[1]

(b) The plastic rod becomes negatively charged when rubbed by the cloth.

(i) Describe what happens to the charges on the rod and on the cloth during the charging process.

.....

.....

.....

.....[2]

(ii) Describe a simple experiment to show that the plastic rod is charged.

You may draw a diagram if you wish.

.....

.....

.....

.....

.....[2]

7 Electrostatics can be a nuisance but is also useful.

(a) A person walks across a carpet. As he touches a door handle he receives an electric shock.

Suggest why this happens.

.....

.....

.....[2]

(b) In spray painting, small drops of paint with a positive charge emerge from a nozzle. The drops are used to paint the leg of a metal chair, which has a negative charge, as shown in Fig. 7. 1.

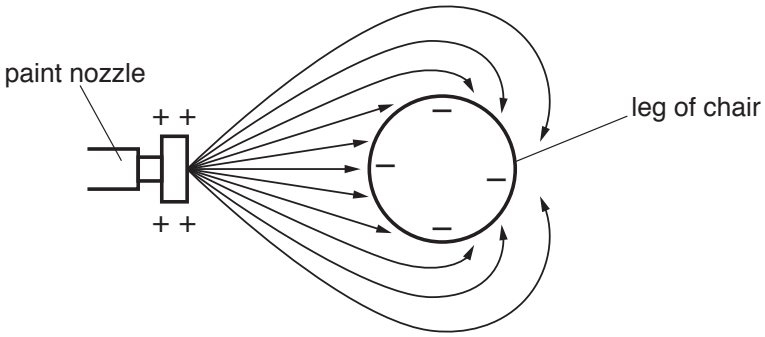

Fig. 7.1 (not to scale)

Fig. 7.2 shows what happens when there is no charge on the nozzle, or on the drops or on the leg of the chair.

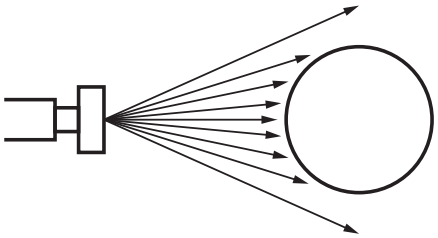

Fig. 7.2 (not to scale)

(i) The drops in Fig. 7.1 spread out more as they leave the nozzle than those in Fig. 7.2.

Explain why.

.....

.....[2]

(ii) Explain why the paint reaches the back of the leg in Fig. 7.1.

.....

.....[1]

5 **(a)** Fig. 5.1 shows part of a machine used to investigate electrostatic charging.

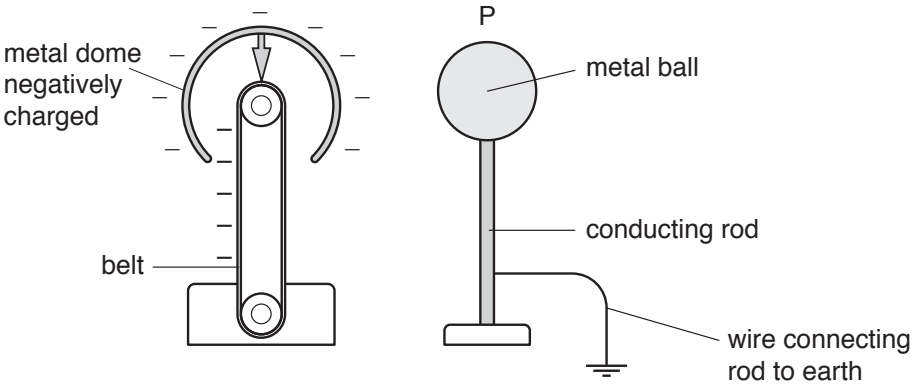

Fig. 5.1

Before the machine is switched on the metal dome and the ball are uncharged.

When the machine is switched on, the metal dome becomes negatively charged.

Explain how charging the dome causes the metal ball P to become positively charged.

.....

.....

.....

..... [2]

(b) A photocopier works using electrostatic charging. It contains a drum whose surface conducts charge where it is exposed to light.

Fig. 5.2 shows a piece of paper, the drum and the heater of a photocopier.

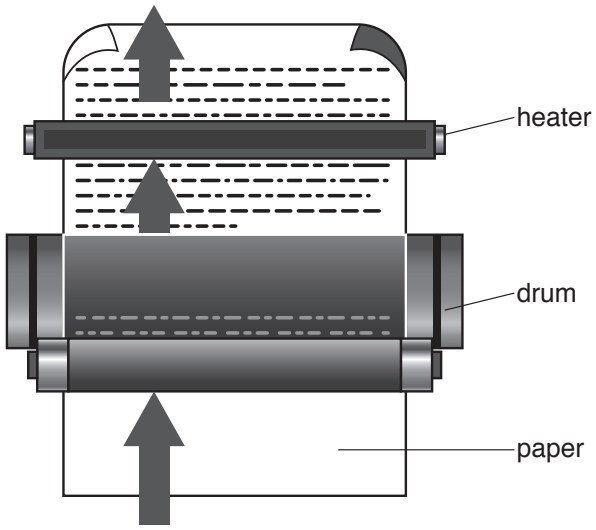

Fig. 5.2

The photocopier produces a copy of an original page on a piece of paper.

The sentences below describe the process of making the copy but the sentences are in the wrong order.

A The drum is given a positive charge.

B The positively charged parts of the drum attract a black powder.

C Where light hits the drum, the positive charge leaks away.

D An image of the original page is projected onto the drum.

E The drum rolls against a piece of paper, transferring powder to the paper.

F The paper is heated which makes the black powder stick to it.

Arrange the sentences in the correct order. The first and last sentences are already in the correct boxes.

[2]

[Total: 4]

[Turn over

For Examiner's Use

5 Fig. 5.1 shows the boiler of a coal-fired power station. Hot gases rise and thermal energy warms the water inside the metal pipes.

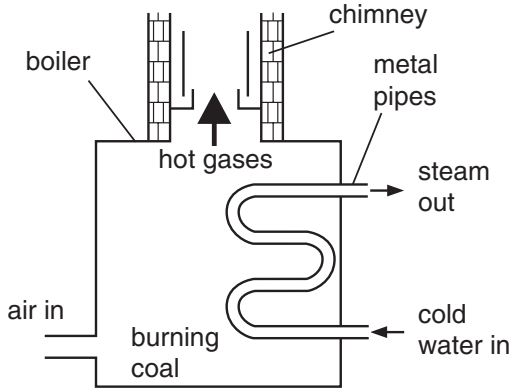

Fig. 5.1

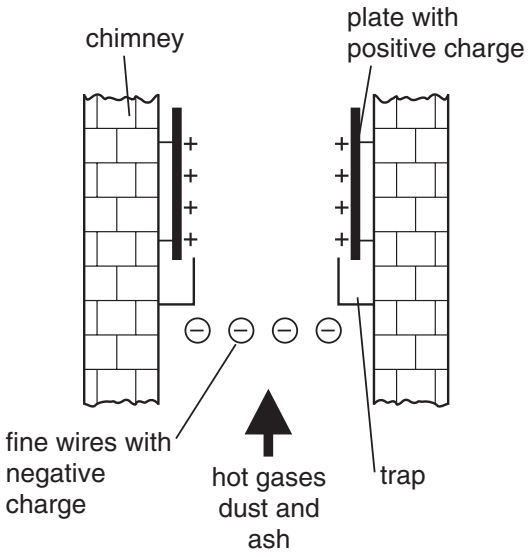

Fig. 5.2

(a) **(i)** Explain why the hot gases rise.

.....

.....

(ii) Explain how energy passes through the metal pipes by conduction. Use your ideas about particles.

.....

.....

.....

[3]

(b) Fig. 5.2 shows an electrostatic precipitator that stops dust and ash emerging from the chimney.

Explain how the precipitator works.

.....

.....

.....

.....

.....[3]

For Examiner's Use

6 An experiment to show charging by induction uses a metal sphere mounted on an insulated support. The sphere is initially uncharged and is shown in Fig. 6.1.

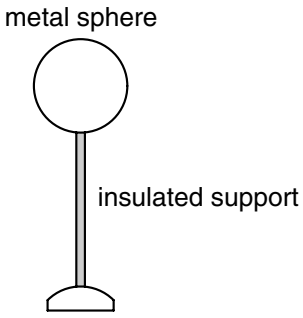

Fig. 6.1

(a) A negatively charged rod is brought near the sphere, as shown in Fig. 6.2.

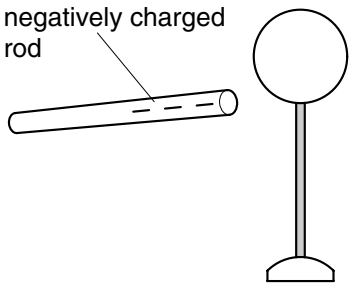

Fig. 6.2

(i) State and explain the movement of electrons in the sphere that occurs as the rod is brought near.

.....

.....

.....

.....

(ii) On Fig. 6.2, draw the charges on the metal sphere.

[3]

For Examiner's Use

(b) The metal sphere is now touched at point A by a wire connected to earth, as shown in Fig. 6.3.

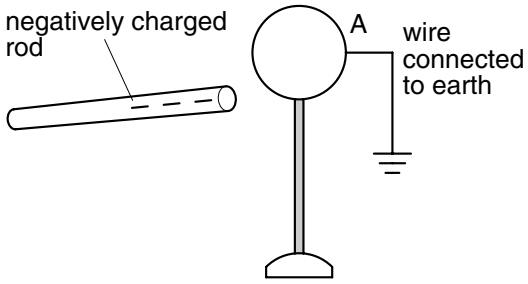

Fig. 6.3

On Fig. 6.3, draw the charges on the metal sphere. [1]

(c) The wire connected to earth is removed. Then the negatively charged rod is also removed, as shown in Fig. 6.4.

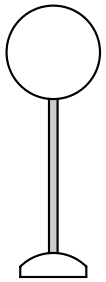

Fig. 6.4

On Fig. 6.4, draw the charges on the metal sphere. [1]

(d) The support is made from an insulator.
State one material that may be used to make the support.

.....[1]

[Turn over

For Examiner's Use

6 An electrostatic generator is used to produce sparks, as shown in Fig. 6.1.

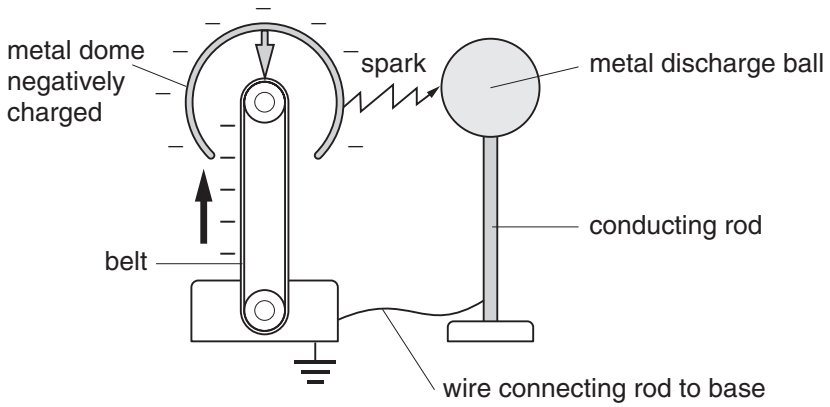

Fig. 6.1

The belt carries negative charge to the dome, making the dome negatively charged.

(a) Before a spark is produced, the discharge ball becomes positively charged.

(i) Describe and explain the movement of electrons in the discharge ball and in the rod as the ball becomes charged.

.....

.....

.....

..... [2]

(ii) On Fig. 6.1, mark with an X where there is the most positive charge on the discharge ball. [1]

(b) A spark jumps between the dome and the discharge ball when there is enough negative charge on the dome.

A charge of 0.00016 C flows in the spark in a time of 0.012 s.

Calculate the average current in the spark. State the equation that you use.

current = ... [3]

[Turn over

3 A hockey player trains on a nylon-fibre surface. As he runs around, his shoes rub against the surface and he becomes positively charged.

For Examiner's Use

(a) (i) Explain, in terms of the particles involved, how he becomes positively charged.

.....

.....

.....[2]

(ii) State what happens to the nylon-fibre surface as he becomes positively charged.

.....

.....[1]

(b) At the end of the training session, the hockey player touches a metal gate and feels an electric shock.

(i) State how this shock is produced.

.....

.....[1]

(ii) The shock lasts for 0.15 ms. During this time, the current has an average value of 1.6 mA. Calculate the size of the charge on the hockey player just before he touches the gate.

charge = ...[3]

5 Fig. 5.1 shows a nylon rod being rubbed with a woollen cloth.

Fig. 5.1

The rod becomes negatively charged.

(a) (i) Explain how rubbing the nylon rod makes it negatively charged.

.....

.....[1]

(ii) State what happens to the cloth as the rod becomes negatively charged.

.....

.....[1]

(b) Fig. 5.2 shows the negatively-charged rod placed near to a conducting sphere. The sphere is suspended by an insulating thread.

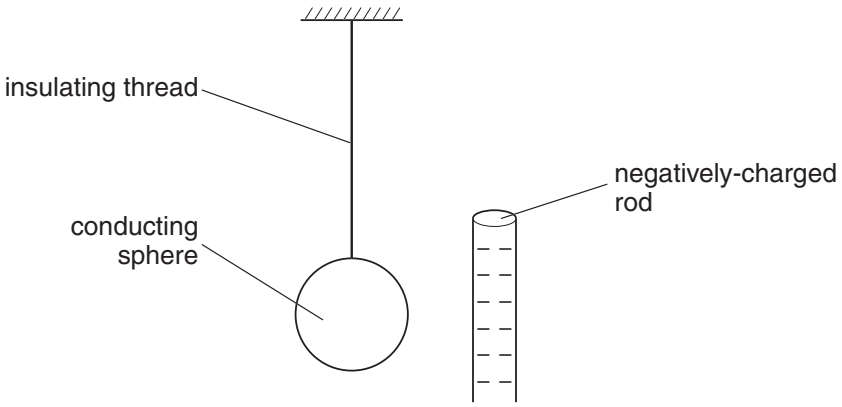

Fig. 5.2

(i) On Fig. 5.2, draw the distribution of positive and negative charges on the sphere. [2]

(ii) Explain why the sphere is attracted to the rod.

.....

.....

.....[2]

6 At an airport, fuel is pumped through a pipe from a tanker to an aeroplane, as shown in Fig. 6.1.

For Examiner's Use

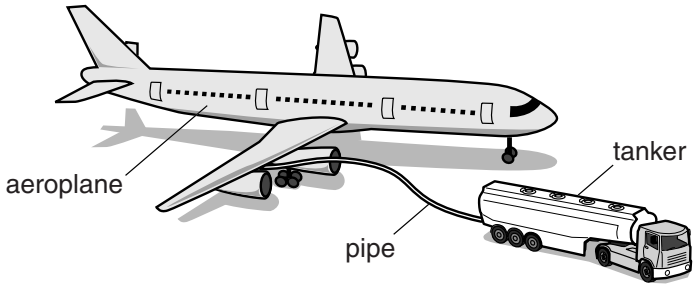

Fig. 6.1

As it rubs against the pipe, the fuel becomes negatively charged and this charges the aeroplane.

(a) Explain, in terms of the particles involved, how the fuel becomes negatively charged.

.....

.....

.....[2]

(b) Suggest and explain one problem that can arise when an aeroplane becomes charged.

.....

.....

.....[2]

(c) To prevent an aeroplane becoming charged, a metal cable connects the aeroplane to the ground.

Explain

(i) why the cable is made of metal,

.....

.....[1]

(ii) how the cable prevents the aeroplane becoming charged.

.....

.....[1]

[Turn over

6 The base of a storm cloud is negatively charged. Fig. 6.1 shows the cloud above flat ground.

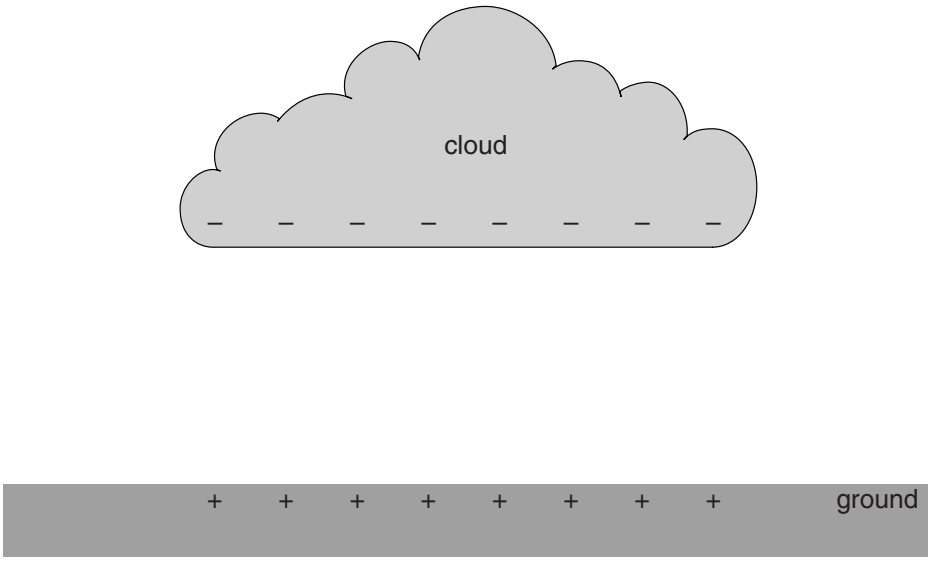

Fig. 6.1

(a) The cloud causes the ground beneath it to become positively charged.

Explain, in terms of the particles involved, how the ground becomes positively charged.

.....

.....

.....[2]

(b) In the space between the negative charge on the cloud and the positive charge on the ground, there is an electric field.

State what is meant by an *electric field*.

.....

.....[1]

(c) A lightning strike takes place. In 0.0015 s, a charge of 180 C passes between the cloud and the ground.

Calculate the average current in the lightning strike.

current = ...[2]

5 Two uncharged conducting spheres, K and L, are mounted on insulating stands.

(a) State how the structure of an insulator differs from that of a conductor and give one example of an insulator.

.....

.....

..... [2]

(b) The two spheres are in contact.

Fig. 5.1 shows a positively-charged insulating rod held next to K.

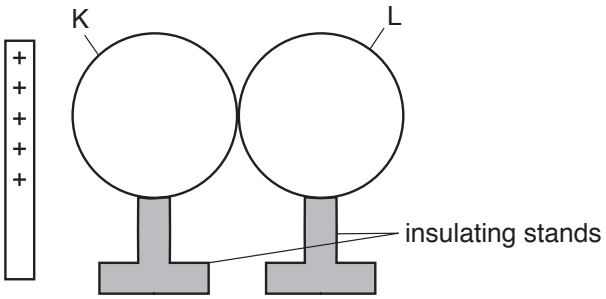

Fig. 5.1

(i) On Fig. 5.1, draw the charges on K and on L. [2]

(ii) Sphere L is moved to the right, a long way from sphere K.

1. The positively charged rod is moved away.

State what happens to the charge on K.

.....

..... [1]

2. An earthing wire is connected to sphere L.

State what happens to the charge on L.

.....

..... [1]

[Turn over