

O Level Pure Physics Structured

Static Electricity Test 2.0

Q1

An electron travels horizontally towards a vertical uniform electric field formed by a pair of parallel metal plates as shown in Fig. 8.

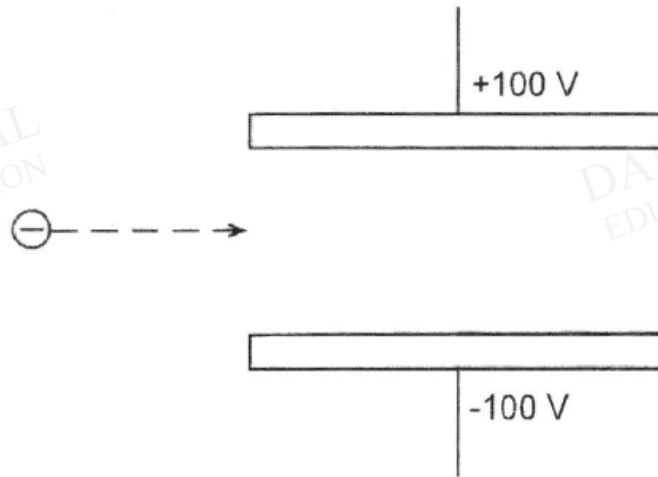


Fig. 8

(a) Define *electric field*.

.....
.....

[1]

(b) On Fig. 8,

(i) draw the electric field pattern between the plates,

[2]

(ii) complete the path of travel of the electron through the plates.

[1]

Q2

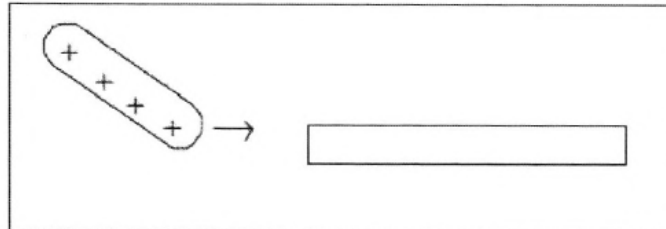
Two electrostatic charging processes are illustrated below.

- a. A rubber rod R is originally uncharged. When rubbed with fur, the rod becomes positively charged.
Explain briefly how the net positive charge arises on the rod.

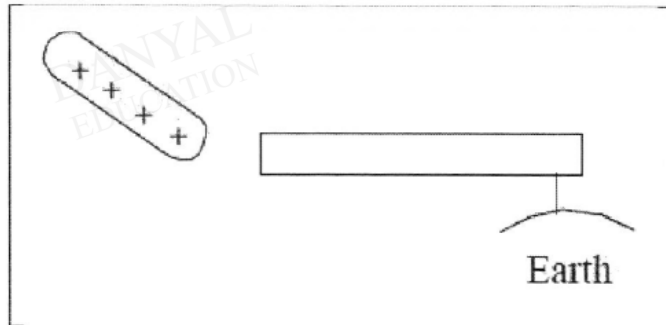
[2]

- b. A positively charged rubber rod is used to charge a metal rod by electrostatic induction. The diagrams below show the steps in the process.
For each step, draw the charge distribution in the metal rod.

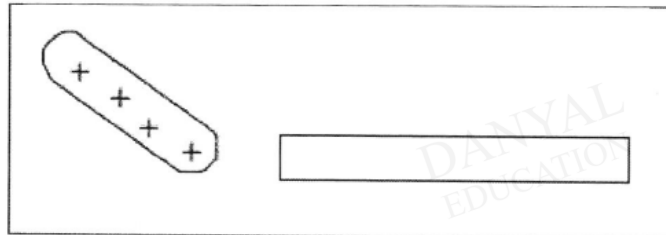
- i. The charged rubber rod is brought close to the metal rod.



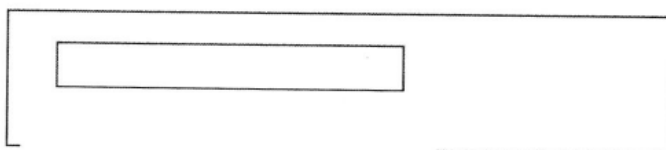
- ii. The metal rod is connected to earth.



- iii. The earth connection is removed.



- iv. The rubber rod is removed.



Q3

Fig. 6.1 shows how fuel is pumped through a pipe from a tanker to an aeroplane at an airport.

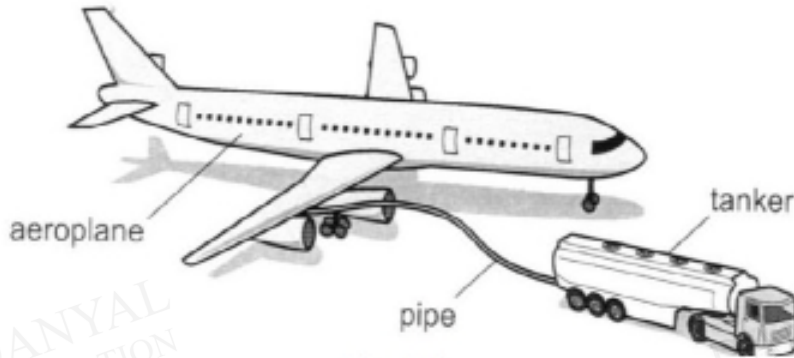


Fig. 6.1

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

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

[2]

(b) (i) The aeroplane gains 2.4 nC of charge in 5.0 s.
Calculate the average current during this time.

average current = _____ [1]

(ii) Describe a hazard that can arise when the aeroplane becomes charged.

[1]

(iii) Suggest and explain how the aeroplane can be prevented from being charged.

[2]

Q4

- (a) An insulated plate is rubbed with a cloth and becomes positively charged.
Explain, in terms of the movement of electrons, how the plate becomes positively charged.

.....
.....
..... [2]

- (b) Two stages in the production of a photocopy are shown in Fig. 8.1.

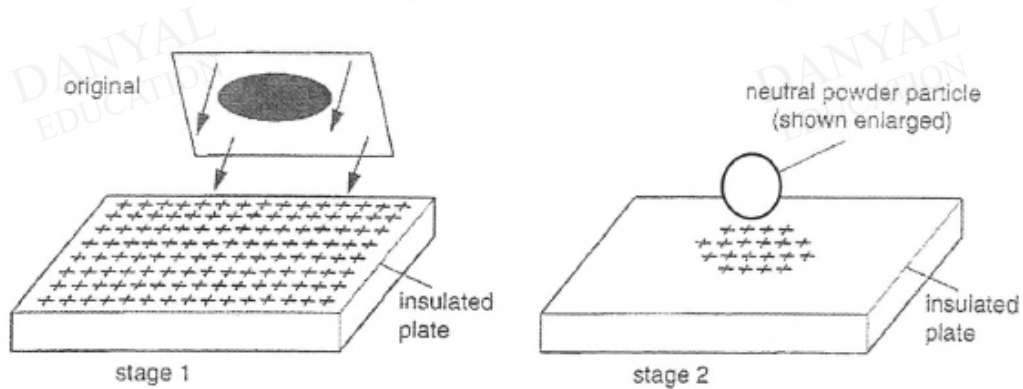


Fig. 8.1

In stage 1, reflected light from the white parts of the original hits the positively charged plate, leaving it as shown in stage 2.

Black powder (toner) is then sprayed onto the plate.

One neutral powder particle is shown enlarged in stage 2.

- (i) Based on the information provided, state the effect of light on the charged plate.

.....
.....
..... [1]

- (ii) On Fig. 8.1 stage 2, draw the charge distribution on the neutral powder particle.

..... [1]

- (iii) Explain why the particle of powder is attracted to and sticks to the charged plate.

.....
.....
.....
..... [2]

Q5

Fig. 8.1 shows a carpet charged positively as a man ran across it in a dry room.

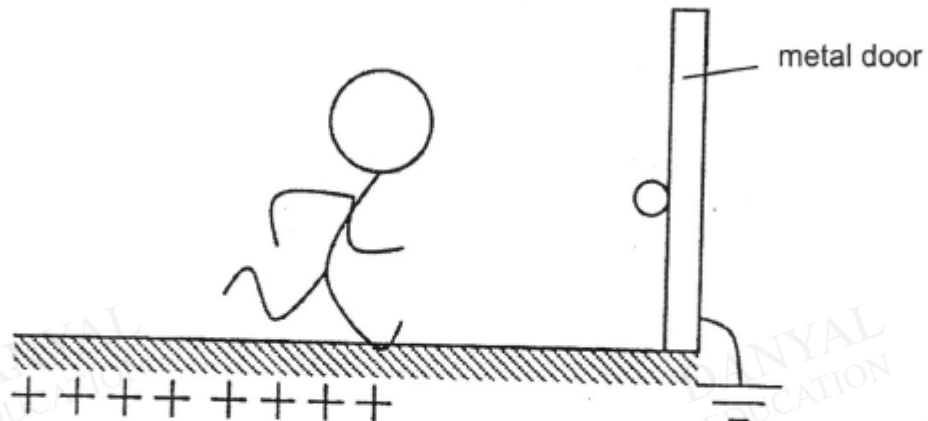


Fig. 8.1

(a) Explain how the carpet could be charged positively.

[1]

(b) Describe and explain the distribution of charges on the metal door from the time when the man runs towards the door until the time when he is next to the door.

[2]

(b) Explain why the man experiences an electric shock upon touching the door handle.

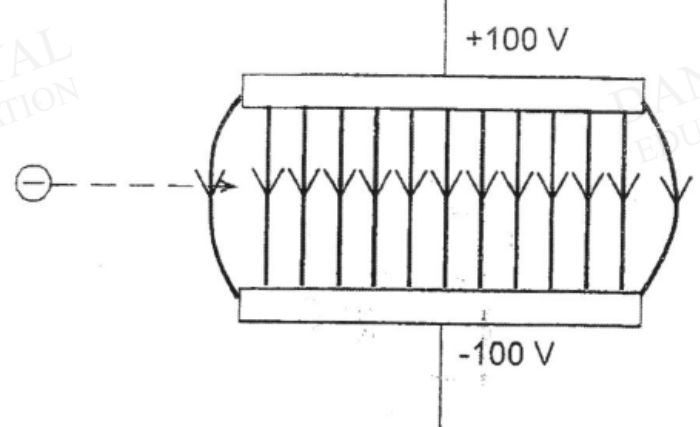
[1]

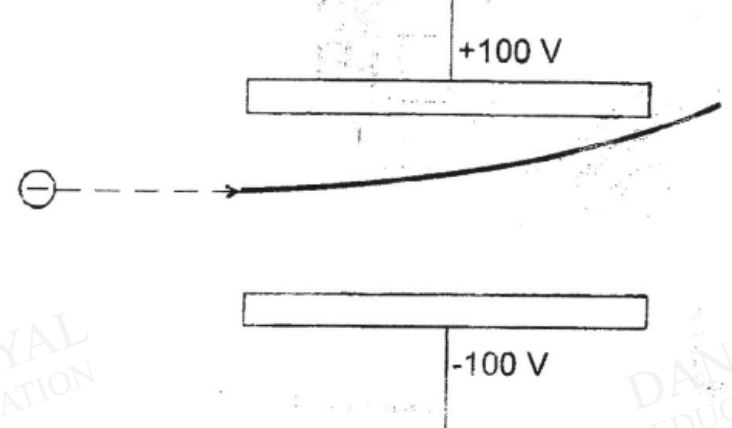
Answers

Static Electricity Test 2.0

Q1

a	Electric field is a region where an electric charge experiences an electric force.	[1]
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ibi	 <p>[1] for correct shape [1] for correct direction</p>	[2]
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ibii		[1]
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Q2

- a. A rubber rod R is originally uncharged. When rubbed with fur, the rod becomes positively charged. Explain briefly how the net positive charge arises on the rod.

[2]

The rod was initially uncharged (same number of positive and negative charges)

A1/2

The electrons from the rod will move over to the fur upon rubbing.

A1

There is a net positive charge left on the rod as a result of the movement of electrons.

A1/2

Q3

(a)	When the fuel rubs against the pipe, friction causes electrons to move/transfer from the pipe to the fuel.	[1]
	The fuel gains electrons and becomes negatively charged.	[1]
(b)	(i) Current = Q / t = $2.4 \times 10^{-9} / 5.0$ = $4.8 \times 10^{-10} \text{ A}$	[1]
	(ii) Discharge/Sparks in air may occur which can ignite the fuel (vapour) and cause a fire/explosion. / Workers may get an electric shock when they come into contact with the plane. (any one)	[1]
	(iii) A metal cable can be connected from the aeroplane to the ground. Charges accumulated on the plane can flow along the cable to earth and the plane will be earthed.	[1] [1]

Q4

(a)

The electrons move from the plate to the cloth, [1]
resulting in the plates to have excess positive charge. [1]
This causes the plate to become positively charged.

Mention "less negative charge/ electron" is not sufficient as the object can still be negatively charged.

Candidates must also be specific over where the charges are since there are two objects here: Plate and cloth.

(bi)

Light neutralises the charge on the plate.

(bii)

negative charge at the bottom and positive charge at the top of the powder particle

(biii)

The negative charge on the particle is attracted to positive charge on the plate. [1]
This is because the force of repulsion between positive charges on the plate and particle is weaker than the attractive force between the positive charge on the plate and the negative charge on the particle. [1]

Q5

- (a) Rubbing between the shoes of the man and the carpet by friction causes electrons to be transferred from the carpet to the man [B1]
Carpet hence becomes positively charged
- (b) Excess negative charges on man sets up an electric field around him
In the presence of this electric field, force of repulsion exerted on the electrons on the surface of the metal door repels to the earth [B1]
The end of the door nearer to man becomes deficient of electrons and has a net positive charge [B1]
- (c) Upon touching the door handle, the electrons on the man is discharged through his body down to the earth
The rate of flow of a large quantity of charges through the man gives him the sensation of electric shock. [B1]