

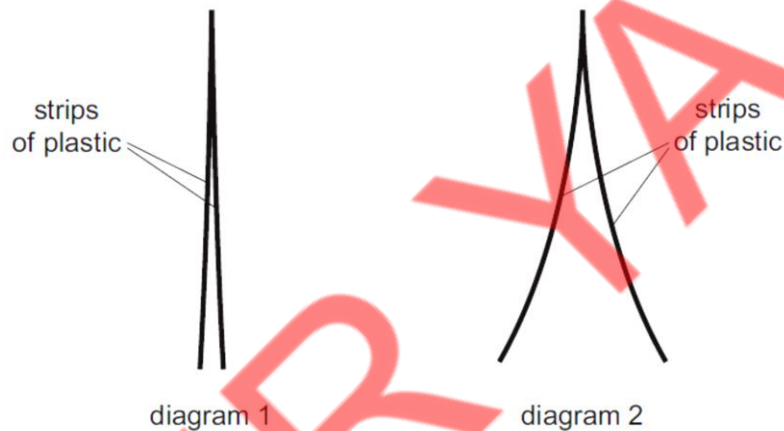
## Chapter # 18

### Static Electricity

#### Attraction/Repulsion of charges

- Q-1:** Which statement about electric charges is correct?
- A** Like charges attract and unlike charges attract.
  - B** Like charges attract and unlike charges repel.
  - C** Like charges repel and unlike charges attract.
  - D** Like charges repel and unlike charges repel.

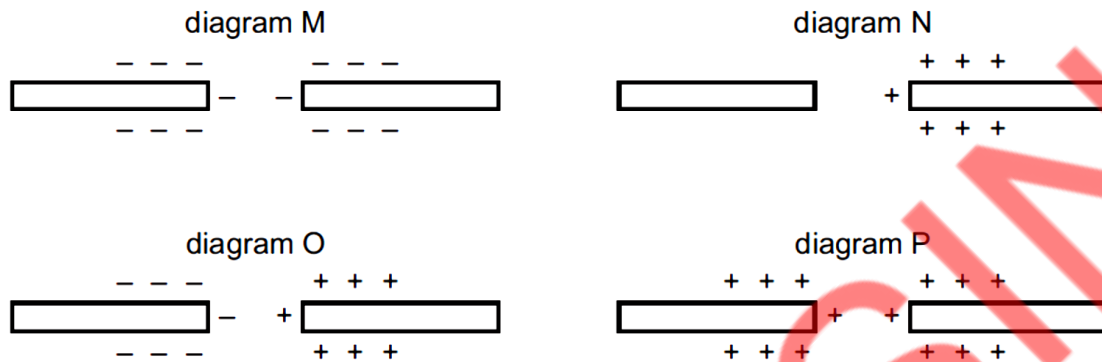
- Q-2:** Diagram 1 shows two thin, uncharged strips of plastic.  
Diagram 2 shows the same strips after they have been rubbed with a dry cloth.



Which row describes the charge on the strips after rubbing, and the force between the strips after rubbing?

|          | charge on strips | force between strips |
|----------|------------------|----------------------|
| <b>A</b> | opposite         | attraction           |
| <b>B</b> | opposite         | repulsion            |
| <b>C</b> | the same         | attraction           |
| <b>D</b> | the same         | repulsion            |

**Q-3:** Each of the four diagrams M, N, O and P shows a separate pair of insulating rods. Each rod is charged as shown.



In which **two** arrangements do the pairs of rods experience a force of repulsion?

- A M and N
- B O and P
- C M and P
- D N and O

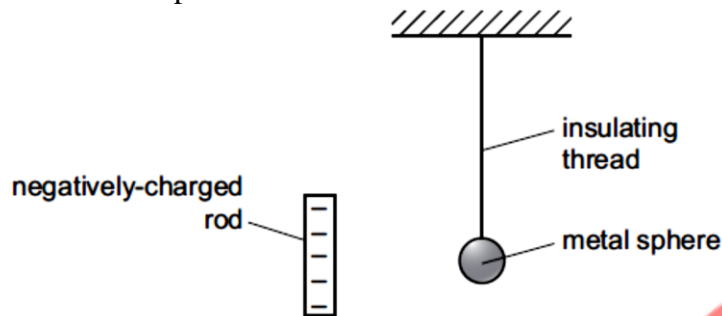
**Q-4:** The diagram shows a positively charged acetate strip and a negatively charged polythene strip that are freely suspended.



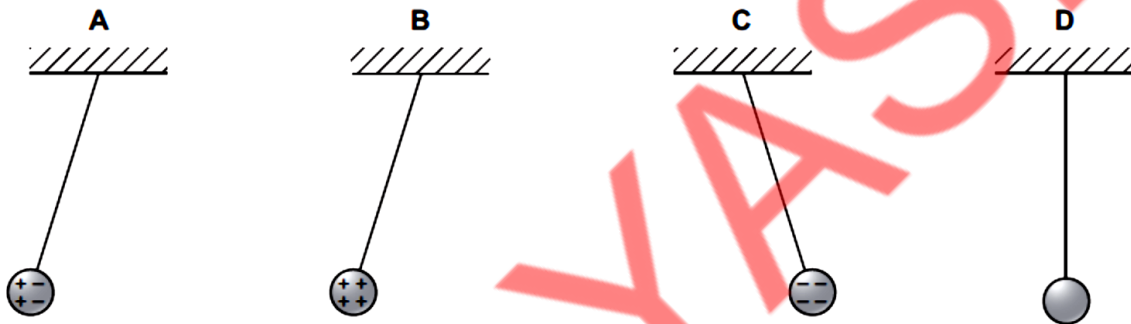
Two rods X and Y are brought up in turn to these two strips. Rod X attracts the acetate strip but repels the polythene strip. Rod Y does not repel either the acetate strip or the polythene strip. Which type of charge is on each rod?

|   | rod X    | rod Y     |
|---|----------|-----------|
| A | negative | positive  |
| B | negative | uncharged |
| C | positive | negative  |
| D | positive | uncharged |

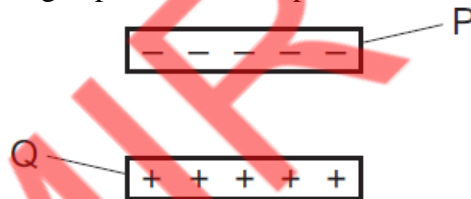
**Q-5:** A small uncharged metal sphere hangs from an insulating thread. A negatively-charged rod moves close to the sphere.



Which diagram shows the charges on the sphere and its final position?



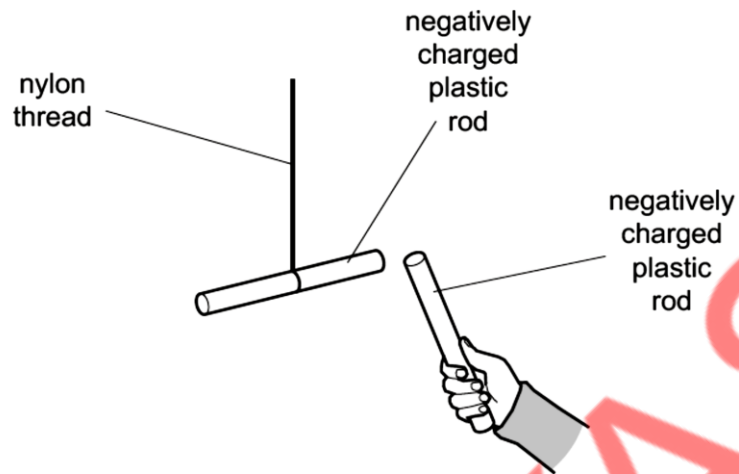
**Q-6:** A negatively charged plastic rod P is placed above a positively charged plastic rod Q.



What are the directions of the electrostatic forces on rod P and on rod Q?

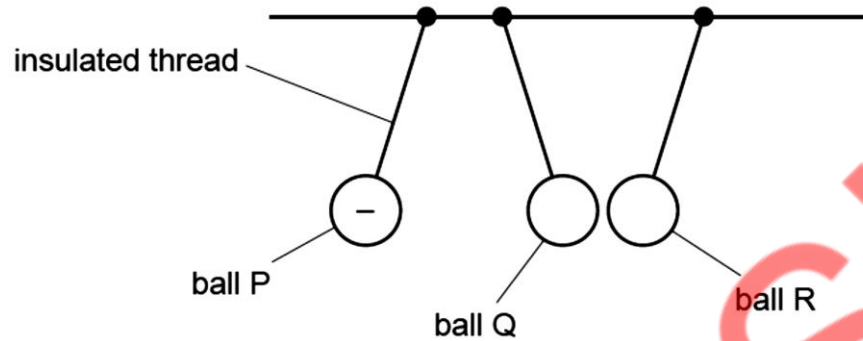
|          | electrostatic force on rod P | electrostatic force on rod Q |
|----------|------------------------------|------------------------------|
| <b>A</b> | downwards                    | downwards                    |
| <b>B</b> | downwards                    | upwards                      |
| <b>C</b> | upwards                      | downwards                    |
| <b>D</b> | upwards                      | upwards                      |

**Q-7:** A student does an experiment with some electrostatically charged plastic rods. Fig. shows the student's arrangement.



Describe and explain what happens as the student brings one negatively charged rod close to the other negatively charged rod.

**Q-8:** Three balls P, Q and R are electrically charged. The balls are suspended by threads of insulating material. Fig. shows the arrangement.



Ball P is negatively charged.

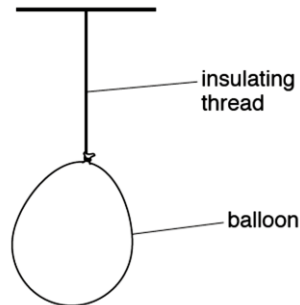
**a)** State the charge on ball Q and the charge on ball R.

Charge on Q:

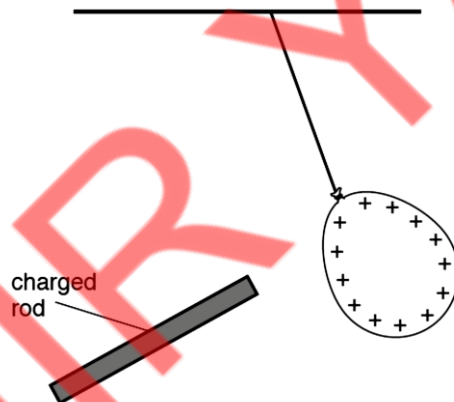
Charge on R:

**b)** Explain your answer for part (a) for the charge on ball Q.

Q-9: a) Fig.1 shows a balloon hanging from an insulating thread.



- i) A student gives the balloon a positive charge. Which statement explains why the balloon becomes positively charged? Tick **one** box.
- The balloon gains electrons
  - The balloon loses electrons
  - The balloon gains protons
  - The balloon loses protons
- ii) The student brings a charged rod close to the balloon as shown in Fig. 2



State the type of charge on the rod. Explain your answer.

- b) Electrical charges can move easily through some materials. Draw a circle around each material that charges can move through easily.

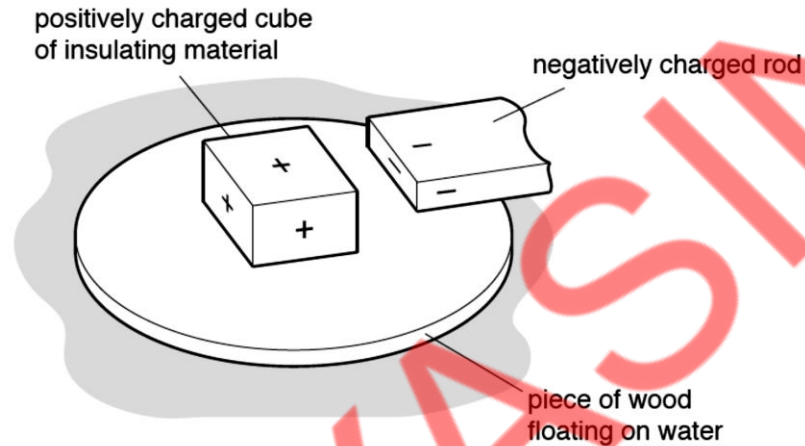
copper plastic

rubber

silver

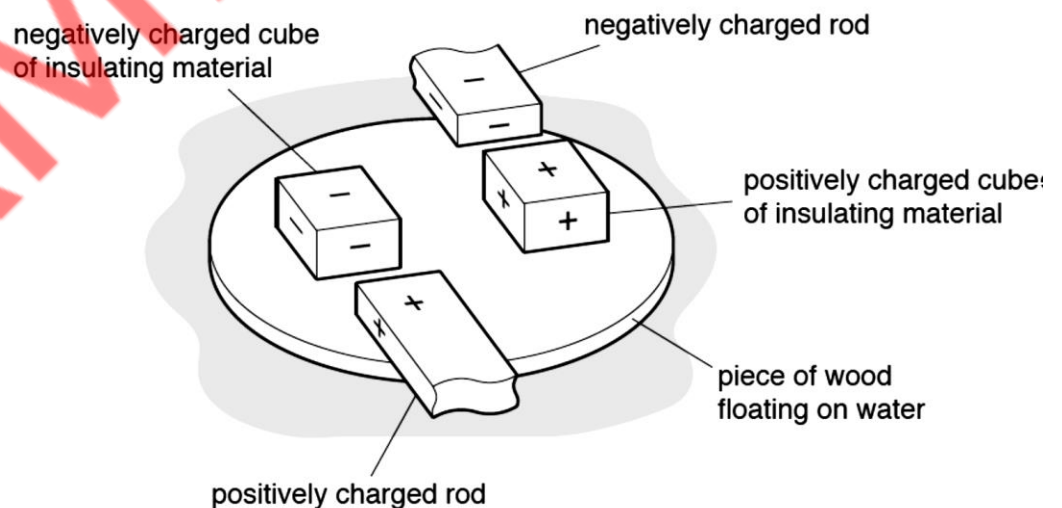
wood

- Q-10: a) i)** Fig. 1 shows a positively charged cube of insulating material. The cube is fixed to a piece of wood that is floating on water. A negatively charged rod is held above the piece of wood and brought close to the cube, as shown.



State and explain any movement of the piece of wood.

- ii)** Fig. 8.2 shows two cubes of insulating material. One is positively charged and the other is negatively charged. The cubes are fixed to a piece of wood that is floating on water. Charged rods are held above the piece of wood and brought close to the cubes, as shown.



State and explain any movement of the piece of wood.

- b) In terms of a simple electron model, describe the differences between conductors and insulators.

**Conductor:**

**Insulator:**

- c) On Fig. 3, draw the electric field pattern around a single point positive charge.



## Charging of Insulators

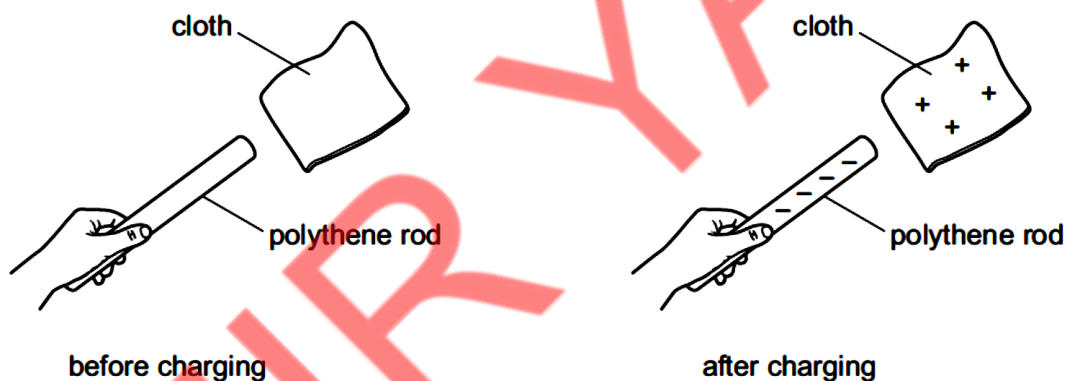
**Q-11:** Which statement about charging an insulator is correct?

- A It can be given an electrostatic charge by placing it in a magnetic field.
- B It can be given an electrostatic charge by connecting it to a battery.
- C It can be given an electrostatic charge by friction.
- D It cannot be given an electrostatic charge.

**Q-12:** A polythene rod is charged negatively by rubbing it with a cloth. Which statement explains why the rod has become charged?

- A The rod has gained electrons.
- B The rod has gained protons.
- C The rod has lost electrons.
- D The rod has lost protons.

**Q-13:** A polythene rod is charged by rubbing it with a cloth.



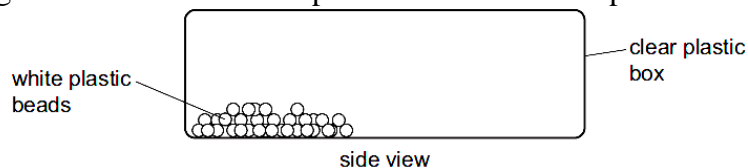
Which statement explains why the cloth is charged?

- A Electrons move from the cloth to the rod.
- B Electrons move from the rod to the cloth.
- C Protons move from the cloth to the rod.
- D Protons move from the rod to the cloth.

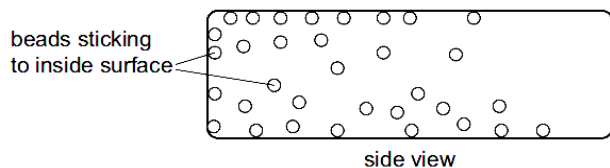
**Q-14:** A piece of polythene is rubbed with a cloth duster. The polythene becomes negatively charged and the cloth becomes positively charged. What has happened to the polythene and the cloth to cause this?

- |   | <u>Polythene</u> | <u>Cloth</u>    |
|---|------------------|-----------------|
| A | Gained electrons | Gained protons  |
| B | Gained electrons | Lost electrons  |
| C | Lost protons     | Gained protons  |
| D | Lost protons     | Lost electrons. |

**Q-15:** The diagram shows some white plastic beads in a clear plastic box.



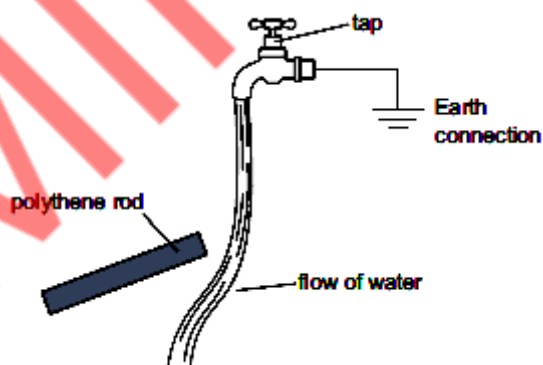
The box is shaken and the beads rub against the box. The beads stick to the inside surface of the box.



Which row is a possible explanation for this?

|   | box                    | beads                  |
|---|------------------------|------------------------|
| A | gains electrons        | no change of electrons |
| B | loses electrons        | gain electrons         |
| C | no change of electrons | lose electrons         |
| D | no change of electrons | gain electrons         |

**Q-16:** A polythene rod is brought near to a stream of water from a metal tap which is earthed. Tap water is an electrical conductor. The water moves towards the rod, as shown.



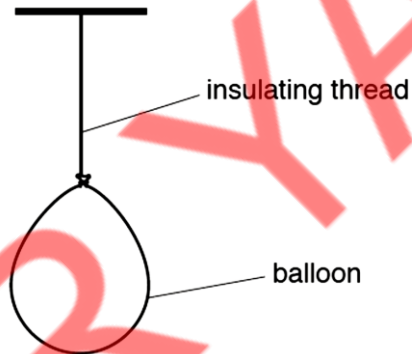
Which description of the rod and water is correct?

|   | rod       | water     |
|---|-----------|-----------|
| A | charged   | charged   |
| B | charged   | uncharged |
| C | uncharged | charged   |
| D | uncharged | uncharged |

**Q-17:** A student experiments with electric charge.

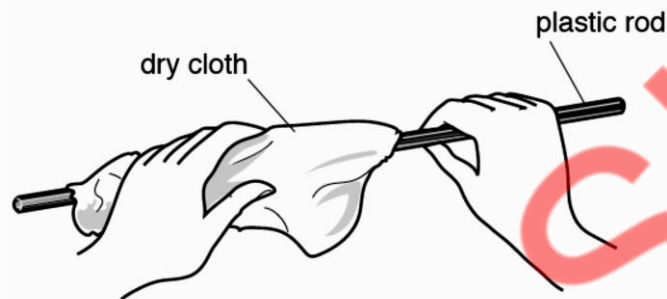
- a) The student uses a dry cloth to rub a plastic rod. The rod becomes positively charged. Explain how the friction between the rod and the cloth causes the rod to become positively charged. Use your ideas about the movement of charge.

- b) The student suspends a balloon from an insulating thread, as shown in Fig.1.



The balloon has an electric charge. Explain how the student can use a positively charged rod to determine the charge on the balloon.

- Q-18:** a) A student rubs a plastic rod with a dry cloth, as shown in Fig. 1. The rod becomes negatively charged.



- i) Use words from the box to complete the sentence.

|     |       |           |      |          |         |
|-----|-------|-----------|------|----------|---------|
| air | cloth | electrons | hand | neutrons | protons |
|-----|-------|-----------|------|----------|---------|

The rod becomes negatively charged because .....  
 move from the..... to the rod.

- ii) The student moves the rod close to a suspended, charged rod. The two rods repel each other. State the type of charge on the suspended rod.

- iii) Explain your answer to (a)(ii).

- b) A device has a metal case. Any charge on the case must be able to move to earth.

- i) Draw **one** ring around a material that is suitable for the connection to earth.

copper          glass          plastic          rubber

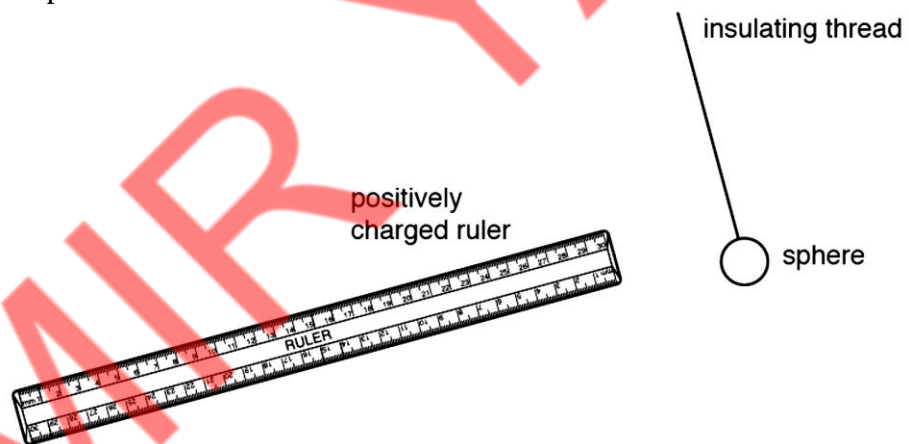
- ii) Explain your answer to (b)(i).

**Q-19:** Fig. 1 shows a plastic ruler.



a) Suggest and explain how a student could give a positive charge to a plastic ruler.

b) A plastic ruler is given a positive charge. A sphere hangs from an insulating thread. A student holds the ruler near the sphere, as shown in Fig. 2. The ruler repels the sphere.



i) State what charge, if any, the sphere carries.

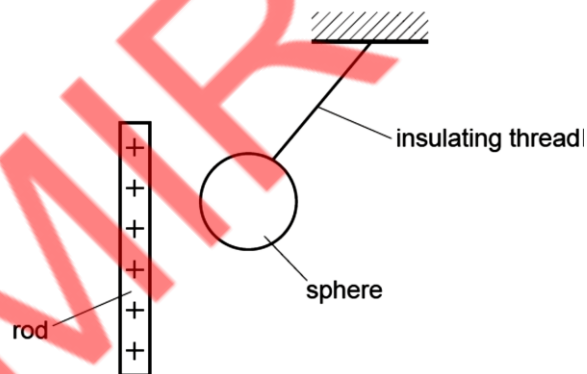
ii) Explain your answer to (b)(i).

**Q-20:** A plastic rod that is initially neutral is rubbed with a woollen cloth. After the rod has been rubbed, it is positively charged.

**a) i)** Explain, in terms of particles, why the rod is now positively charged.

**ii)** State what happens to the woollen cloth.

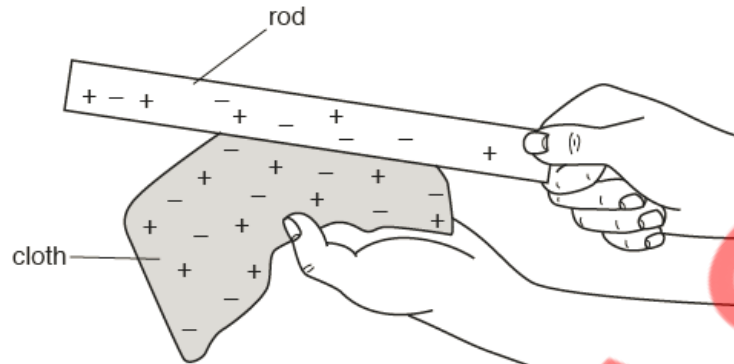
**b)** An uncharged, conducting sphere is suspended from an insulating thread. The positively charged rod is placed near to the sphere, as shown in Fig.



**i)** On Fig. 1, draw the distribution of charge on the sphere.

**ii)** Explain why the sphere is pulled towards the rod.

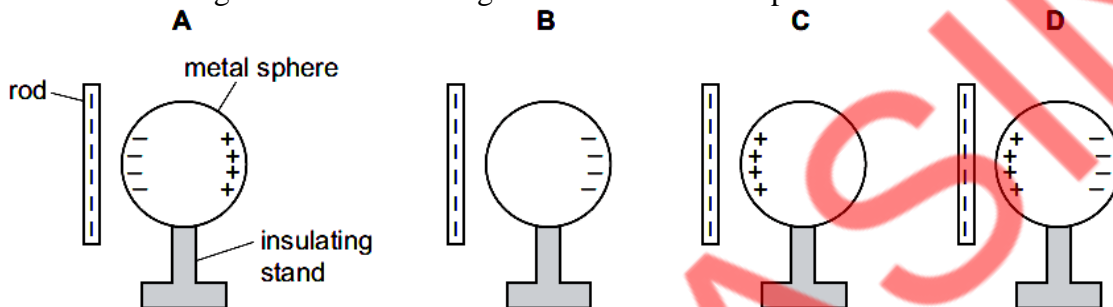
**Q-21:** Fig. 1 shows charges on a rod and on a cloth.



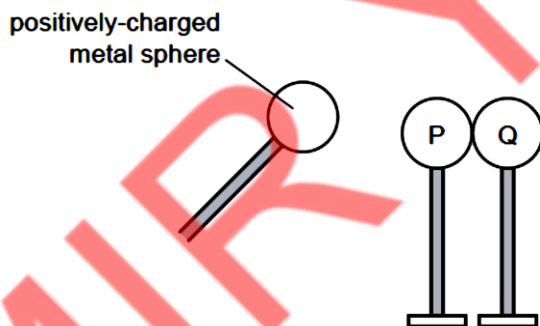
- a) State how Fig. 1 shows that the rod and the cloth are uncharged.
- b) The plastic rod becomes negatively charged when rubbed by the cloth.
- Describe what happens to the charges on the rod and on the cloth during the charging process.
  - Describe a simple experiment to show that the plastic rod is charged. You may draw a diagram if you wish.

### Charging of Conductors

**Q-22:** A negatively-charged rod is brought near to an uncharged metal sphere on an insulating stand. Which diagram shows the charge distribution on the sphere?



**Q-23:** Two metal spheres P and Q are mounted on insulating stands and are touching each other. They are uncharged. A positively-charged metal sphere on an insulating handle is brought close to P but does not touch it. This induces charges on P and Q.



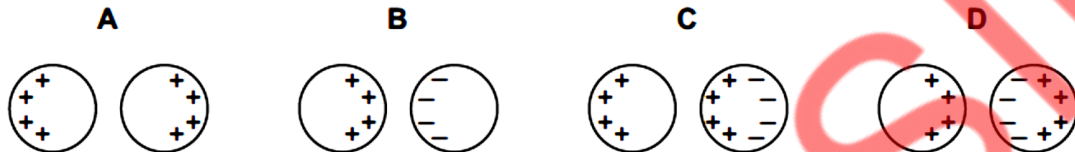
The positively-charged metal sphere is held in this position and sphere Q is moved to the right away from sphere P. What are the signs of the induced charges on P and Q and how do the sizes of these charges compare?

|          | charge on P | charge on Q | sizes of the charges |
|----------|-------------|-------------|----------------------|
| <b>A</b> | negative    | positive    | equal                |
| <b>B</b> | negative    | positive    | unequal              |
| <b>C</b> | positive    | negative    | equal                |
| <b>D</b> | positive    | negative    | unequal              |

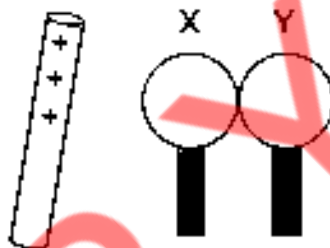
**Q-24:** A positively-charged insulated metal sphere is brought close to, but does not touch, a similar uncharged metal sphere.



Which diagram shows the charge distribution on the spheres?



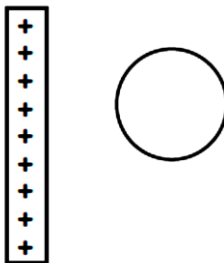
**Q-25:** Two insulated and uncharged metal spheres X and Y are touching. A positively charged rod is held near X and then the spheres are moved apart. X now has a negative charge.



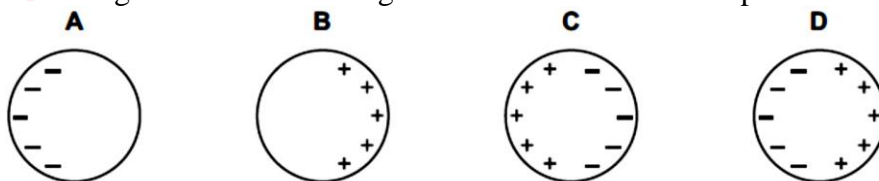
What is the charge on Y?

- A negative and smaller than that on X
- B negative and the same size as that on X
- C positive and smaller than that on X
- D positive and the same size as that on X

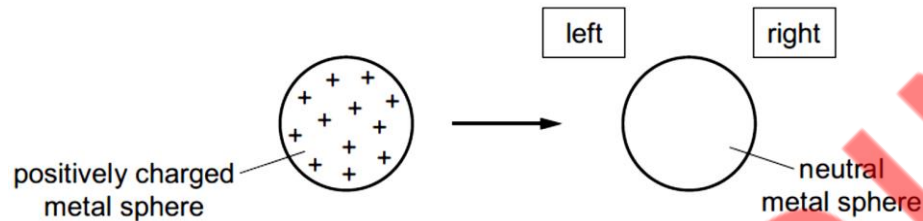
**Q-26:** A positively-charged rod is held close to, but not touching, an isolated metal sphere.



Which diagram shows the charges that are induced on the sphere?



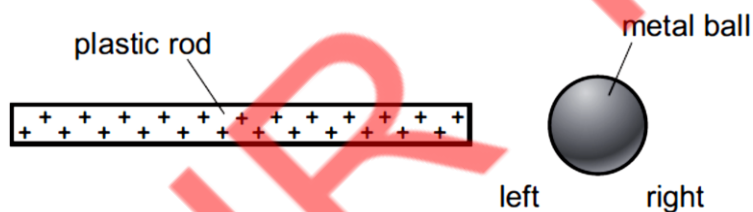
**Q-27:** An isolated metal sphere is positively charged. It is then brought near to another isolated metal sphere that is neutral.



What happens to the charges on the neutral sphere as the positively charged sphere is brought close to it?

- A** Some positive charges move to the left and some negative charges move to the right.
- B** Some positive charges move to the right and some negative charges move to the left.
- C** Some positive charges move to the right, but the negative charges do not move.
- D** The positive charges do not move, but some negative charges move to the left.

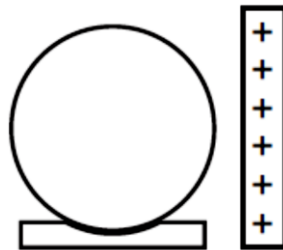
**Q-28:** A positively charged plastic rod is held near but not touching an insulated and previously uncharged metal ball. No charge leaves the rod.



What are possible charges on the left-hand side and right-hand side of the ball?

|          | charge on left-hand side of ball | charge on right-hand side of ball |
|----------|----------------------------------|-----------------------------------|
| <b>A</b> | $-2.0 \times 10^{-9} \text{ A}$  | $-1.0 \times 10^{-9} \text{ A}$   |
| <b>B</b> | $-2.0 \times 10^{-9} \text{ A}$  | $+2.0 \times 10^{-9} \text{ A}$   |
| <b>C</b> | $-2.0 \times 10^{-9} \text{ C}$  | $+2.0 \times 10^{-9} \text{ C}$   |
| <b>D</b> | $+2.0 \times 10^{-9} \text{ C}$  | $-2.0 \times 10^{-9} \text{ C}$   |

**Q-29:** An uncharged, metal sphere is placed on an insulating support. A positively charged rod is brought close to the sphere, but does not touch it.



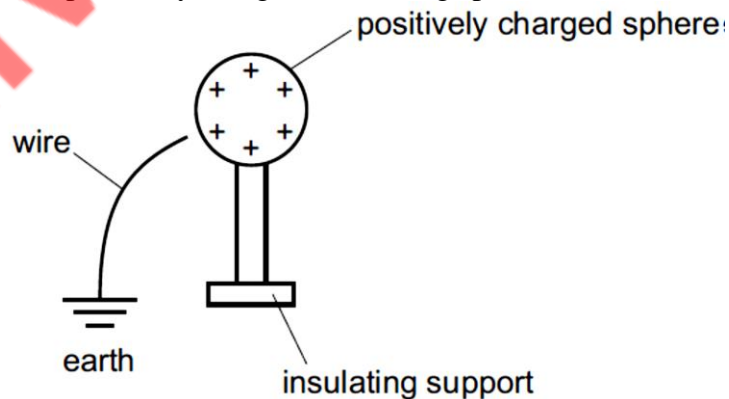
How do the charges in the sphere move and what is now the charge on the sphere?

|          | movement of charges                              | charge on sphere |
|----------|--|------------------|
| <b>A</b> | negative charges move to the right of the sphere | positive         |
| <b>B</b> | negative charges move to the right of the sphere | neutral          |
| <b>C</b> | positive charges move to the left of the sphere  | positive         |
| <b>D</b> | positive charges move to the left of the sphere  | neutral          |

**Q-30:** A negatively charged plastic rod is brought near to an uncharged metal sphere and held there. What happens when the metal sphere is earthed?

- A** Electrons flow from the metal sphere to earth.
- B** Electrons flow from earth to the metal sphere.
- C** Positive charge flows from the metal sphere to earth.
- D** Positive charge flows from earth to the metal sphere.

**Q-31:** The diagram shows a positively charged conducting sphere and a wire connected to earth.

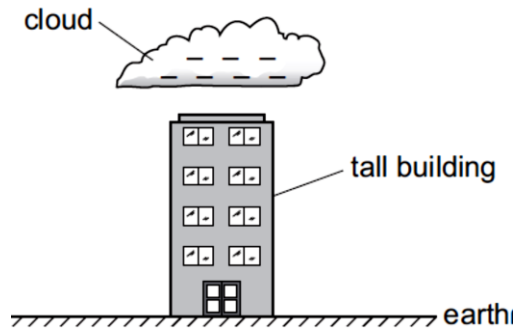


What happens when the wire is touched onto the sphere?

- A** Electrons flow from earth to the sphere.

- B Electrons flow from the sphere to earth.
- C Positive charges flow from earth to the sphere.
- D Positive charges flow from the sphere to earth.

**Q-32:** A negatively charged cloud passes over a tall steel-framed building. A charge is induced on the building by the cloud because charges flow through the building.



What charge is induced on the building and in which direction do the charge carriers move?

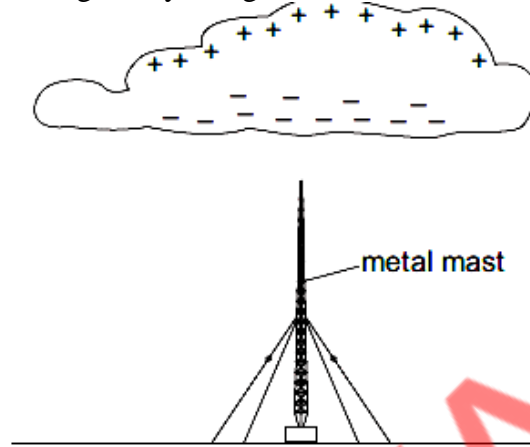
|          | charge induced on building | direction of charge flow   |
|----------|----------------------------|----------------------------|
| <b>A</b> | positive                   | from the building to earth |
| <b>B</b> | positive                   | from earth to the building |
| <b>C</b> | negative                   | from the building to earth |
| <b>D</b> | negative                   | from earth to the building |

**Q-33:** An aircraft flying through the air becomes electrically charged.

What causes this to happen?

- A background radiation in the aircraft
- B friction of the aircraft with the air
- C heating of the aircraft surface
- D radio waves emitted by the aircraft

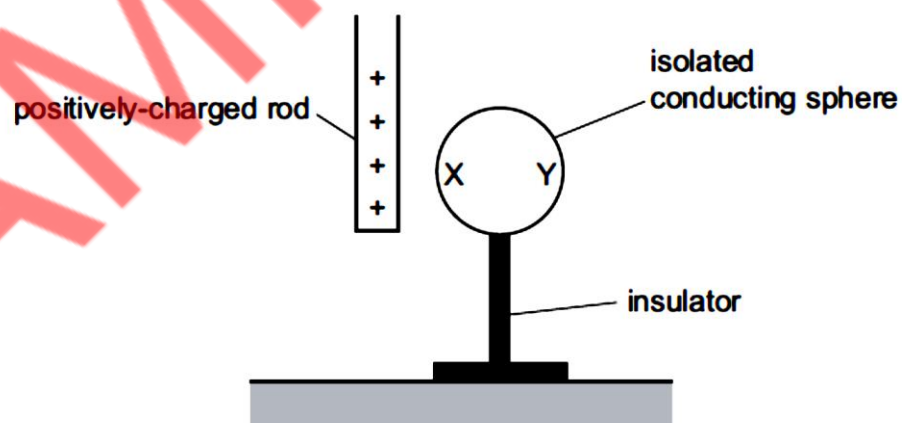
**Q-34:** The base of a cloud is negatively charged. The cloud is over a metal mast as shown.



Which row describes the charge induced at the top of the mast and how it is produced?

|          | charge at the top of the mast | charge at the top of mast is produced by   |
|----------|-------------------------------|--|
| <b>A</b> | negative                      | electrons moving to the top of the mast    |
| <b>B</b> | negative                      | protons moving to the bottom of the mast   |
| <b>C</b> | positive                      | electrons moving to the bottom of the mast |
| <b>D</b> | positive                      | protons moving to the top of the mast      |

**Q-35:** A positively-charged rod is brought near to an isolated uncharged conducting sphere.

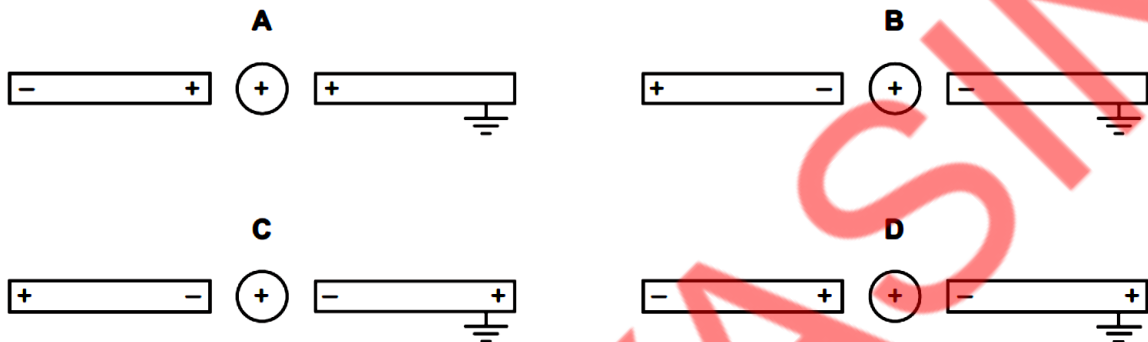


What are the charges on sides X and Y of the sphere?

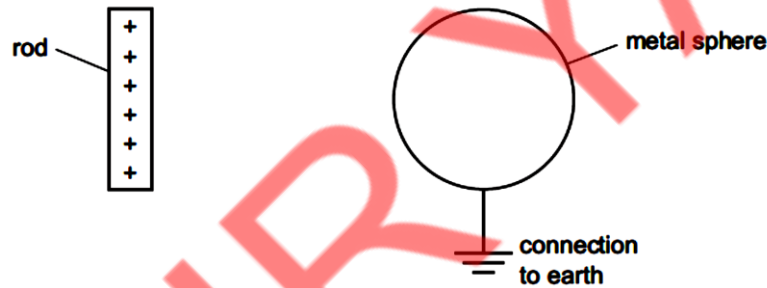
- A** Both X and Y are positively charged.
- B** Both X and Y are negatively charged.
- C** X is positively charged and Y is negatively charged.

D X is negatively charged and Y is positively charged.

**Q-36:** A positively charged metal sphere is placed midway between two previously uncharged metal rods, one of which is connected to earth. Which diagram shows the charges on the rods?



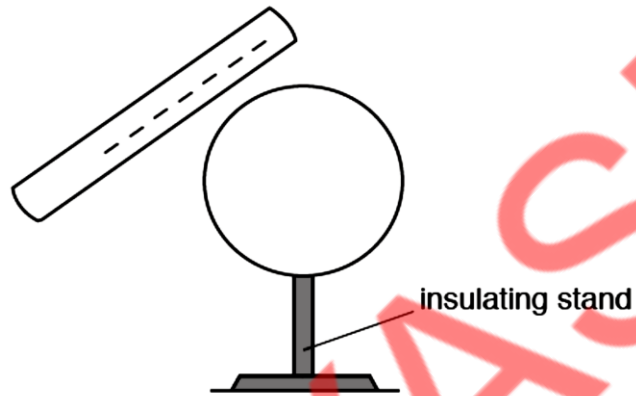
**Q-37:** A metal sphere is connected to earth. A positively charged rod approaches the sphere and stops before touching it.



What is the movement of charge on the sphere and what is the final charge on the sphere?

|          | movement of charge                             | final charge on sphere |
|----------|--|------------------------|
| <b>A</b> | negative charge moves from earth to the sphere | negative               |
| <b>B</b> | negative charge moves from earth to the sphere | neutral                |
| <b>C</b> | positive charge moves from the sphere to earth | negative               |
| <b>D</b> | positive charge moves from the sphere to earth | neutral                |

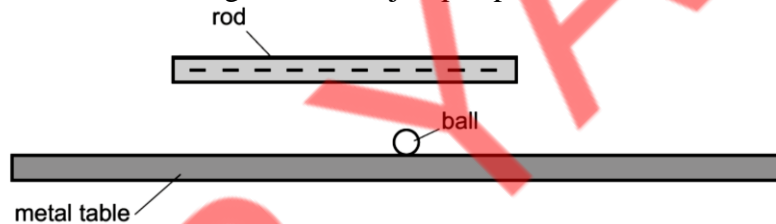
- Q-38: a)** Fig. 1 shows a negatively charged rod close to an uncharged metal sphere that is mounted on an insulating stand.



- i) Suggest a material for the insulating stand.
  
- ii) On Fig.1, draw the distribution of charges on the sphere.
- iii) A metal wire connected to earth is touched against the sphere.
  1. Explain what happens to the charge on the sphere.
  
  2. The earth wire remains in contact with the sphere. Describe what happens in the wire as the rod is moved away.

- Q-39:** A plastic rod becomes negatively charged when it is rubbed with a woollen cloth.
- a) Describe, in terms of particles, how the rod becomes negatively charged when rubbed with the cloth.

- b) A light, conducting ball is at rest on a metal table. When the rod is brought close to the ball, as shown in Fig. 1, the ball jumps up towards the rod.

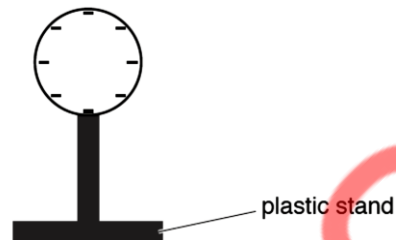


- i) Explain why the ball jumps up.

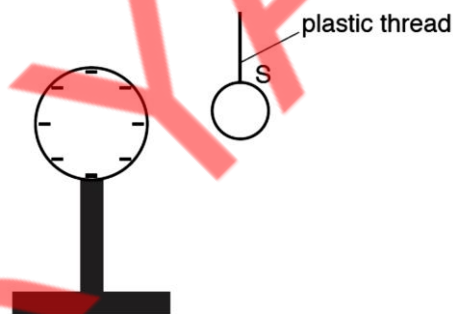
- ii) The ball touches the rod and falls back down to the table. Explain why this happens.

Q-40:

Fig. 1 shows a sphere that is negatively charged. The sphere is attached to a plastic stand.



- a) On Fig. 1, draw arrows to indicate the pattern and direction of the electric field in the region surrounding the sphere.
- b) A smaller, uncharged metal sphere S is suspended by a plastic thread and brought close to the negatively charged sphere. Fig. 2 shows the two spheres.



- i) By drawing on Fig. 2, indicate the distribution of charge on S.
- ii) State what happens to S.

- iii) An earth wire is then touched against S. Describe what happens in the wire and state how this affects the charge on S.

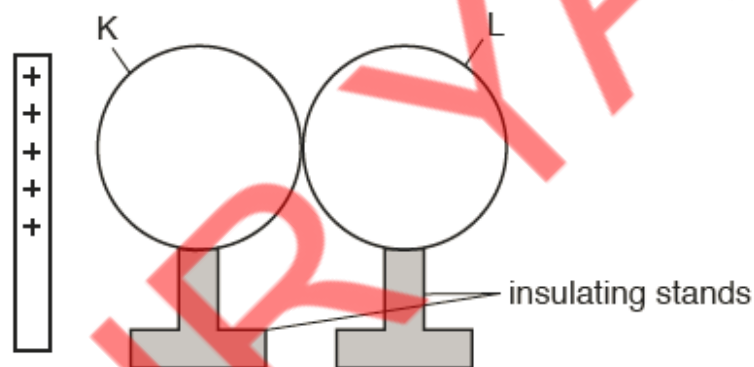
- c) The metal sphere S is an electrical conductor. The plastic thread is an electrical insulator. Explain this difference by referring to the structures of the two materials.

**Q-41:** 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.

b) The two spheres are in contact.

Fig. 1 shows a positively-charged insulating rod held next to K.



i) On Fig. 1, draw the charges on K and on L.

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

1. The positively charged rod is moved away.

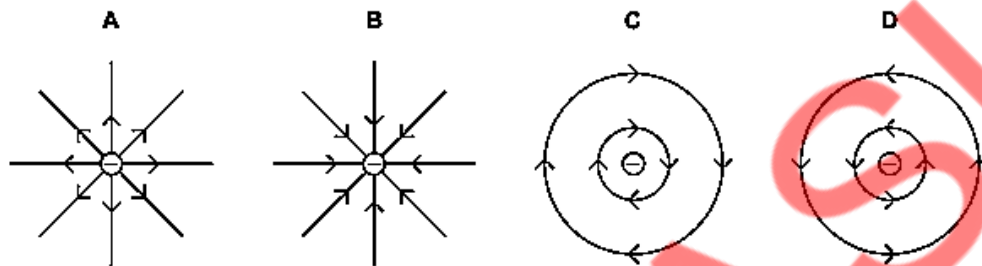
State what happens to the charge on K.

2. An earthing wire is connected to sphere L.

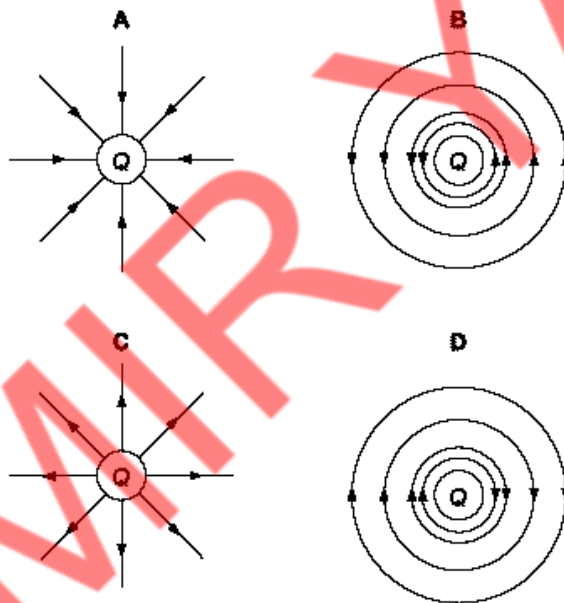
State what happens to the charge on L.

### Electric Field Pattern

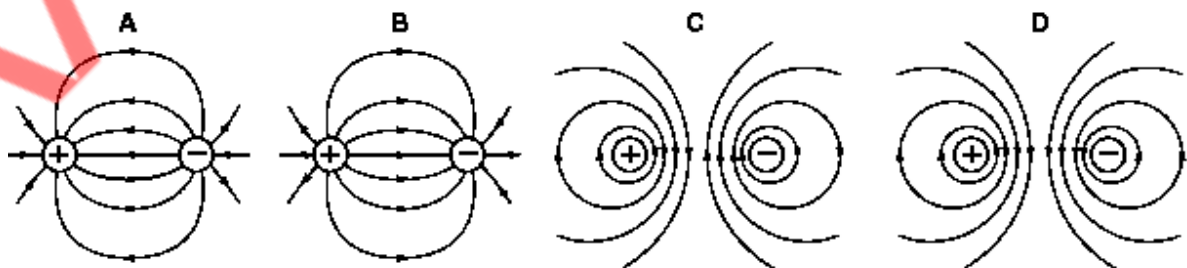
**Q-42:** Which diagram shows the electric field pattern of an isolated negative point charge?



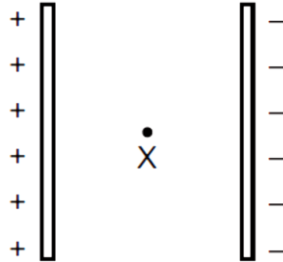
**Q-43:** Which diagram represents the electric field in the vicinity of a positive electric charge of magnitude  $Q$ ?



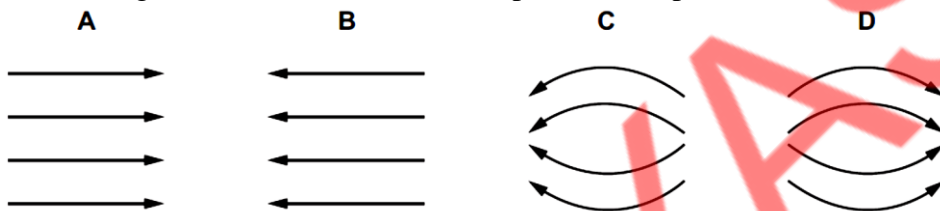
**Q-44:** A positive charge and a negative charge of equal magnitude are placed a short distance apart. Which diagram best represents the associated electric field?



Q-45: The diagram shows point X between two charged plates.

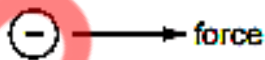


Which diagram shows the electric field pattern near point X?



Q-46: A stationary negative charge in an electric field experiences an electric force in the direction shown.

left

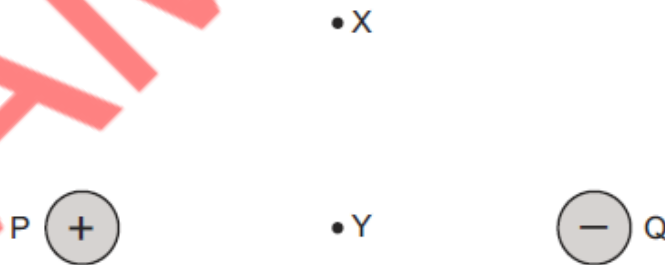


right

What is the direction of the electric field?

- A to the left
- B to the right
- C down the page
- D up the page

Q-47: An electric field is formed by two isolated, equal and opposite charges P and Q.

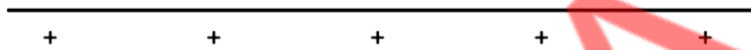
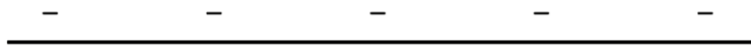


How does the field at X compare with the field at Y?

- A It is stronger at X than at Y and is in the opposite direction.
- B It is stronger at X than at Y and is in the same direction.
- C It is weaker at X than at Y and is in the opposite direction.
- D It is weaker at X than at Y and is in the same direction.

- Q-48:** An electrically charged plastic ball is at rest.  
Which types of field are caused by the ball?
- A** electric, gravitational and magnetic
  - B** electric and gravitational only
  - C** electric and magnetic only
  - D** gravitational and magnetic only
- Q-49:** A small negative charge is placed at a point where an electric field is vertically upwards.  
There is a force on the charge due to the field.  
In which direction does it act?
- A** vertically upwards
  - B** vertically downwards
  - C** horizontally to the right
  - D** horizontally to the left

- Q-50: a)** Fig. shows two charged metal plates with a gap between them. The plates are parallel to each other. The top plate is negatively charged and the bottom plate is positively charged.

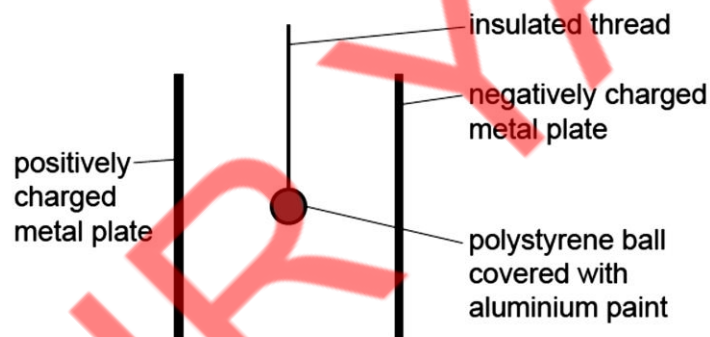


On Fig., draw **five** electric field lines between the two plates.

Q-51: a) i) Describe what is meant by an *electric field*.

ii) State what is meant by the *direction* of an electric field.

b) Fig. 1 shows a polystyrene ball covered with aluminium paint. The polystyrene ball is suspended between two charged metal plates by an insulated thread.



The ball oscillates between the two charged plates. Explain why the ball oscillates.

**Q-52:**

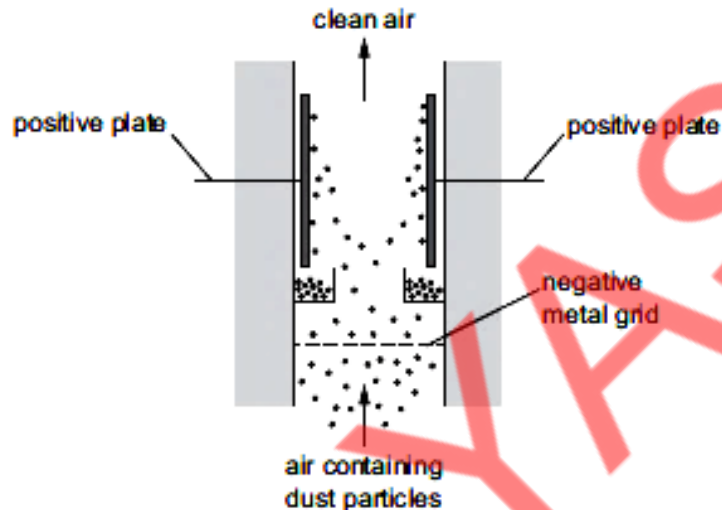
Fig. 1 shows two charged metal spheres. One sphere has a positive charge and the other sphere has a negative charge.



- a) On Fig. 1, draw the electric field between the two spheres.
- 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  $4.8 \times 10^{-9}$  C to zero in time of  $2.0 \times 10^{-6}$  s. Calculate the average current in the wire.

## Uses/Hazards/Applications of Static Electricity

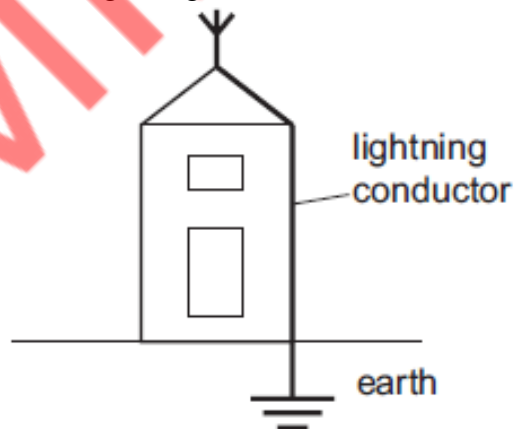
**Q-53:** The diagram shows an electrostatic precipitator. It can be used to remove dust from air.



What happens at the negative grid?

- A Dust particles gain electrons.
- B Dust particles gain protons.
- C Dust particles lose electrons.
- D Dust particles lose protons.

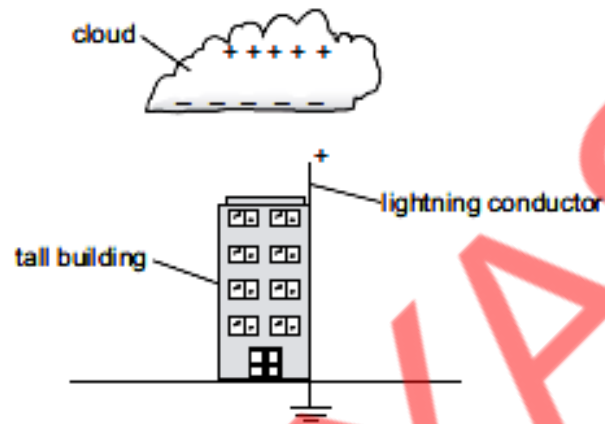
**Q-54:** The diagram shows a metal lightning conductor attached to a building



Why is the lightning conductor made of copper?

- A Both positive and negative charges can flow through copper.
- B Copper can be electrostatically charged.
- C So the lightning conductor has a low electrical resistance.
- D So the heat is conducted away quickly.

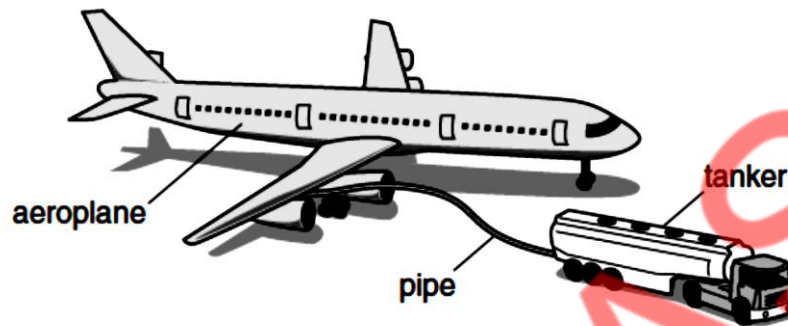
**Q-55:** A metal lightning conductor is placed on the top of a tall building. The conductor is connected to Earth. When a charged cloud passes over the building, the metal lightning conductor becomes positively charged.



What happens to the lightning conductor to produce a positive charge at its top?

- A Electrons move downwards and protons move upwards in the conductor.
- B Only electrons move in the conductor.
- C Only protons move in the conductor.
- D Protons in the air attach themselves to the conductor.

**Q-56:** At an airport, fuel is pumped through a pipe from a tanker to an aeroplane, as shown in Fig.



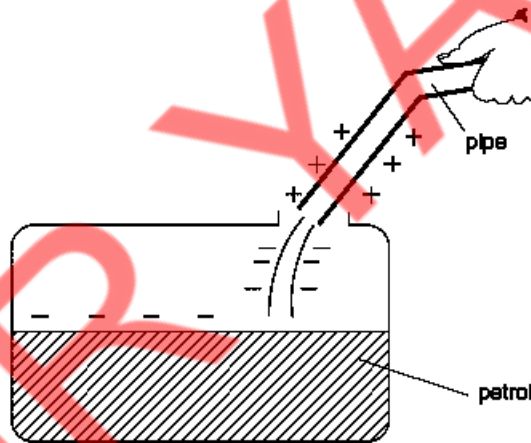
As it rubs against the pipe, the fuel becomes negatively charged and this charges the aeroplane.

- a) Explain, in terms of the particles involved, how the fuel becomes negatively charged.
  
  
  
  
  
  
  
  
  
  
- b) Suggest and explain one problem that can arise when an aeroplane becomes charged.
  
  
  
  
  
  
  
  
  
  
- 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,
  
  
  
  
  
  
  
  
  
  
  - ii) how the cable prevents the aeroplane becoming charged.

**Q-57:** 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.

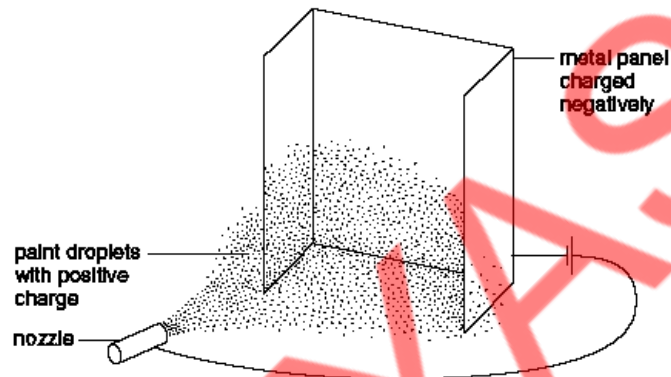
**b)** Fig. 1 shows petrol (gasolene) being pumped into a can. Electrostatic charges build up on the petrol and the pipe.



**i)** Explain why this is dangerous.

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

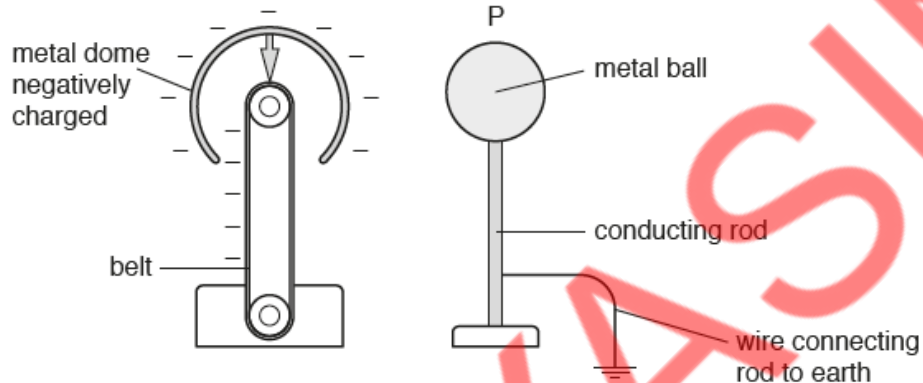
**Q-58:** One method of painting a metal panel uses electrostatic charges. A paint spray produces paint droplets, all of which are given a positive charge. The metal panel is given a negative charge, as shown in Fig.



- a) State the effect that charges have on each other.
- like charges
  - unlike charges
- b) i) Explain why the droplets spread out as they leave the nozzle in Fig.
- Explain why it is important that the metal panel has a negative charge.

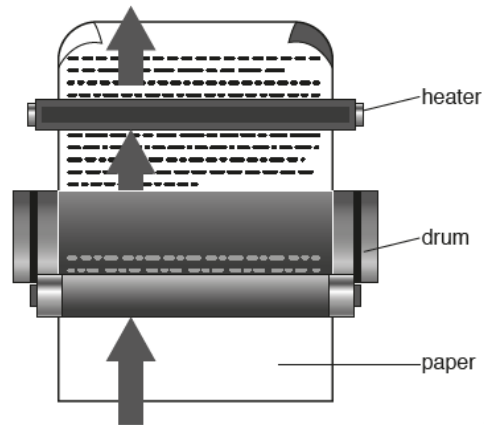
- c) State one advantage of using electrostatics in this way to paint the metal panel.

Q-59: a) Fig. 1 shows part of a machine used to investigate electrostatic charging



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.

- b) A photocopier works using electrostatic charging. It contains a drum whose surface conducts charge where it is exposed to light. Fig. 2 shows a piece of paper, the drum and the heater of a photocopier



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.



### Insulators/Conductors

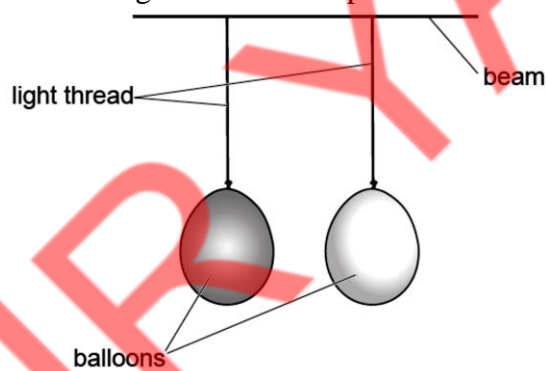
**Q-60:** Which row shows a conductor and an insulator?

|          | conductor | insulator |
|----------|-----------|-----------|
| <b>A</b> | aluminium | copper    |
| <b>B</b> | aluminium | glass     |
| <b>C</b> | plastic   | copper    |
| <b>D</b> | plastic   | glass     |

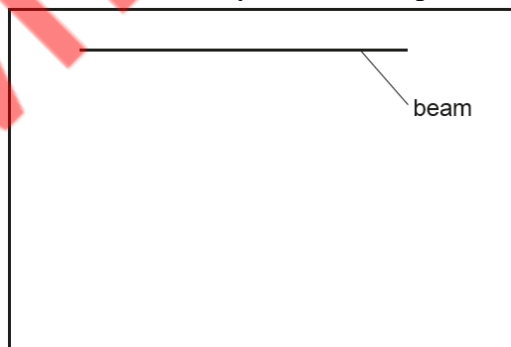
**Q-61:** Which of the following statement about an electrical insulator is correct?

- A** It contains some electrons but more protons.
- B** It contains some protons but more electrons.
- C** It contains electrons but they are not free to move.
- D** It contains no electrons at all.

Q-62: a) Fig. 1 shows two uncharged balloons suspended from a beam by light thread.



The balloons are close to each other but not touching. In the box below, draw the position of the balloons when they both have a positive charge.



b) Table includes a list of materials.  
State whether each material is an electrical conductor or an electrical insulator.  
The first example is done for you.

| material | conductor or insulator |
|----------|------------------------|
| copper   | conductor              |
| rubber   |                        |
| wood     |                        |
| iron     |                        |
| gold     |                        |

- c) An uncharged cloth rubs an uncharged plastic rod. The cloth becomes positively charged and the plastic rod becomes negatively charged. Explain how the cloth becomes positively charged.

### Answers

Q-1: C      Q-2: D      Q-3: C      Q-4: B      Q-5: A      Q-6: B

Q-7: rods repel OR move apart / away  
like / same (type of) charges on both rods

Q-8: a) (charge on Q is) negative  
(charge on R is) positive  
b) (ball) Q is repelled (by negative charge on P)  
has same charge (as on P)

Q-9: a) i) second box (The balloon loses electrons) ticked  
ii) positive (charge)  
like charge(s) repel  
b) circle around copper AND silver

Q-10: a) i) (moves) towards negative rod / to right  
opposite / unlike charges attract  
ii) (wood / it) or cubes( / float) rotates / turns / spins  
2 forces cause moment / couple / torque / turning effect  
b) conductors: free / delocalised electrons OR electrons move  
insulators: no free / delocalised electrons OR electrons / charges cannot move  
OR electrons fixed in place  
c) at least 4 approx. evenly spaced straight lines with correct arrows radially outwards



- repelled (by negative charge on rod)  
(sphere) becomes positive
2. flow of electrons / negative charge and (in direction) earth to sphere
- Q-39: a) electrons mentioned  
negative charges / electrons move from cloth or move to rod
- b) i) electrons / negative charge(s) repelled to earth or ball charged by induction ball positively charged  
opposite charges attract
- ii) negatively charged (by rod) or ball discharges / becomes neutral  
repelled by rod or pulled down by gravity / its weight
- Q-40: a) four or more radial arrows / lines outside surface  
at least one arrow pointing towards (centre of) sphere and none wrong
- b) i) positive charges on left and negative charges on right of S  
equal numbers
- ii) it moves towards / attracted towards the negatively charged sphere / to the left
- iii) electrons / negative charges move (along the wire) towards Earth / towards ground / down the wire S becomes positively charged
- c) electrons mentioned free (to move) / delocalised / mobile in metals / S or fixed in position in plastic / stand
- Q-41: a) charges / electrons are not free to move (in an insulator)  
any sensible example e.g. plastic / nylon / glass / rubber
- b) i) negative charge on left of K and positive charge on right of L  
equal numbers of charges and number  $\leq 5$  and no charges on right of K and no charges on left of L
- ii) 1. (negative) charge spreads throughout (surface of) sphere  
2. (positive) charge on L disappears or L becomes neutral or equal number of positive and negative charges
- Q-42: B      Q-43: C      Q-44: B      Q-45: A      Q-46: A      Q-47: D      Q-48: B
- Q-49: B
- Q-51: a) i) region in which an electric charge experiences a force  
ii) direction of force on a positive charge
- b) any four from:
- ball moves towards positive plate
  - ball touches positive plate
  - made of conducting material so becomes positively charged
  - repelled from positive plate
  - touches negative plate and loses charge
  - negatively charged ball attracted back to positive plate and process repeats
- Q-52: a) three lines from one sphere to the other and some lines should spread out as they leave one sphere and come together nearing the other correct direction on at least one line and none wrong

- b)  $(I =) Q/t$  in any form numerical or algebraic  $2.4 \times 10^{-3} \text{ A}$
- Q-53: A      Q-54: C      Q-55: B
- Q-56: a) electrons (move) to the fuel or from the pipe or pipe becomes positively charged (not moving protons/+ve charges)
- b) spark (jumps from the plane) ignite the fuel/explosion/blast or current from ground shock (to worker/passenger)
- c) i) (metal an electrical) conductor or has low resistance or allows/lets charges/ electrons to flow through it (this is general: about the conduction property of metals)
- ii) charge/electrons flow along the cable or (plane/charges) earthed (this is specific: about the conduction in this case)
- Q-57: a) Electron
- b) i) Charge can spark the fire
- ii) Give Earth connection to both can and pipe
- Q-58: a) i) Repel      ii) Attract
- b) i) All the droplets will have positive charge due to repulsion
- ii) Positive charged droplets are attracted towards the negatively charged plate
- c) paint is spread evenly on the plate and loss of paint is minimum
- Q-59: a) negative charge / electrons / experience repulsive force (from dome)
- negative charge / electrons are earthed / move to earth
- b) D at start or E at end
- D C B E
- Q-60: B      Q-61: C
- Q-62: a) showing repulsion
- b) insulators: rubber AND wood
- conductors: iron AND gold
- c) electrons / negative charges
- move / transfer
- from cloth to rod