2026 Sec 4 Physics Notes Answers
Chapter 13 Static Electricity

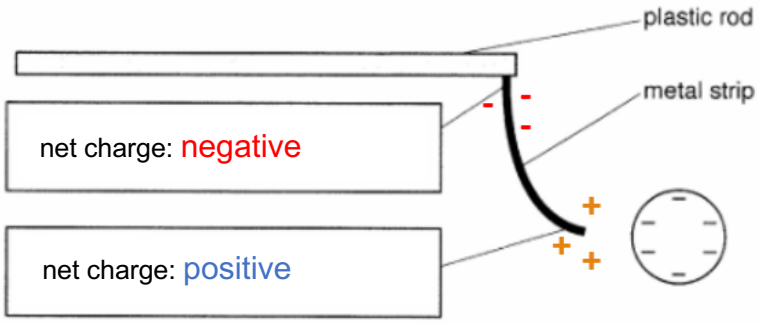
Example 1

(a) **A** (+8 μC) **B** (+4 μC) **C** (+6 μC)

(b) **A** (+4 μC each) **B** (+2 μC each) **C** (+3 μC each)

Example 2

(a)



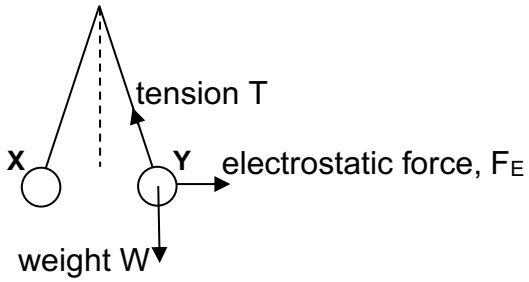
(b) The unlike charges are nearer than the like charges.

Example 3

a. The spheres carry charge of the same type, since they repel each other.
b. Draw and label the forces acting on Y.

c. Each sphere experiences 3 forces: tension T, weight W and electrostatic force F_E. These forces are shown on Y.

Since the same set of forces act on each sphere, the threads make equal angles from the vertical.

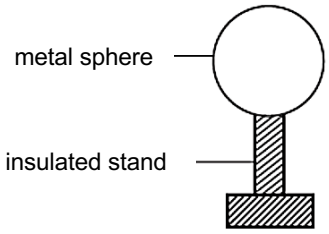
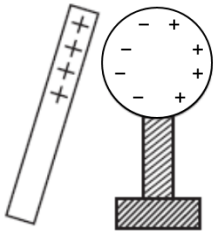
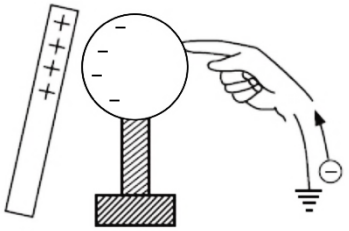
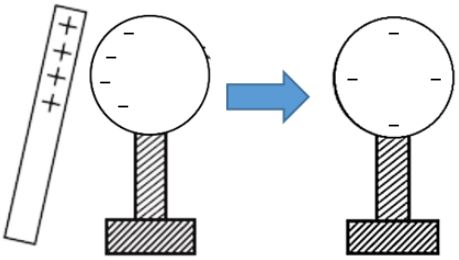


d. No, the two spheres exert equal and opposite forces on each other (by Newton's third law of motion).

Example 4

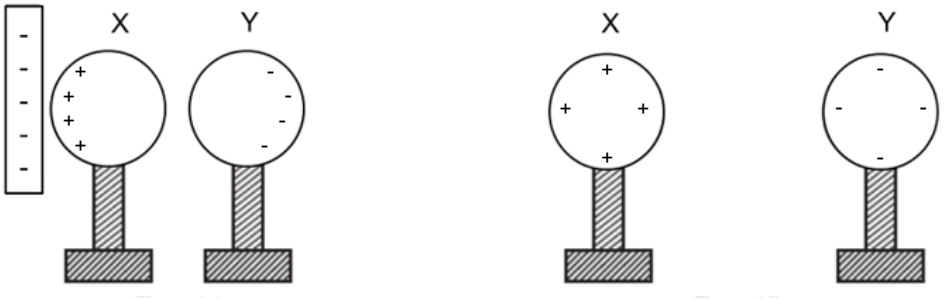
a. Yes. A neutral body has the same quantity of negative and positive charge.
b. Yes. It is negatively charged.
c. Friction between the two materials pulls the electrons from the glass rod to silk cloth.
The glass rod ends up with excess positive charges as it has lost electrons and becomes positively charged.
Silk cloth ends up with excess of electrons as it has gained electrons and becomes negatively charged.

3.2.1 **Basic Steps in Charging by Induction**

	Steps	Explanation
1	The conductor to be charged (metal sphere) is placed on an insulating stand. 	To prevent electron flow between the charged metal sphere and the Earth
2	A positively charged rod is brought near the sphere. 	The positive charge of the charged rod will attract the electrons in the metal sphere. Electrons accumulate at the end nearer to the charged rod. The other end of the sphere has a shortage of electrons and is therefore positively charged.
3	The metal sphere's surface is now in contact with a finger **while the positively charged rod is still held in position** 	Earthing (with our hands or with a ground wire) allows **electrons** to flow up from Earth to neutralise the positive charge on the sphere, leaving the sphere negatively charged.
	 The **hand is moved away from the metal sphere first**, followed by the positively charged rod.	Without the positively charged rod to attract the electrons to the left side of the sphere, the electrons flow and redistribute throughout the sphere.

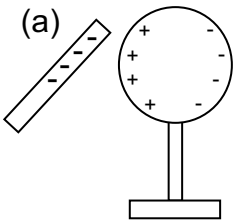
3.2.2 **Charging Two Conductors**

Draw the charges on spheres X and Y.



Example 5

(a)



(b) zero

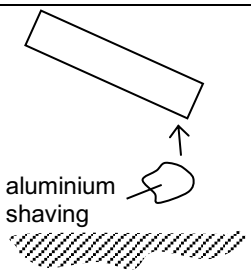
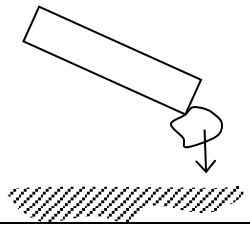
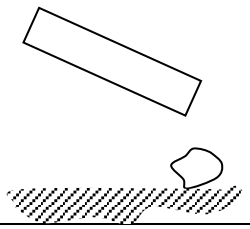
(c) Touching the sphere allows the <u>electrons to be repelled further away</u> into the person's body.

When the finger is removed, the sphere becomes <u>positively</u> charged as it has excess <u>positive</u> charges now.

Charge in the sphere = positive

Example 6

(a) Electrons move from sphere Z to the ground.
(b) positive

3.4	**Attraction of conductors to charged objects**	
		When the negatively charged rod is brought near to the aluminium shavings, electrons in the aluminium shaving are repelled to its far end, leaving the positive charges to be closer to rod. Since the unlike charges are closer than the like charges, the force of attraction is stronger than the force of repulsion, resulting in a net force upwards. If the upward electrostatic force is greater than the weight of the aluminium shavings, the aluminium shaving is attracted to the rod.
		On contact, the aluminium shaving gains excess negative charges from the rod and becomes negatively charged. Since like charges repel, the aluminium shaving is repelled away from the rod.
		Once the aluminium shaving touches the ground, it is discharged through the ground and becomes neutral. The process then repeats itself.

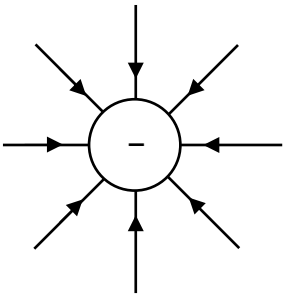
Example 7

a. Explain why the ball is attracted to S initially.
The negatively charged sphere S induces positive charges at the near end and negative charges at the far end of the metal ball (by repelling electrons to the far end). Since the force of attraction between unlike charges is stronger than the force of repulsion between like charges, the metal ball is attracted towards S.

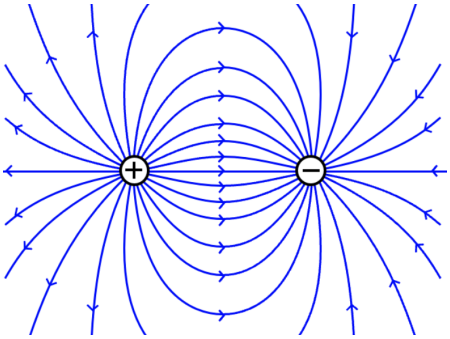
b. Explain why the ball is repelled away from S after touching S.
When the metal ball touches S, some electrons from S will flow into the ball to neutralise some positive charges in the ball. This causes the ball to be negatively charged due to excess negative charges. Since both objects are now of like charges, the ball will be repelled away from S

Example 8

(a) Radial Field

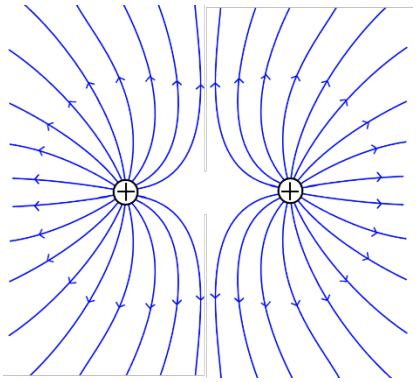


(b) Two unlike charges of the same magnitude



source: https://xmphysics.com/2023/01/08/12-6-1-field-lines/

(c) Two positive charges of the same magnitude:



source: https://xmphysics.com/2023/01/08/12-6-1-field-lines/

Example 9 **(** B)

Example 10

When the paper passes through the nylon friction pads, it is being charged (negatively). The glue droplets are charged oppositely to the paper (positively) when passed through the nozzle, hence the glue droplets are attracted to the paper. The droplets repel each other, spread out and stick on the paper evenly.

Example 11

(a) This allows the discharge of any excess charges that has already built up on the tanker to prevent ignition of the flammable liquid due to sparking.

(b) Carbon (graphite) is an electrical conductor. It will allow excess charges to be continually discharged before the charges accumulate.