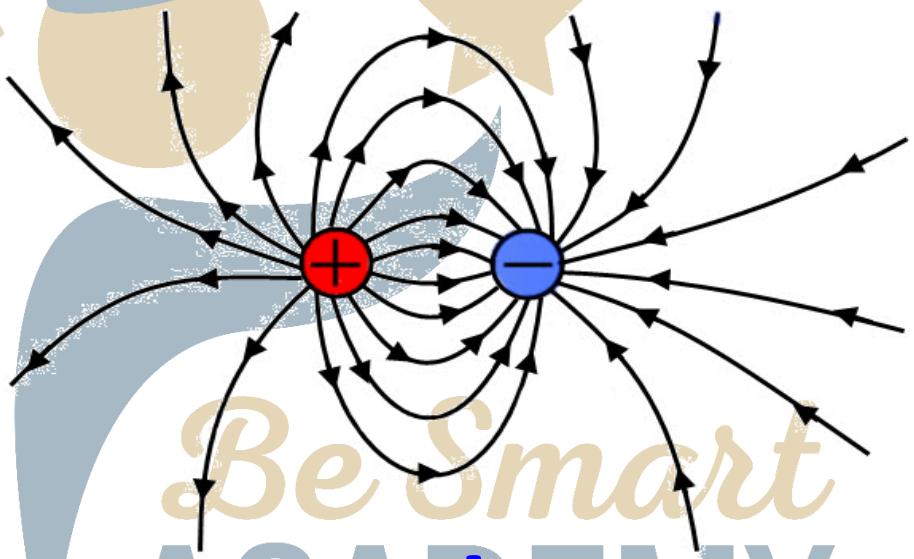
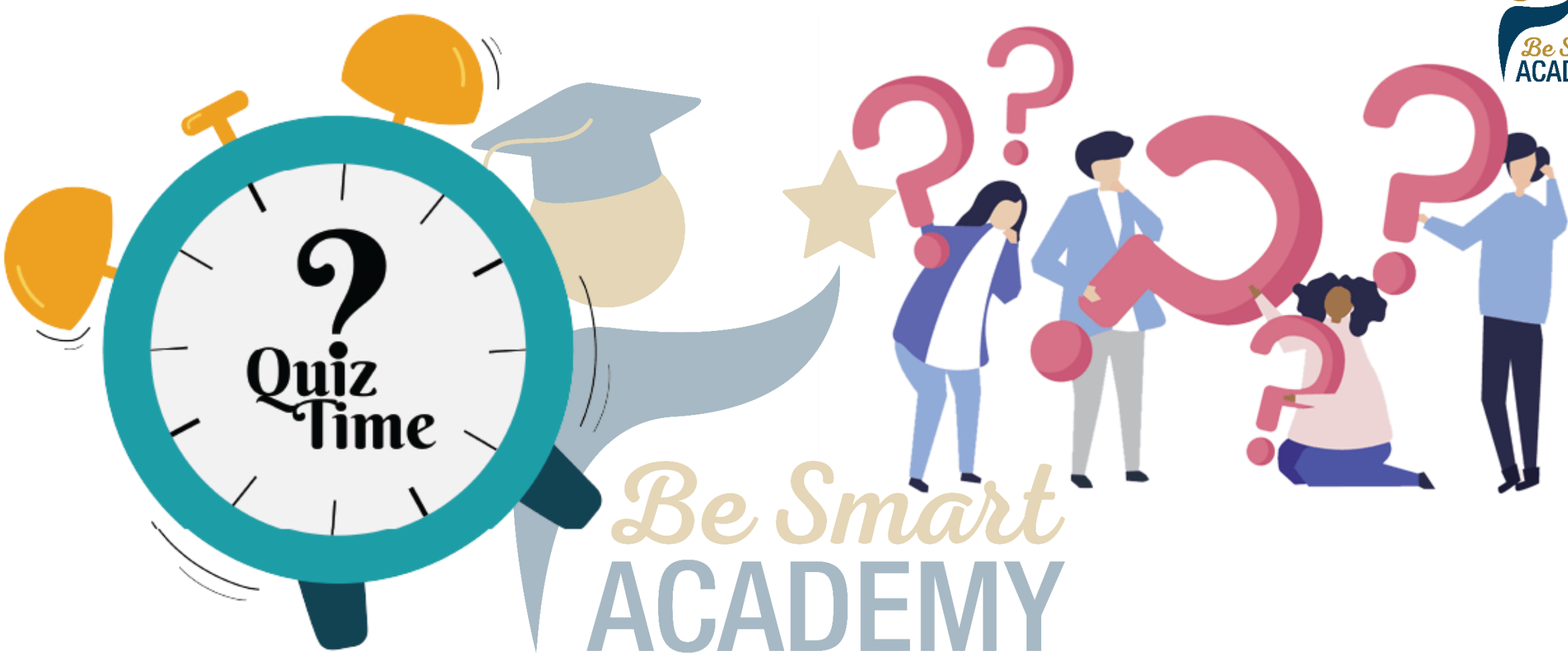
Physics – Grade 10
Unit 1: Electricity



Chapter 1: Electrostatic

Prepared and presented by: Mr. Mohamad Seif


Quiz Time
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Exercise 4 physics 20 min

Two groups of students performed two experiments using the following materials: Piece of fur, glass rod, plastic rod and electroscope.

First Experiment:

The first group of students rubs a neutral plastic rod with neutral piece of fur, 10^9 electrons transfer from the fur to the plastic rod. ($e = 1.6 \times 10^{-19} C$)

1.What do we mean by "A neutral plastic rod"?

2.Name the method of electrification used.

3.Give the charge of each after rubbing. Justify

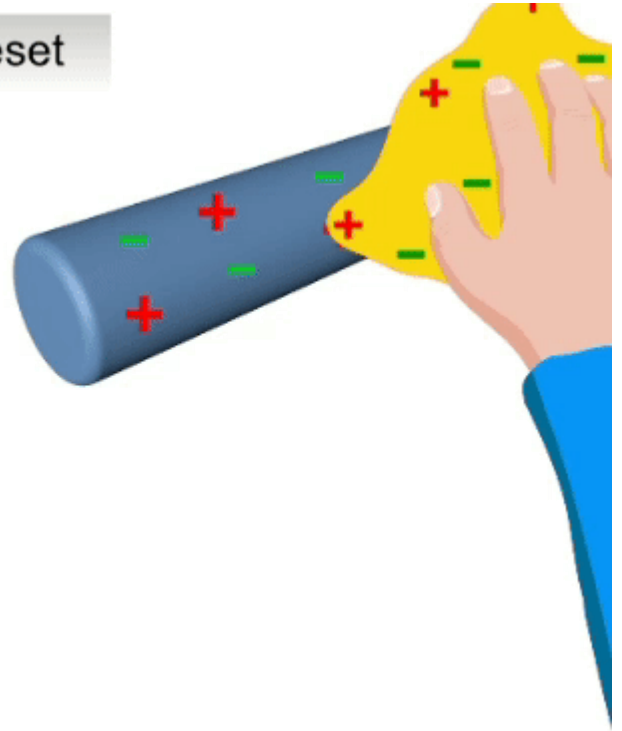
Exercise 4 physics 20 min

4. Determine the charge (q_1) carried by the plastic rod after rubbing.
5. By applying law of conservation of the electric charges, determine the charge carried by the piece of fur after rubbing.

Exercise 4 physics 20 min

Rubbing a neutral plastic rod with neutral piece of fur, 10^9 electrons transfer from the fur to the plastic rod. ($e = 1.6 \times 10^{-19} C$).

1.What do we mean by "A neutral plastic rod"?



A neutral plastic rod: the number of negative charges is equal to the number of positive charges

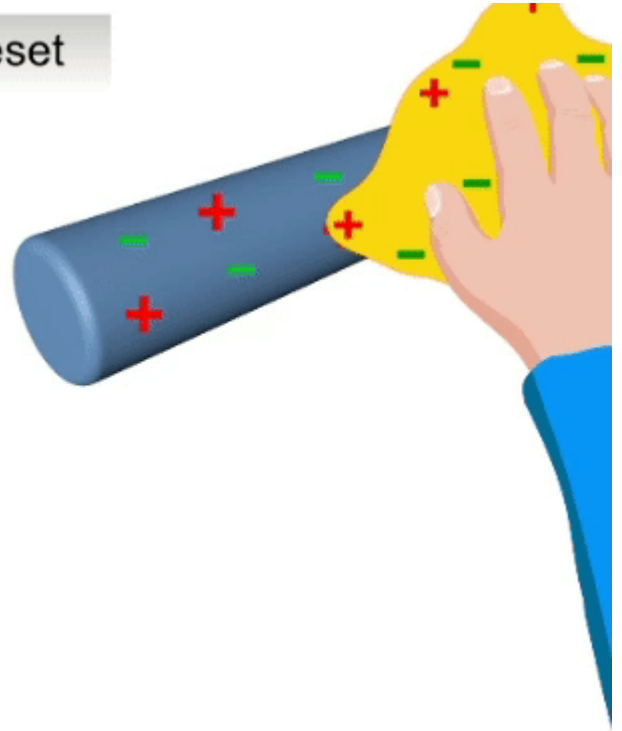
2. Name the method of electrification used

Electrification by friction

Exercise 4 physics 20 min

Rubbing a neutral plastic rod with neutral piece of fur, 10^9 electrons transfer from the fur to the plastic rod. ($e = 1.6 \times 10^{-19} C$).

3. Give the charge of each after rubbing. Justify



After rubbing; <u>electrons transfer</u> from fur to plastic rod.

The fur becomes <u>positively charged.</u>

The plastic rod has excess of electrons, so it becomes <u>negatively charged</u>.

Exercise 4 physics 20 min

Rubbing a neutral plastic rod with neutral piece of fur, 10^9 electrons transfer from the fur to the plastic rod. ($e = 1.6 \times 10^{-19} C$).

4. Determine the charge (q'_1) carried by the plastic rod after rubbing.

$$q'_1 = N \times e$$

$$q'_1 = 10^9 \times (-1.6 \times 10^{-19})$$

$$q'_1 = -1.6 \times 10^{-10} C$$

Exercise 4 physics 20 min

Rubbing a neutral plastic rod with neutral piece of fur, 10^9 electrons transfer from the fur to the plastic rod. ($e = 1.6 \times 10^{-19} C$).

5. **By applying the law of conservation of the electric charges, determine the charge q'_2 carried by the piece of fur after rubbing.**

$$q_1 + q_2 = q'_1 + q'_2$$

But before rubbing, the plastic rod and the fur piece are neutral then $q_1 = q_2 = 0$

$$0 + 0 = -1.6 \times 10^{-10} + q'_2$$

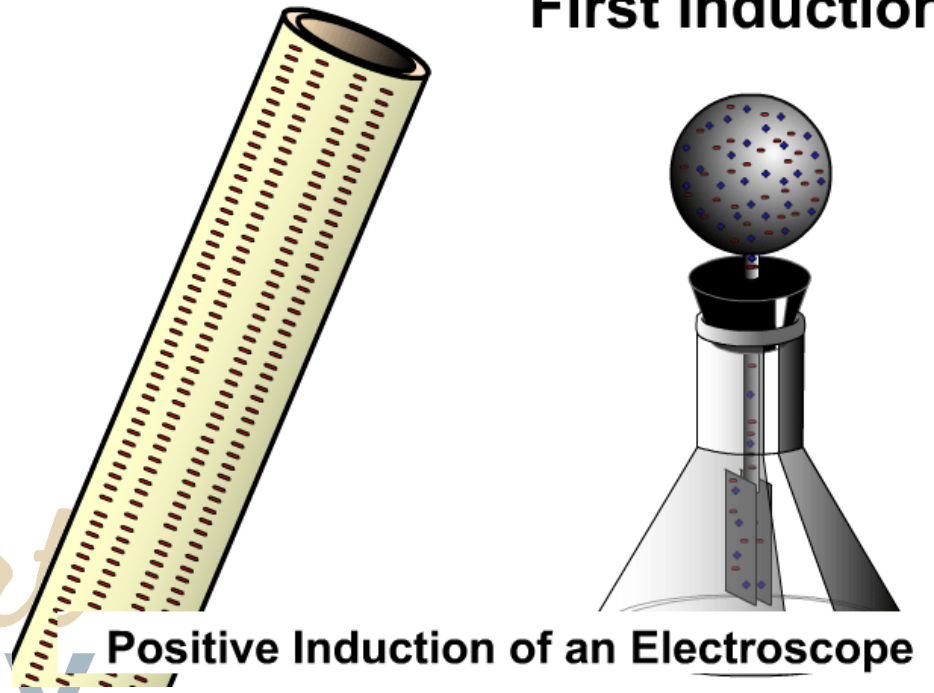
$$q'_2 = +1.6 \times 10^{-10} C$$

Exercise 4 physics 20 min

Second Experiment:

The students put the negatively charged plastic rod in touch with the knob of the neutral electroscope. The leaves become divergent.

1.Name the method of electrification followed in this experiment.



2.Explain why the leaves diverge.

3.If the rod is moved away, what will happen to the leaves?

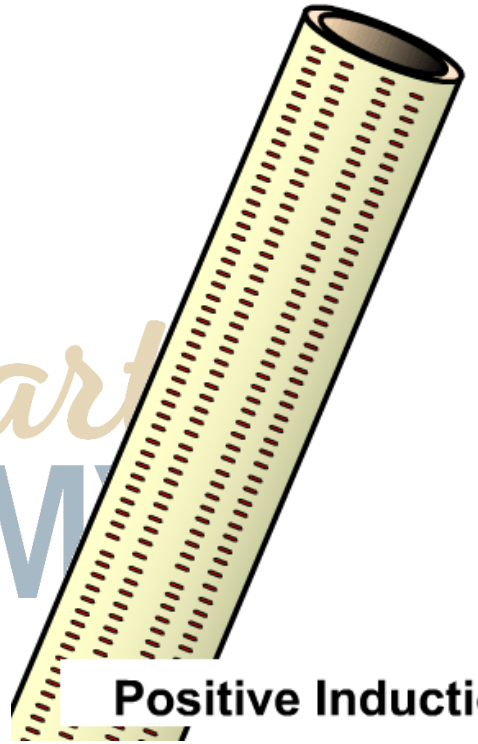
Exercise 4 physics 20 min

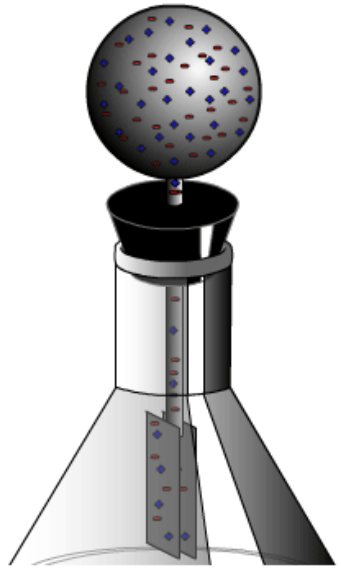
4. One student touches the knob of the above charged electroscope.
   a. Name this process.
   b. What will happen to the leaves? Justify.

Exercise 4 physics 20 min

1. Name the method of electrification followed in this experiment.

Electrification by contact.





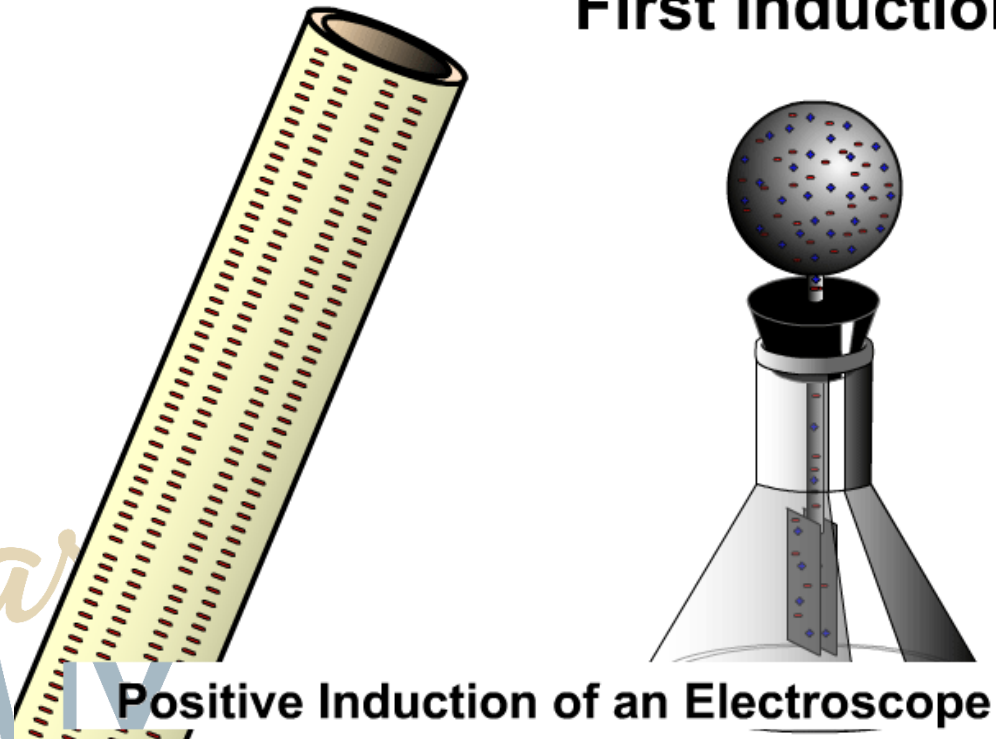
First Induction

Positive Induction of an Electroscope

2. Explain why the leaves diverge.

When the negatively charged rod touches the neutral knob:
some negative charges transfer from the rod to the knob.
The negative charges move from the knob to the leaves.
The leaves become of same charge then diverge.

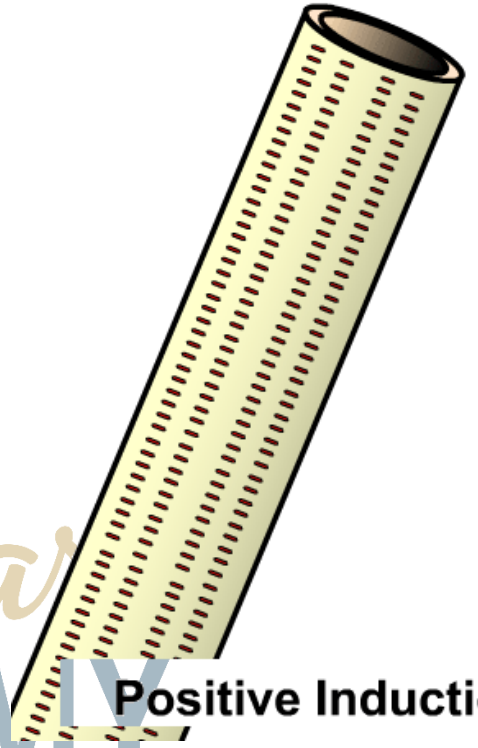
First Induction



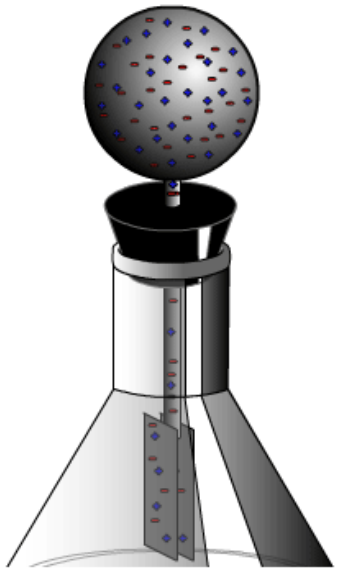
Positive Induction of an Electroscope

3. If the rod is moved away, what will happen to the leaves?

After moving the rod, the leaves still diverge, because they are negatively charged.



First Induction



Positive Induction of an Electroscope

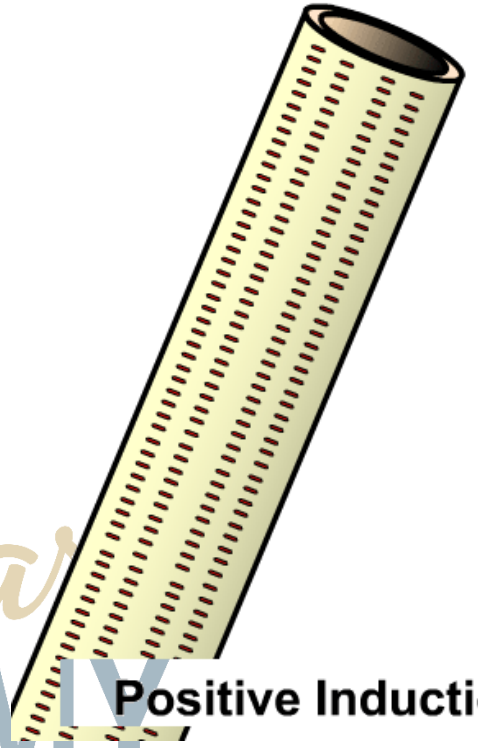
Exercise 4 physics 20 min

4. One student touches the knob of the above charged electroscope.

a. Name this process.

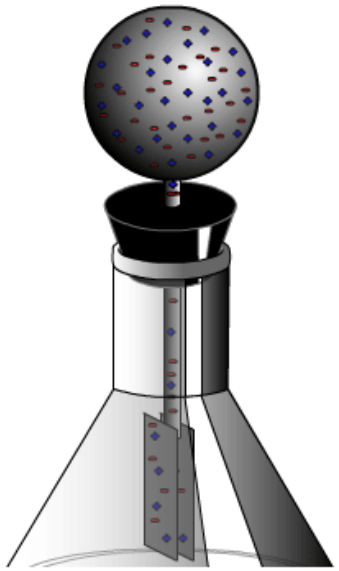
When the student touches the knob it is called grounding

b. What will happen to the leaves? Justify.



Positive Induction of an Electroscope

First Induction



Grounding makes the electroscope neutral then the leaves collapse.

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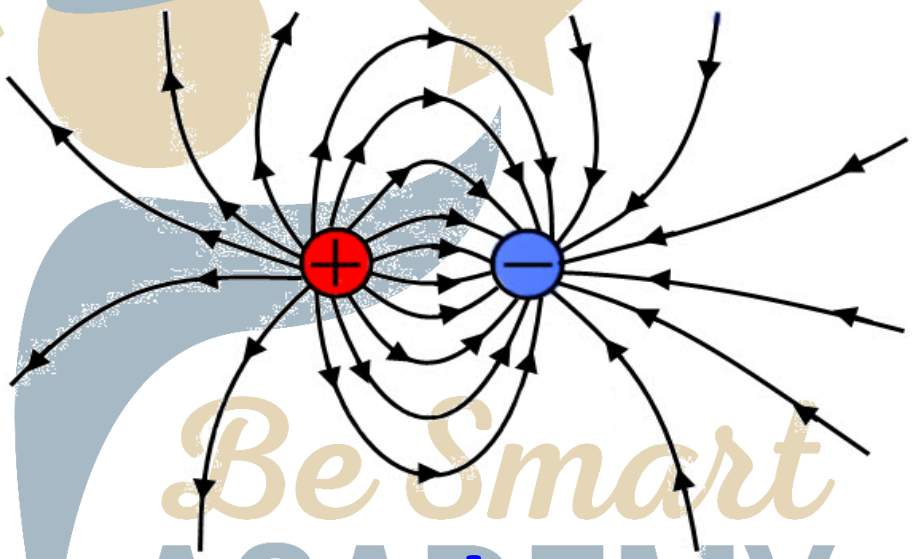

Chapter 1: Electrostatic

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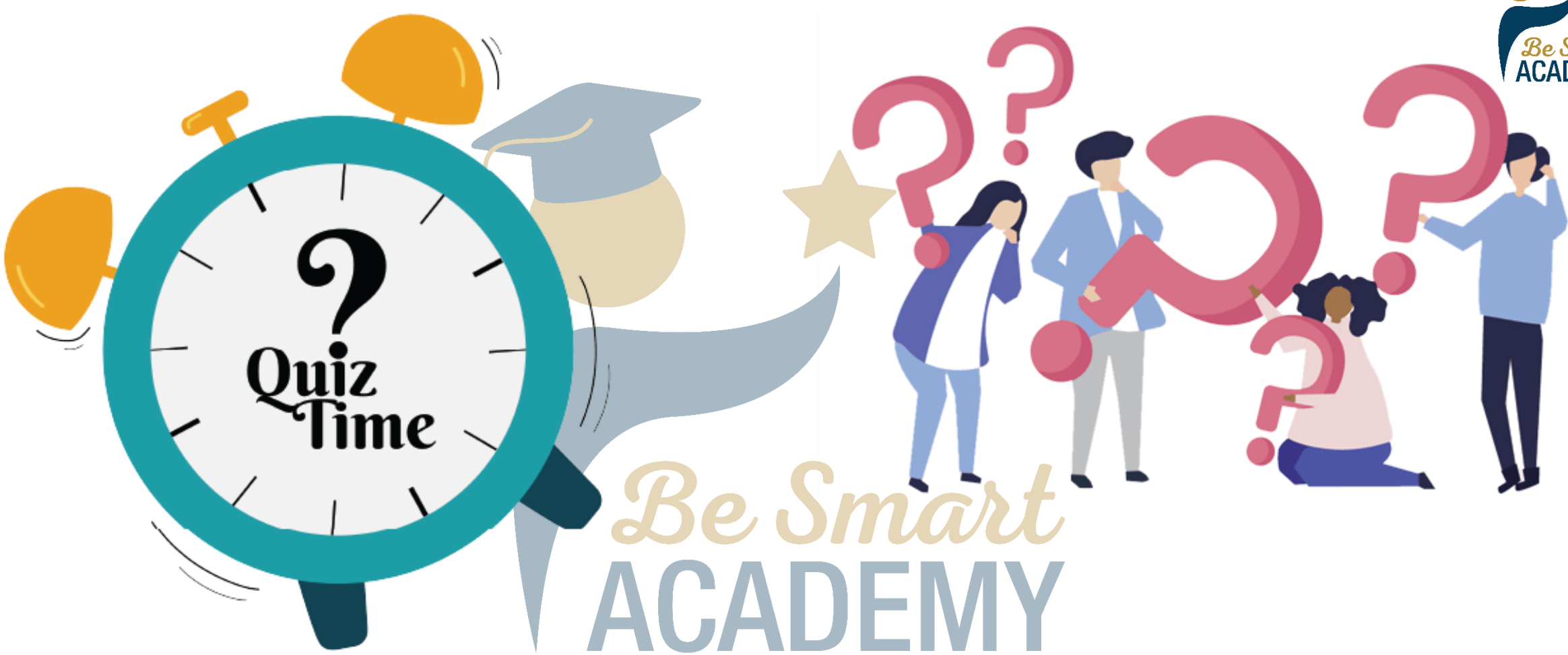
Quiz Time
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Exercise 5: Quiz 15 min

Two identical point charges (A) and (B) of carries the charges $q_A = 5 \times 10^{-5} C$, $q_B = -7 \times 10^{-5} C$ respectively are placed on an isolated support.

Given: $K = 9 \times 10^{9} SI$; $e = 1.6 \times 10^{-19} C$.

The force of attraction between (A) and (B) is $F = 31.5 N$ when the distance between them is d.

1. Determine which point charge has deficit of electrons, then calculate the number of electrons.
2. Calculate the distance (d) separating (A) and (B)

Exercise 5: Quiz 15 min

3. Calculate the new force exerted by (A) on (B) if the distance separating them is doubled.
4. The charges (A) and (B) are left to touch each other then they are found to repel each other.
   a. Explain the observed phenomena.
   b. Calculate the new charge of (A) and (B).

Exercise 5: Quiz 15 min

$q_A = 5 \times 10^{-5} C;\ q_B = -7 \times 10^{-5} C; K = 9 \times 10^9 SI;\ e = 1.6 \times 10^{-19} C; F = 31.5 N$

1. Determine which point charge has a deficit of electrons, then calculate the number of electrons

The point charge A has deficit of electrons because its charge is $q_A = 5 \times 10^{-5} C > 0$

$$|q_A| = N \times |e| \Rightarrow N = \frac{|q_A|}{|e|} = \frac{5 \times 10^{-5}}{1.6 \times 10^{-19}}$$

$$\Rightarrow N = 3.125 \times 10^{14} \text{ electrons}$$

Exercise 5: Quiz 15 min

$q_A = 5 \times 10^{-5} C;\ q_B = -7 \times 10^{-5} C; K = 9 \times 10^9 SI;\ e = 1.6 \times 10^{-19} C;\ F = 31.5 N$

2. Calculate the distance (d) separating (A) and (B)

$$F = \frac{K.|q_A|.|q_B|}{d^2} \Rightarrow \frac{F}{1} = \frac{K.|q_A|.|q_B|}{d^2}$$

$$\frac{d^2}{1} = \frac{K.|q_A|.|q_B|}{F} \Rightarrow d^2 = \frac{9 \times 10^9 . |5 \times 10^{-5}| . |-7 \times 10^{-5}|}{31.5}$$

$$d^2 = 1 \Rightarrow d = 1m$$

Exercise 5: Quiz 15 min

3. Calculate the new force exerted by (A) on (B) if the distance separating them is doubled.

$$F = \frac{K.|q_A|.|q_B|}{d^2} \qquad \text{But } d' = 2d \qquad F' = \frac{K.|q_A|.|q_B|}{(d')^2}$$

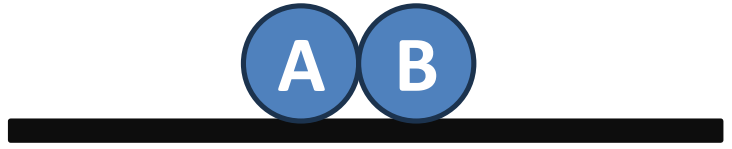
$$F' = \frac{K.|q_A|.|q_B|}{(2d)^2} \Rightarrow F' = \frac{K.|q_A|.|q_B|}{4d^2} \Rightarrow F' = \frac{F}{4}$$

$$F' = \frac{31.5}{4} \Rightarrow F' = 7.875\,N$$

Exercise 5: Quiz 15 min

4. The charges (A) and (B) are left to touch each other, then they are found to repel each other.

   a. Explain the observed phenomena.



When (A) touches (B); electrons transfer from (B) to (A), since (B) has excess of electrons.

Then the point charge (A), after gaining electrons becomes negatively charged.

Then (A) and (B) repel each other, since both are negatively charged.

Exercise 5: Quiz 15 min

b. Calculate the new charges of (A) and (B).

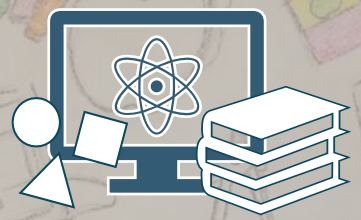
Using law of conservation of charges: $q_A + q_B = q'_A + q'_B$

Since the two-point charges are identical then: $q'_A = q'_B$

$$q_A + q_B = q'_A + q'_A \Rightarrow q_A + q_B = 2q'_A \Rightarrow q'_A = \frac{q_A + q_B}{2}$$

$$q'_A = \frac{5 \times 10^{-5} - 7 \times 10^{-5}}{2} \Rightarrow q'_A = q'_B = -1 \times 10^{-5} C$$

The End



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