

Electrostatic

"The branch of Physics in which we study about charges which are at rest position is called 'electrostatic'"

Electric charge:

Electric charge is a characteristic of material

↓
without material
There is no electric charge.

↓
it is able to
apply force on
other object

OR

"it is The property of material due to which it exert a force"

Type of charge:

Same charge → Repel
different charge → Attract
charges → two types

Benjamin Franklin

- ① Positive charge (+)
- ② Negative charge (-)

charge object

Addition of charges follows the rules of mathematical addition. Therefore, They are given the name +ive, & -ive."

Cause of charge:-

- Material is made up of atom.
- An atom is the smallest unit of matter. Every atom is composed of a nucleus and one or more electrons bound to the nucleus. The nucleus is made of one or more protons and a number of neutrons.
- Protons have a positive electric charge.
- Electrons have a negative electric charge.
- If the number of +ive and -ive charges are equal, then the atom is electrically neutral.
- If an atom has more or fewer electrons than protons, then it has an overall negative or positive charge.

How object can be charged & loses electron

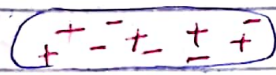
Glass
wool
Hair

Gain electron

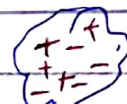
Silk
Plastic
wood
Paper

(1) Give charge on object by friction:-

Step 1:



Glass rod

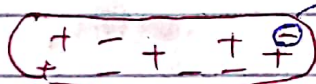


silk fabric

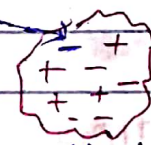
* They do not exert force on each other

both objects are neutral because they have same number of +ve & -ve charges

Step 2:



Glass rod



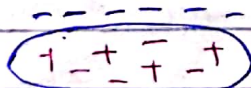
silk fabric

* Now they can exert force on each other.

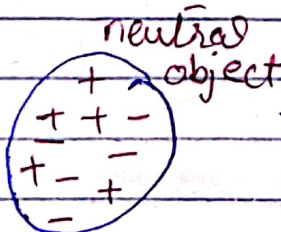
→ A glass rod becomes positively charged when rubbed with silk, while the silk becomes negatively charged.

(2) Give charge on object by Conduction.

(2) Example

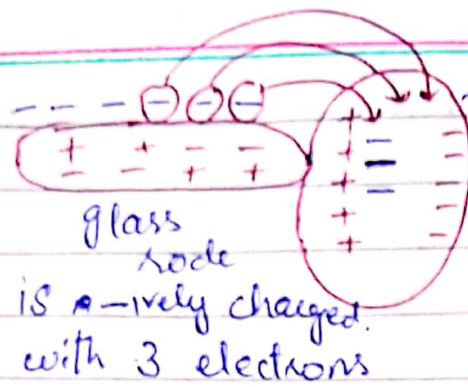


negatively (glass) charged rod with electrons.



neutral object

→ when we link / attach both objects then neutral object becomes negatively charged object.

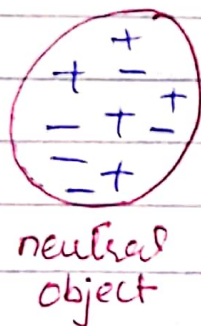


This object is also negatively charged with 3 electrons.

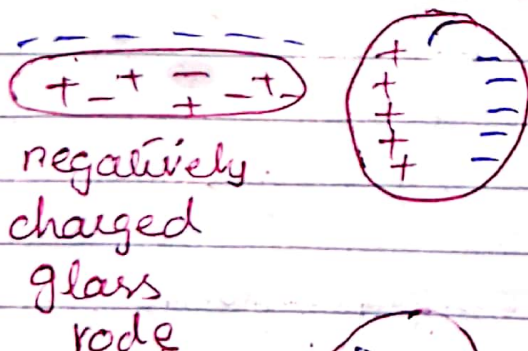
Q Explain the process how object can be positively charged by conduction?

3 by Induction.

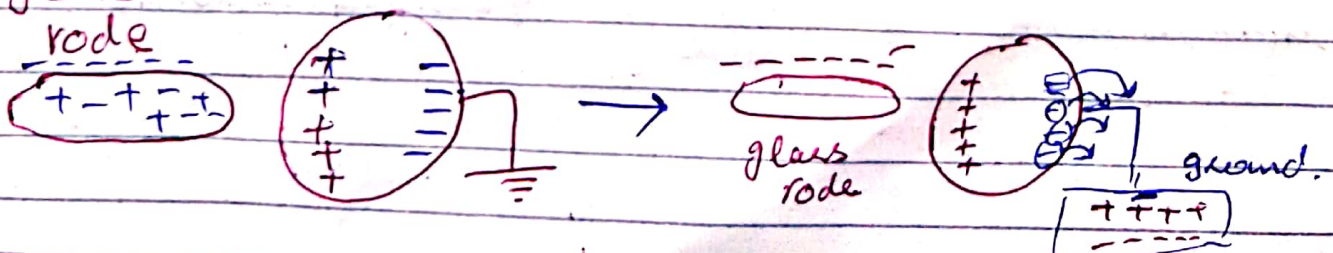
(a)



→ when we negatively charged object pla. near to the neutral object, it separates the charges in neutral object.



→ After separating them we ground the other side of the neutral object



→ As earth is a good conductor, +ive charges in the ground will attract the -ive charges. Only +ive charges are left in the object, and object will become +ively charged object.

Q Explain the process with diagrams, how object can be -ively charged by Induction.

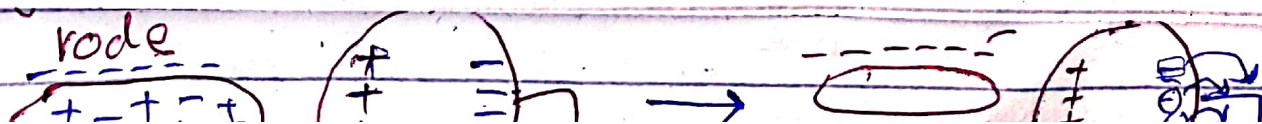
Practice Questions:-

Q: An object has an excess charge of $-1.92 \times 10^{-17} \text{ C}$. How many excess electrons does it have?

Q: I have 2 charged metal conducting spheres on insulating stands which are identical except for having different charge. Sphere A has charge of -5 nC and sphere B has a charge of -3 nC . I then bring the spheres together so that they touch each other. Afterwards, I move the two spheres apart so that they are no longer touched.

a) $\rightarrow$ what happens to the charge on the two spheres?

b) $\rightarrow$ what is the final charge on each sphere?



Properties of Electric Charge:

① Quantization of charge:-

“It states that charge on a object is an integral multiple of the elementary charge.”

$$Q = ne$$

↓
total charge on object

↗ elementary charge

where $n = 1, 2, 3, \dots$

$e = -1.6 \times 10^{-19}$

② Additivity of charge:

“It is stated that total charge on a object is calculated by simply adding algebraically all the charges present on that object.”

→ The net charge on object A can be calculated by simply adding them.

$$\begin{array}{r} +2q \\ +6q \\ -4q \end{array}$$

Object A

net charge $\Rightarrow +2q + 6q + (-4q) = 4q$

→ So object is positively charged with 4 times charges.

③ Conservation of charge:

“It is state that for an isolated system total charge is always constant”

OR

“Charge is neither be created, nor be destroyed,”