LAKSHYA JEE

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Electrostatics : Charges and their properties

-Er. Rohit Gupta

Electrostatics

Charge Rest

Study of charges at rest.

Charge is a property of matter.

Charge less matter

- Neutron ⟹ Quarks (HW) → up, down
- Neutrino
- Antineutrino

Properties of charges

① Charges are of two types
   (a) +ve
   (b) -ve

② Like charges repel & unlike charges attract.

③ Charges are additive

$$Q_{net} = Q_1 + Q_2 + \cdots + Q_n$$

(4) Charges are Quantized :- Charges are integral multiple of fundamental charge. ($e = 1.6 \times 10^{-19} C$)

$$Q = ne$$

n → integer

Ques - Which of the following charge is **not** possible?

(a) $1.6 \times 10^{-19} C$

(b) $1.6 \times 10^{-18} C$

(c) $1.6 \times 10^{-20} C$

(d) $4.5 \times 10^{-19} C$

$$n = \frac{Q}{e} = \frac{1.6 \times 10^{-19}}{1.6 \times 10^{-19}} = 1$$

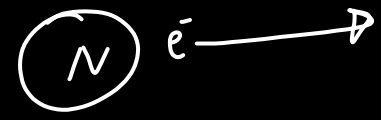
$$n = \frac{1.6 \times 10^{-18}}{1.6 \times 10^{-19}} = 10^{1} = 10$$

$$n = \frac{1.6 \times 10^{-20}}{1.6 \times 10^{-19}} = 10^{-1} = 0.1$$

$$n = \frac{4.5}{1.6} \times \frac{10^{-19}}{10^{-19}} = \frac{45}{16}$$

(5) Net Charge of an isolated system is conserved

β^- decay



$N \rightarrow P + e^- + \bar{\nu}$ (antineutrino: chargeless, fundamental.)

β^+ decay — Positron

$P \rightarrow N + e^+ + \nu$ (neutrino)

Antiparticles

Annihilation

Particle + Antiparticle $\Rightarrow$ energy (γ rad.)

(6) Charge is invariant of speed
or
Charge is non relativistic

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

m_0 → rest mass

Units of Charge

1 Coulomb = $3 * 10^9$ StatCoulomb

1 StatCoulomb = 1 ESU (Electrostatic unit)

1 Coulomb = 0.1 EMU (Electromagnetic unit)

1 emu = 10 C

1 C = 1 As

Methods of charging

- Charging by friction
- Charging by induction
- Charging by conduction

Charging by friction

When two objects are rubbed together, then one object extracts some electrons from the other leaving it with excess of electrons and other deficient. Due to this both are oppositely charged.

Hair comb and the hair are getting charged by friction

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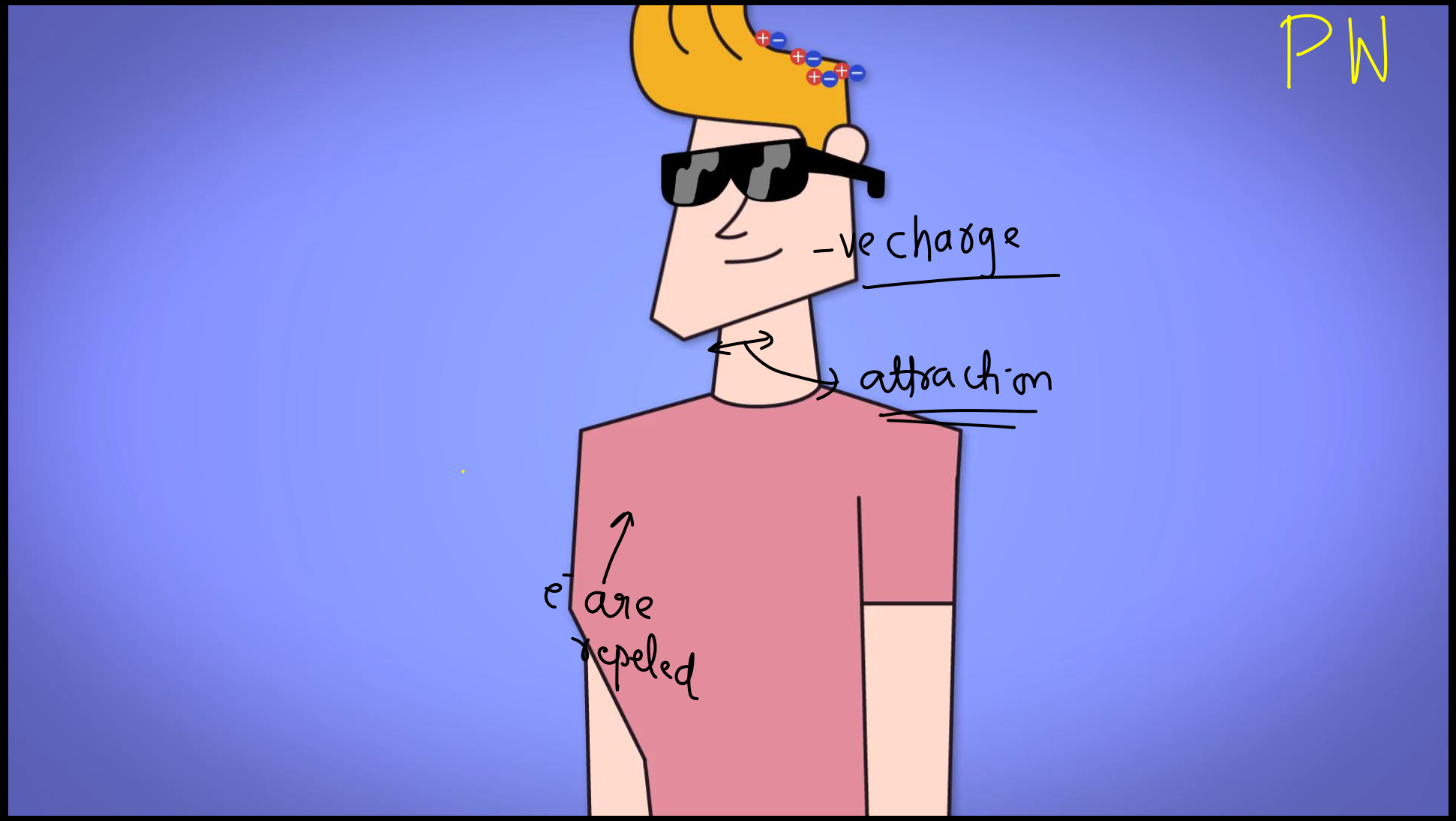
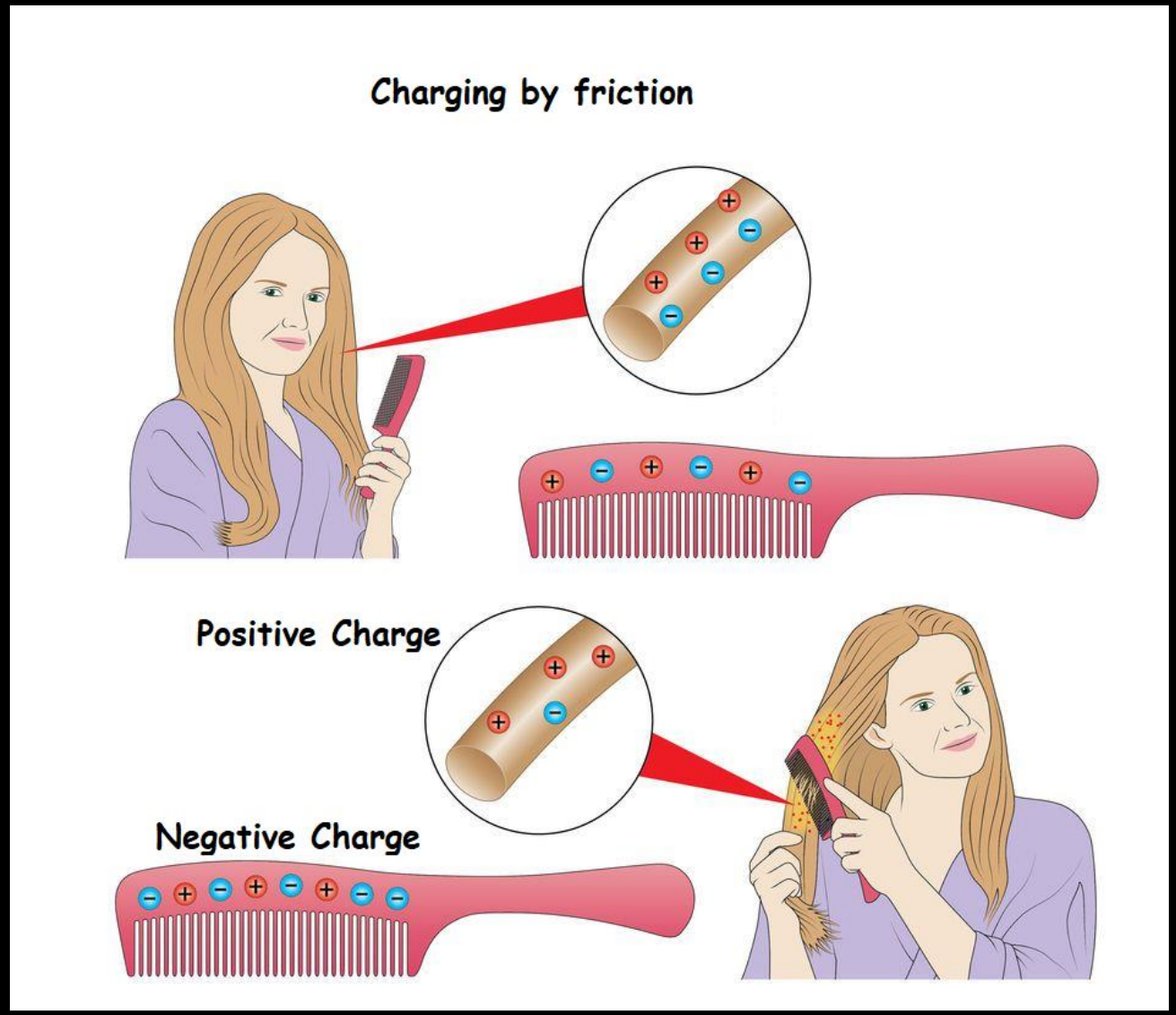


Hair comb and the hair are getting charged by friction



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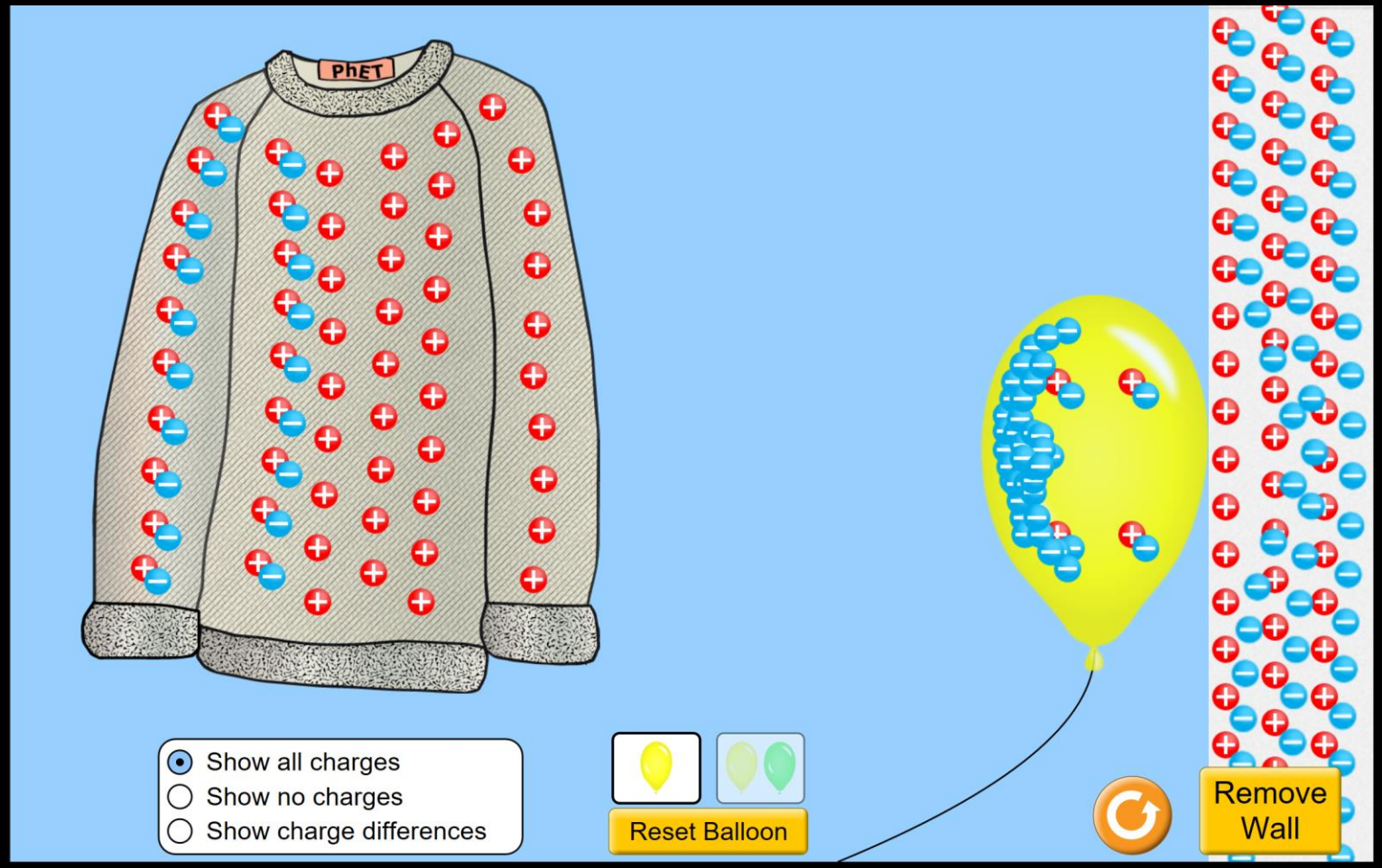


Balloons and Static Electricity

Induction

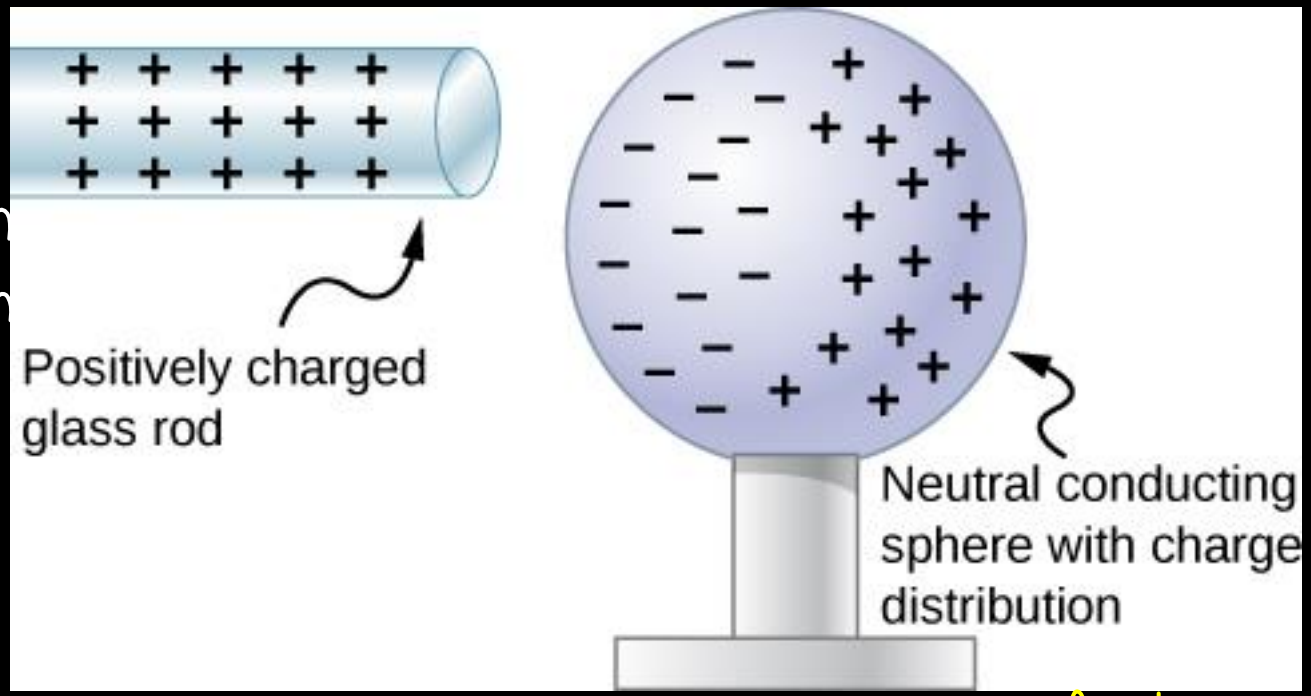
Redistribution of charges inside a conductor in the presence of external electric fields or charges is called induction.

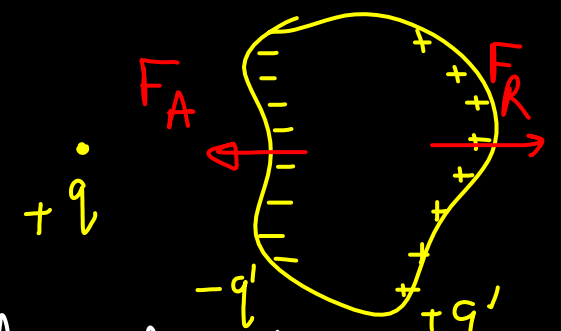
Q Can a charged object attract a neutral object?

Yes!

Q Can induction cause repulsion?

No?





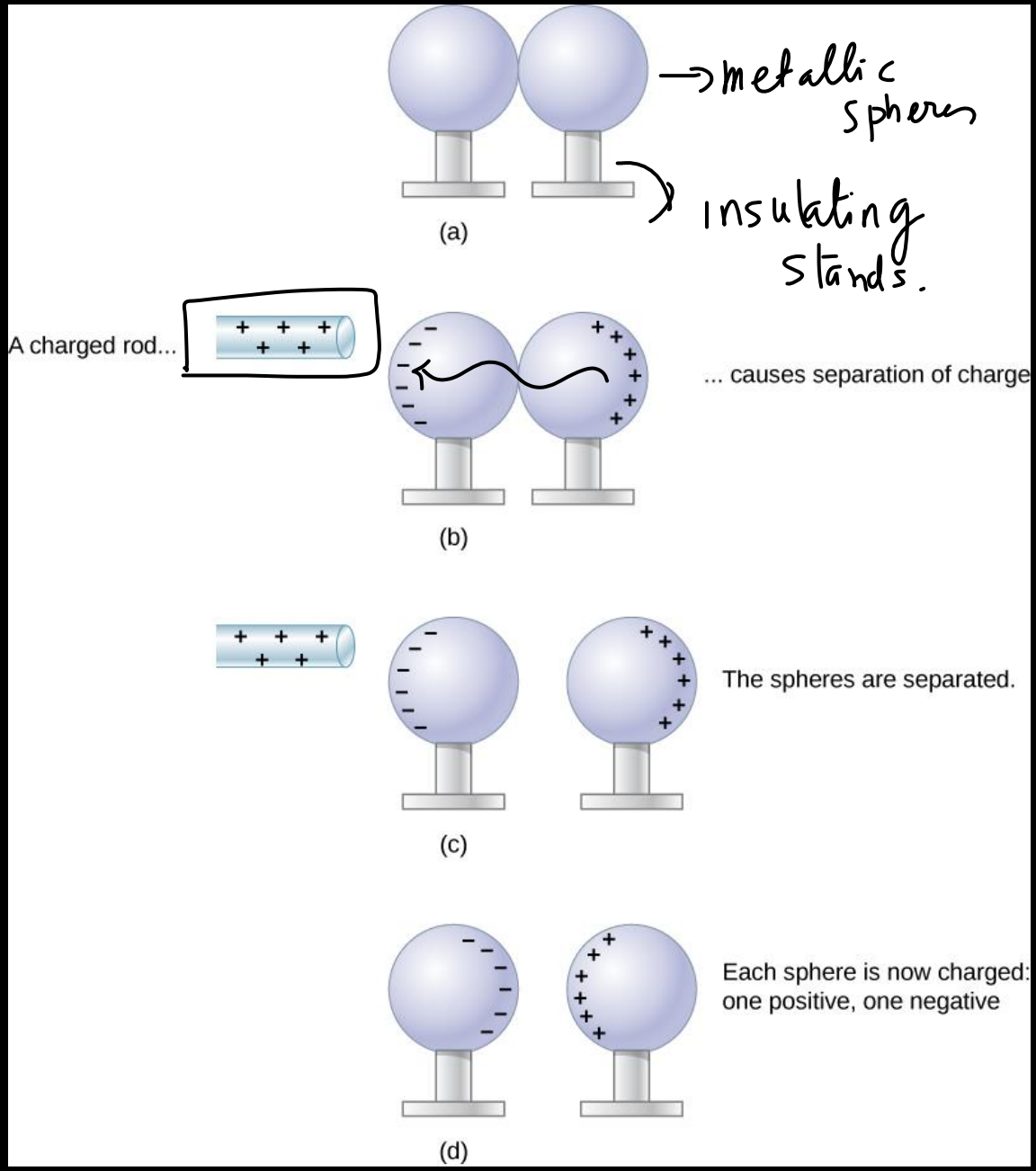
Attractive force will dominate.

Q Can we repel a neutral object?

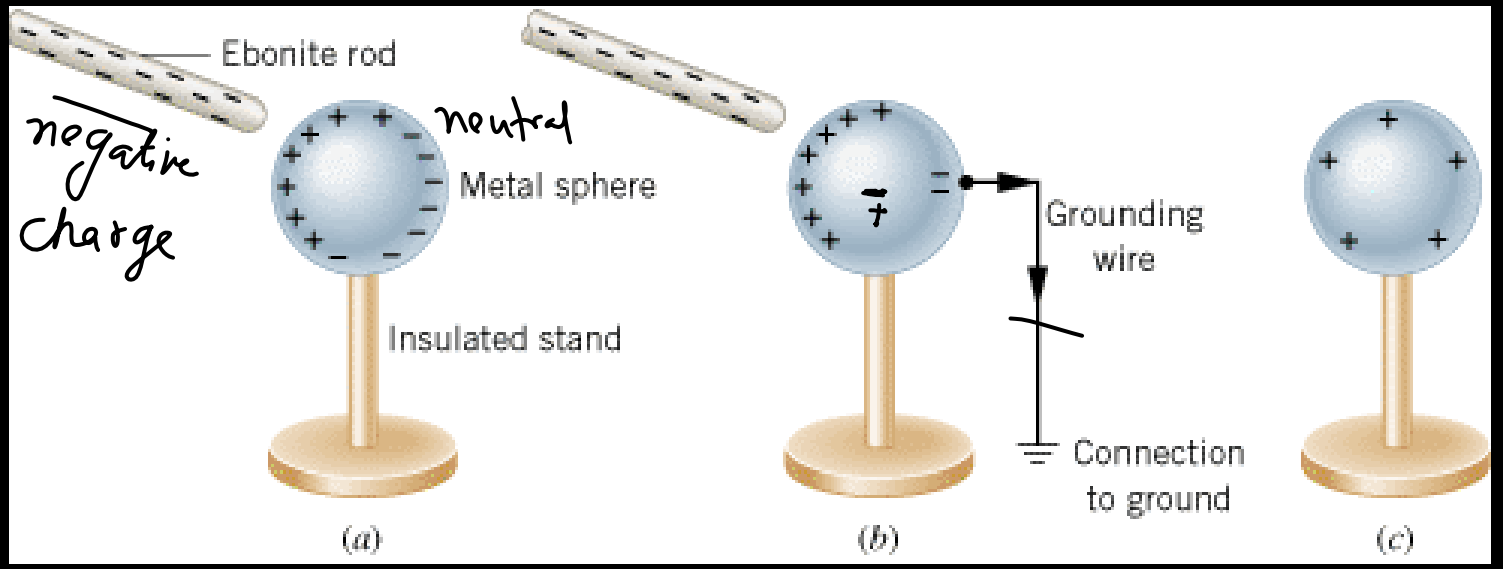
No!

Note:- Repulsion is the sure test of charge

Charging by Induction



Induction



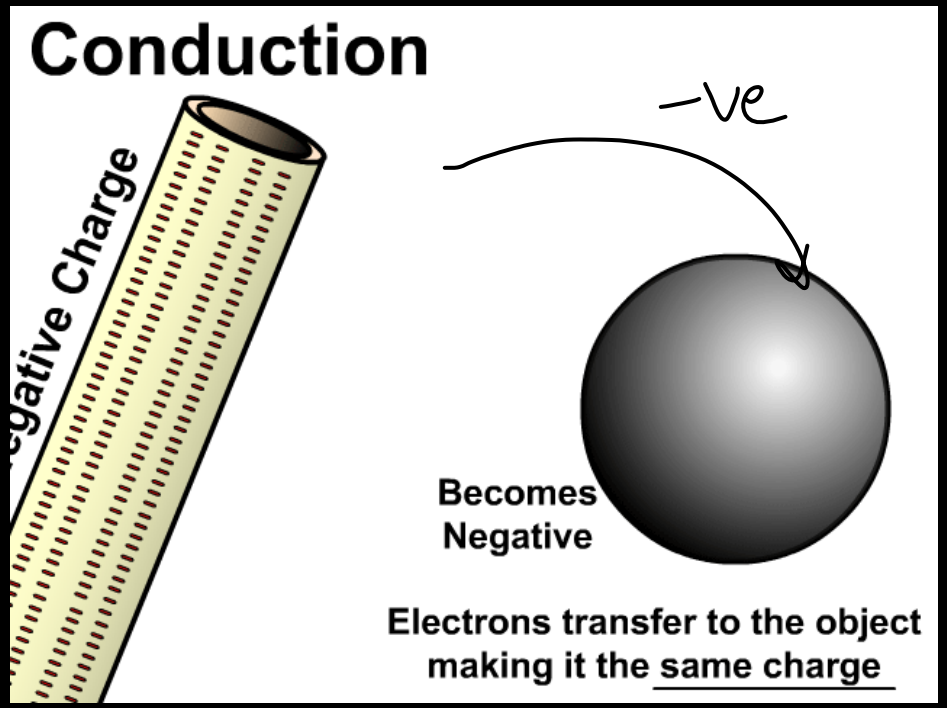
Earthing = Potential = 0

+ve charge creates +ve potential

-ve " " -ve " .

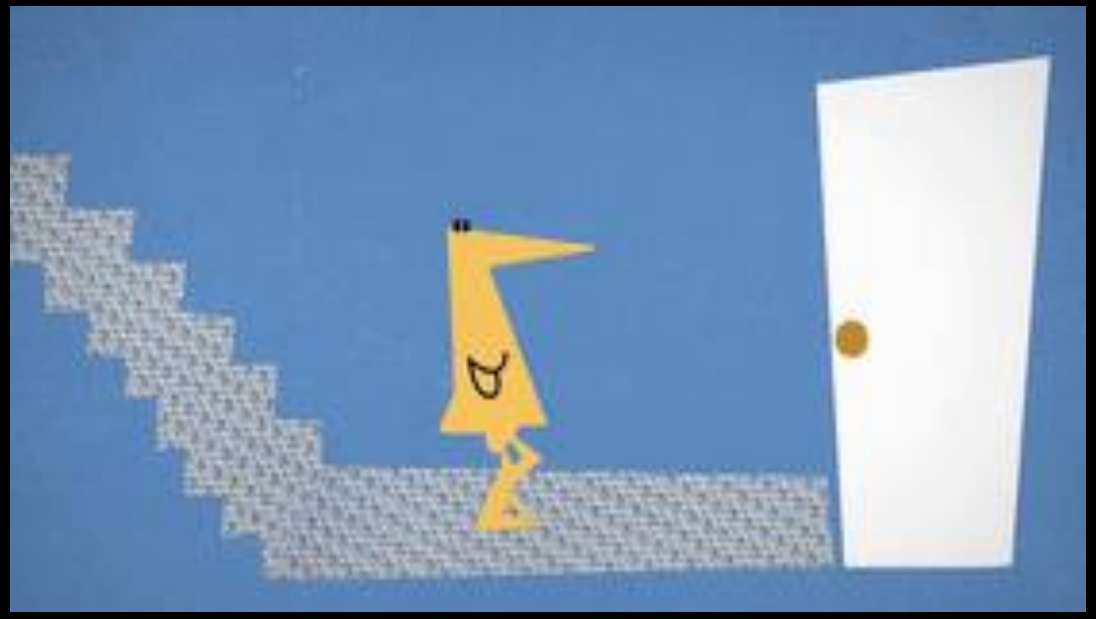
Charging by conduction

Charges travel from higher potential to lower until their potential becomes equal.



A Hair Standing Experiment

Shock laga laga, Shock laga!!



Discharging with conduction

Thank You Lakshyians