PRAYAS

JEE 2025

Lecture - 01

Physics

[redacted] Capacitor

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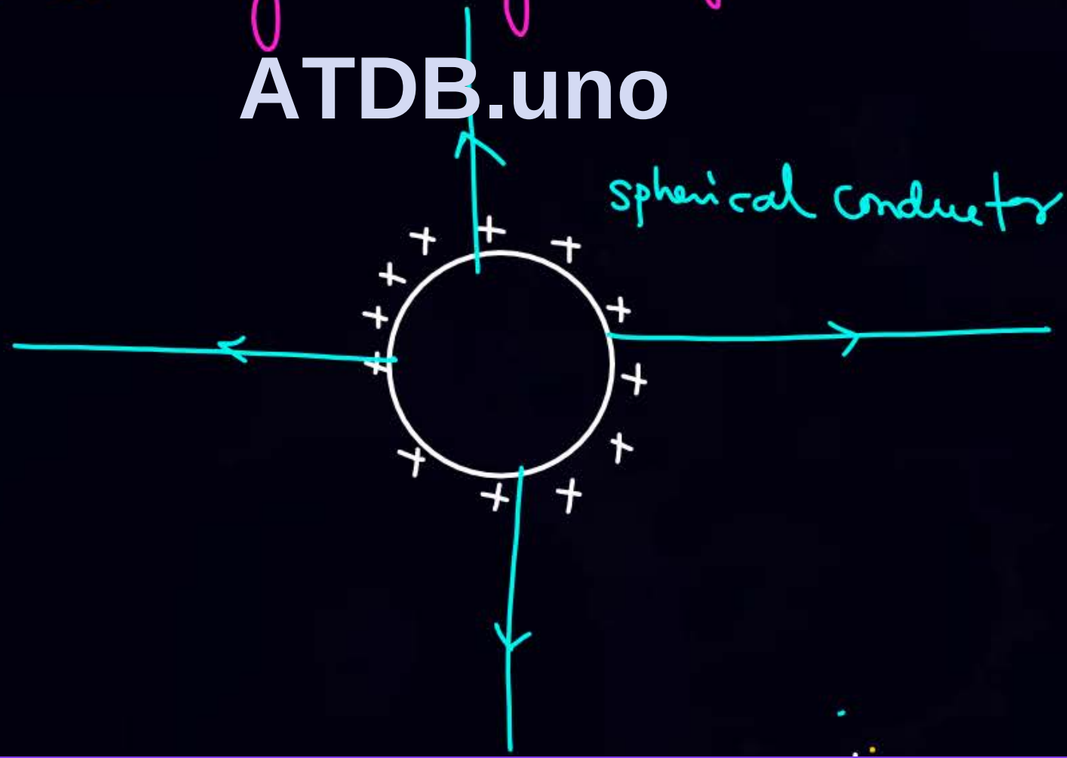
Topics *to be covered*

1. Capacitor
2. Law of Capacitance
3.
4.

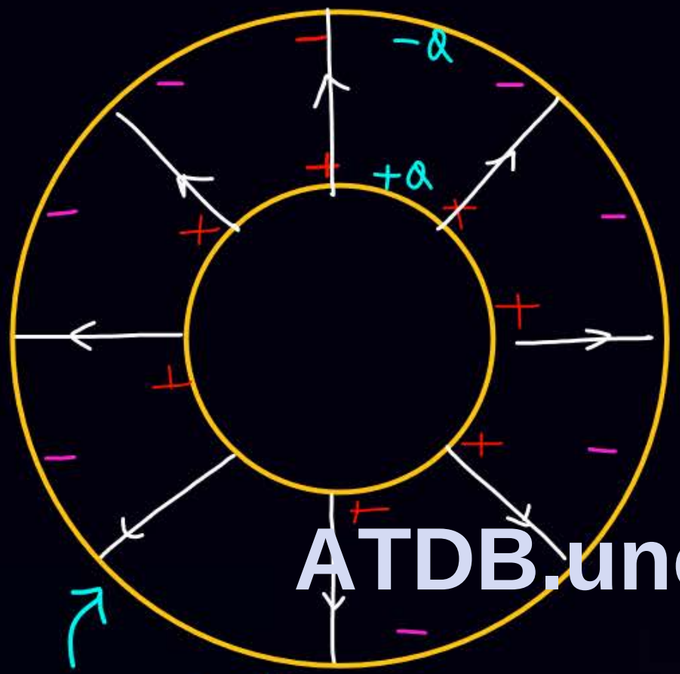
Capacitor

- It is a device which store energy between two boundries in the form of electric field
- It consist of two conducting boundry having equal & opposite charge.

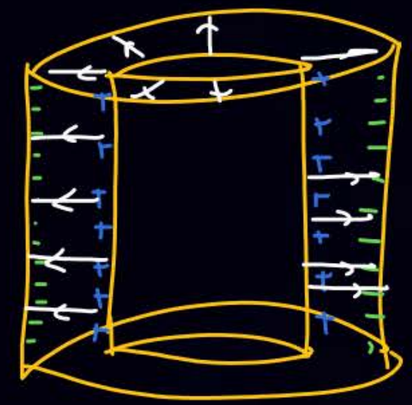
parallel plate capacitor



parallel plate Capacitor

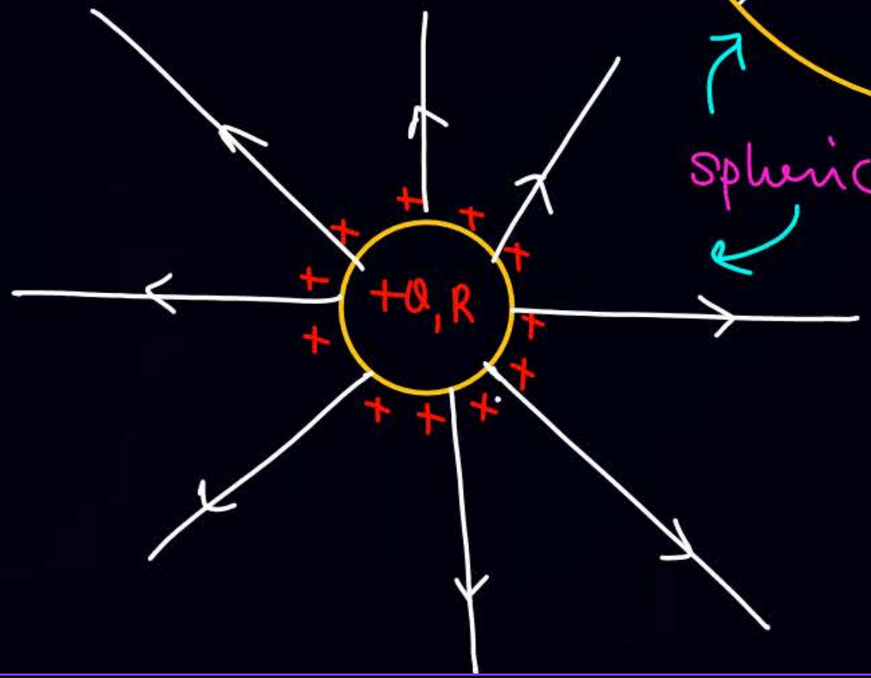


spherical capacitor.



cylindrical capaci

दिल वाला Cap.



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Law of Capacitance

$\Delta V \propto Q$ → charge on the positive plate

$\Delta V = \frac{Q}{C}$ → Capacitance (unit farad)

pot. diff. b/w two boundary

$\Delta V = \frac{Q}{C}$, $Q = C\Delta V$

$V = \frac{Q}{C}$, $Q = CV$

$V = \frac{Q}{C} \Longrightarrow V = iR$

$R = \rho \frac{l}{A}$ → ?

$C \rightarrow R$

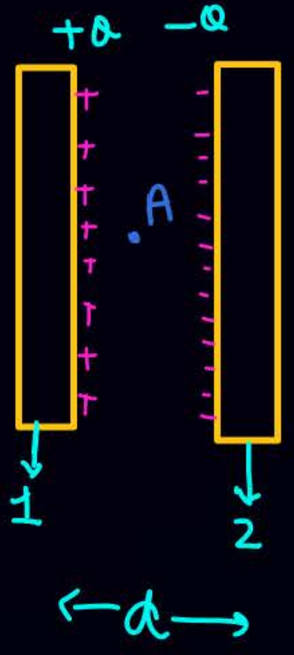
$Q \rightarrow i$

$V \rightarrow V$

(Very close to each other)

$C = \frac{\Delta V}{Q}$

① Parallel plate Capacitor



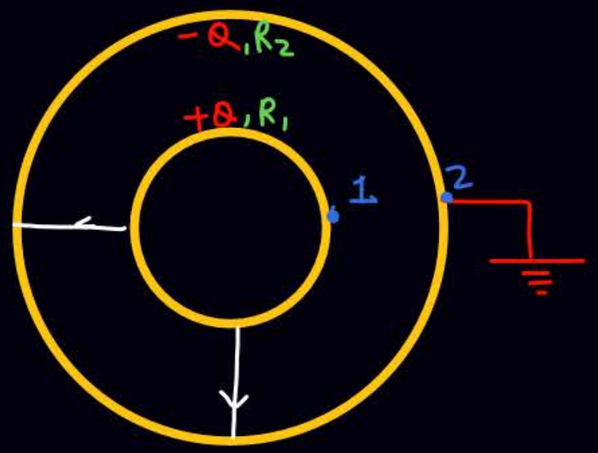
$$E_A = \frac{Q/A}{2\epsilon_0} + \frac{Q/A}{2\epsilon_0} = \frac{Q}{A\epsilon_0}$$

$$\Delta V = V_1 - V_2 = E.d = \frac{Q}{A\epsilon_0}.d$$

$$\Delta V = \frac{Q}{\left(\frac{A\epsilon_0}{d}\right)} = \frac{Q}{C}$$

$$\boxed{C = \frac{A\epsilon_0}{d}} \equiv \text{Independent on charge}$$

(2) Spherical conductor



$$V_1 = \frac{KQ}{R_1} + \frac{K(-Q)}{R_2}$$

$$V_2 = 0$$

$$\Delta V = V_1 - V_2$$

$$\Delta V = \frac{KQ}{R_1} - \frac{KQ}{R_2}$$

$$\Delta V = Q\left(\frac{K}{R_1} - \frac{K}{R_2}\right) = \frac{Q}{C}$$

$$\frac{1}{C} = \frac{K(R_2 - R_1)}{R_1 R_2}$$

$$C = \frac{R_1 R_2 \, 4\pi\epsilon_0}{(R_2 - R_1)}$$

If $R_2 \to \infty$, $C = \frac{R_1}{K}$

$$C = 4\pi\epsilon_0 R_1$$

$$\Delta V = V_1 - V_2 = \frac{KQ}{R} - 0$$

$$\Delta V = \frac{KQ}{R} = \frac{Q}{C}$$

$$C = \frac{R}{K} = 4\pi\epsilon_0 R$$