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CAPACITORS AND CAPACITANCE,

CLASS-XII

SUBJECT : PHYSICS
CHAPTER NUMBER: 02
CHAPTER NAME : ELECTROSTATIC POTENTIAL AND CAPACITANCE

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LEARNING OUTCOME

After this lesson, students will be able:

- To determine the flux density of a capacitor.
- To define relative permittivity and dielectric strength..
- To state the mathematical definition of the di electric medium and to describe the dependence of the electric field strength upon the variables that affect it.
- To list three factors that determine the capacitance of a capacitor..

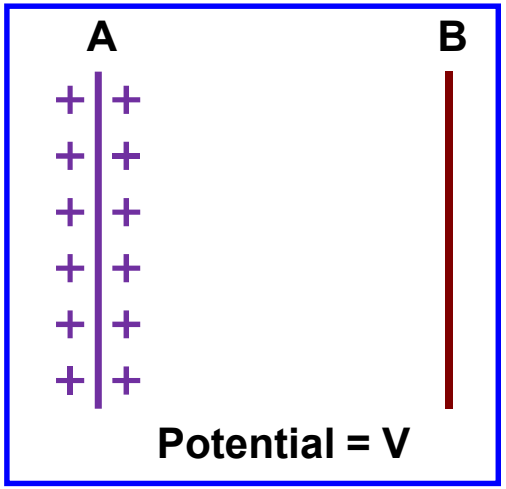
Slide 2

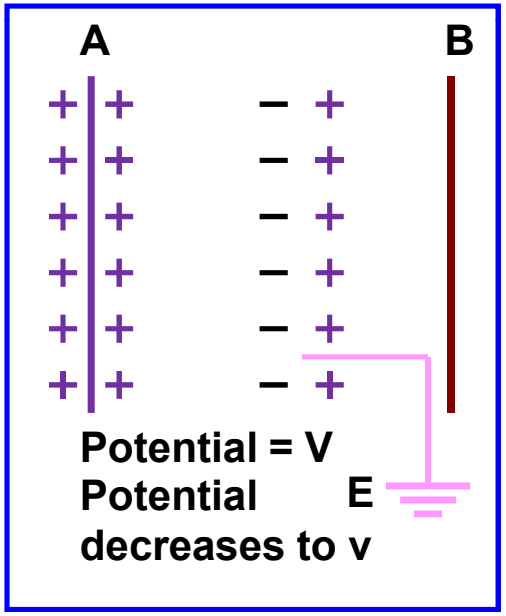
1	@Format for content and slide heading is missing? Just like you have mentioned in DOC., We need to specify, for each slide's heading and text content, what will be the font style +amanrouniyar@odmegroup.org _Assigned to you_ -Swoyan Satyendu , 6/17/2020

REVIEW

1. What are di-electrics ?
2. What is Polarisation vector?
3. What is the relation between dielectric constant and polarization vector?
4. What are charges?

PRINCIPLE OF CAPACITANCE:





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CAPACITOR AND CAPACITANCE

It is an arrangement, which can store more electric charge or potential energy in a small space compared to an isolated conductor.

The capacitance of an isolated conductor: -

When a conductor is given some q charge, it spreads over its outer surface. Hence its potential increases.

Thus; $q \alpha V$

$\Rightarrow q = CV$ .....(1)

Here constant C is called capacitance of the conductor

CAPACITOR AND CAPACITANCE

Definition of capacitance

From equation (1) when V = 1 volt, then C = q

Thus capacitance of a conductor is the charge required to increase its potential by unity.

Units of capacitance:-

- S.I Unit is Farad (F)
- If 1C of charge is required to increase the potential by 1 volt the capacitance of the conductor is said to be 1 Farad.
- Thus, $1\ \text{Farad} = \frac{1\ \text{coulomb}}{1\ \text{volt}}$

Note:

1 F is a very large quantity. Generally smaller units $\mu F, nF, PF$ are used.

Micro Farad $1\mu F = 10^{-6}\,F$

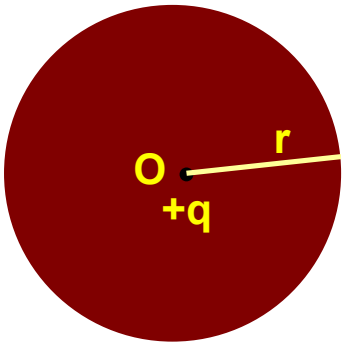
Nano Farad $1nF = 10^{-9}\,F$

Pico Farad $1PF = 10^{-12}\,F$

Dimensional formula; $C = \frac{Q}{V} = \frac{Q}{W/Q} = \frac{Q^2}{W} = \frac{[AT]^2}{[ML^2T^{-2}]} = [M^{-1}L^{-2}T^4A^2]$

CAPACITANCE OF AN ISOLATED SPHERICAL CONDUCTOR:

Let a charge q be given to the sphere which is assumed to be concentrated at the centre.



Potential at any point on the surface is

$$V = \frac{q}{4\pi\varepsilon_0 r}$$

$$C = \frac{q}{V}$$

$$\therefore \quad \boxed{C = 4\pi\varepsilon_0 r}$$

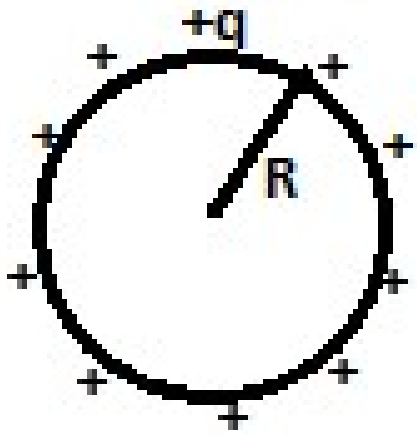
1. **Capacitance of a spherical conductor is directly proportional to its radius.**
2. **The above equation is true for conducting spheres, hollow or solid.**
3. **IF the sphere is in a medium, then $C = 4\pi\varepsilon_0\varepsilon_r r$.**
4. **Capacitance of the earth is 711 μF.**

CAPACITOR AND CAPACITANCE

The capacitance of the spherical capacitor:

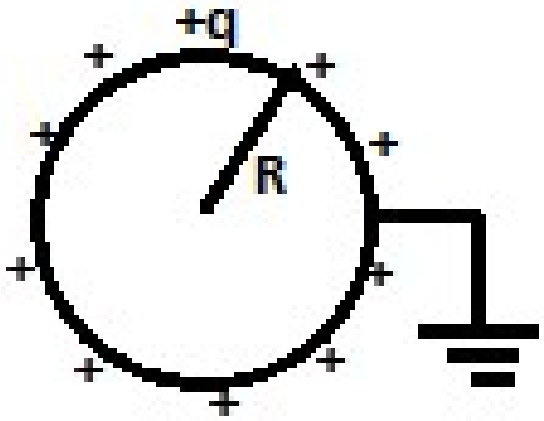
$$V = \frac{kq}{R}$$

$$C = \frac{q}{V} = 4\pi\varepsilon_0 R$$



$$V = 0$$

$$C = \frac{q}{0} = \infty$$



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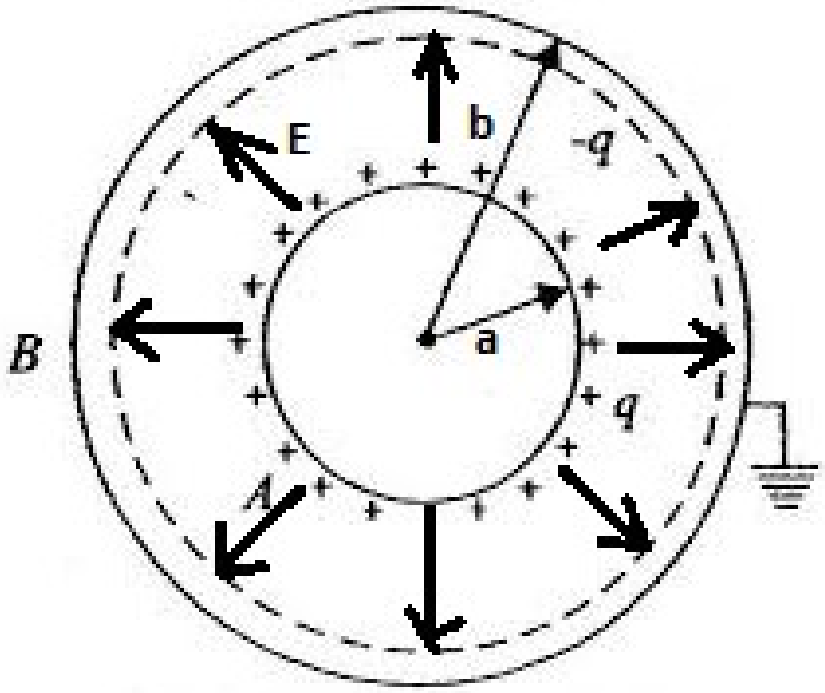
Numerical

Question: Find out the capacitance of the spherical concentric capacitor

a) With earthed outer sphere

b) With earthed inner sphere



HOME ASSIGNMENT

1. Find the radius of an isolated spherical capacitor to achieve the capacitance of 1 microfarad.
2. A capacitor of unknown capacitance is connected across a battery of V volt. A charge of 120 μC is stored in it. When the potential across the capacitor is reduced by 40 V, the charge stored in the capacitor becomes 40 μC. Calculate V and the unknown capacitance. What would have been charge in the capacitor if the voltage is increased by 40 V ?

THANKING YOU

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