CAPACITOR

Date

- Capacitor is a device that store electric charges.

(USES)

1. Used to turn the frequency of radio recievers.
2. As filters in power supplies
3. To eleminate sparkling in automobiles ignition systems
4. As energy-storing devices in electric flash units.

- The potendial diff 'V' exist between the conductors due to presence of charges.

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

The capacitance 'C' of a capacitor is the ratio of magnitude of the charge on either conductor to magnitude ~~the ma~~ of the potential difference between them:

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

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"PARALLEL PLATE CAPACITOR"

- To // metallic plates of equal area 'A' are seperated by a distance 'd', one plate carries a charge Q^+; and other carries a charge Q^-;

Electric field b/w two opposite charge plate is $E = \frac{\sigma}{\epsilon_0}$

$$E = \frac{Q}{\epsilon_0 A} \quad \because \sigma = Q/A$$

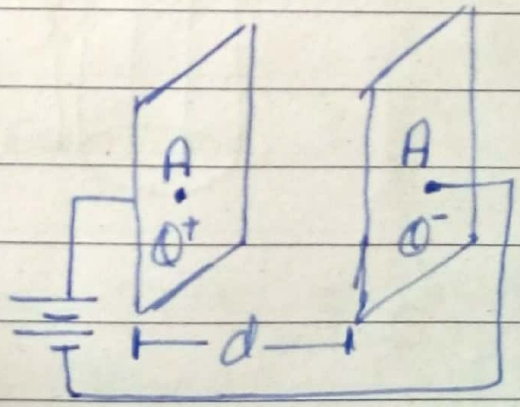
$$\Delta V = Ed$$

$$\Delta V = \frac{Q}{\epsilon_0 A} \cdot d$$

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

$$= \frac{Q}{\frac{Q \cdot d}{\epsilon_0 A}}$$

$$\boxed{C = \frac{\epsilon_0 A}{d}}$$



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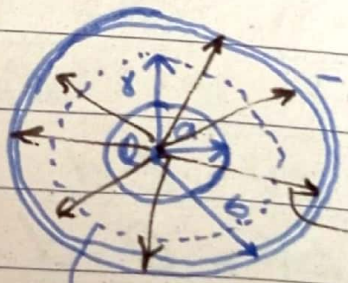
CYLINDRICAL CAPACITOR

A solid cylindrical ~~capacitor~~ conductor of radius 'a' and charge 'Q' is coaxial with a cylindrical shell of a neglible thickness, radius $b > a$, and charge $-Q$.

$$\frac{C}{l} = \frac{1}{2K \ln\left(\frac{b}{a}\right)}$$

→ the capacitance per unit length of capacitor



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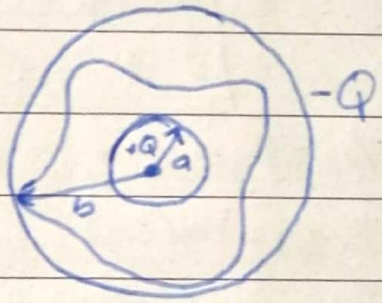
(SPHERICAL CAPACITOR)

A spherical capacitor consist of a spherical conducting shell of radius 'b' and charge '-Q' concentric with a smaller conducting sphere of radius 'a' and charge Q.

$$C = \frac{ab}{K(b-a)}$$

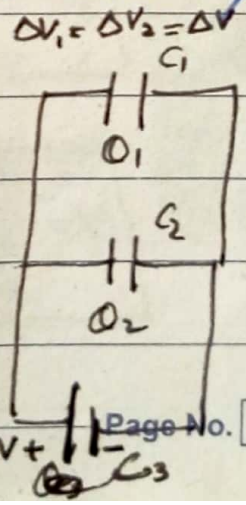


(COMBINATION)

(PARALLEL COMBINATION)

- Potential difference is same accross each capacitor.
- Total charge (current is diff).

$$C_{eq} = C_1 + C_2 + C_3 + \ldots$$



- Equivalent capacitance is always greater than individual capacitance.

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SERIES COMBINATIONS

Potential diff is ~~across~~ diff across each capacitor.

$$\Delta V = V_1 + V_2$$

$$C_{eq} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots$$

- Equivalent capacitance is always less than the individual capacitance of each capacitor

ENERGY STORED IN A CHARGED CAPACITOR

$$\therefore U = \frac{Q^2}{2C} = \frac{1}{2} Q\Delta V = \frac{1}{2} C(\Delta V)^2$$

is energy stored in a parallel plate capacitor

$$U = \frac{1}{2} \frac{\epsilon_0 A}{d} (E^2 d^2) = \frac{1}{2} (\epsilon_0 A d) E^2$$

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energy per unit volume $\boxed{u_E = \frac{U}{V} = \frac{U}{Ad}}$

= Energy density in an electric field

$$\boxed{u_E = \frac{1}{2} \epsilon_0 E^2}$$

Energy density in any electric field is proportional to the square of magnitude of the electric field at a given

(CAPACITORS WITH DIELECTRIC)

A dielectric is a non conducting material such as rubber, glass or waxed.

- Capacitance incr. when dielectric is placed b/w the capacitors. If the dielectric completely fills the space b/w the plates, the capacitance increases by a dimensionless factor k, which is called the dielectric constant.

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$$\Delta V = \frac{\Delta V_0}{K}$$

$$\therefore C = \frac{Q_0}{\Delta V} = \frac{Q_0}{\Delta V_0 / K} = \frac{K Q_0}{\Delta V_0}$$

$$\boxed{C = K C_0}$$

Advantages:

1- Increase in capacitance
2- Incs in max. operating voltage.
3- Possible mechanical support b/w the plates, which allows the plates to be close together without touching, thereby decreasing 'd' & incs. 'C'.

"TYPES OF CAPACITOR"

AN ATOMIC DISCRIPTION OF DIELECTRIC

$$E = \frac{E_0}{K}$$

$$E = E_0 - E_{ind}$$