CALIBRANT

ELECTROSTATICS

LEGEND

$\phi \rightarrow Electric\ flux$

$E \rightarrow Electrical\ field$

$\varepsilon \rightarrow Permittivity$

$H \rightarrow Magnetic\ field$

$\rho \rightarrow electrical\ resistivity$

$Q \rightarrow electric\ charge$

$W \rightarrow Work\ done$

$V \rightarrow Electric\ potential$

$C_s \rightarrow Equivalent\ capacity\ in\ series\ combination$

$C_p \rightarrow Equivalent\ capacity\ in\ parallel\ combination$

$\lambda \rightarrow linear\ charge\ density$

$C_0 \rightarrow Original\ capacitance$

$E_0 \rightarrow Original\ electric\ field$

$E_d \rightarrow Electric\ field\ with\ dilectric$

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1. Charge per unit length (Linear charge density):

$$\lambda = \frac{q}{l}$$

2. Charge per unit surface area (Surface charge density):

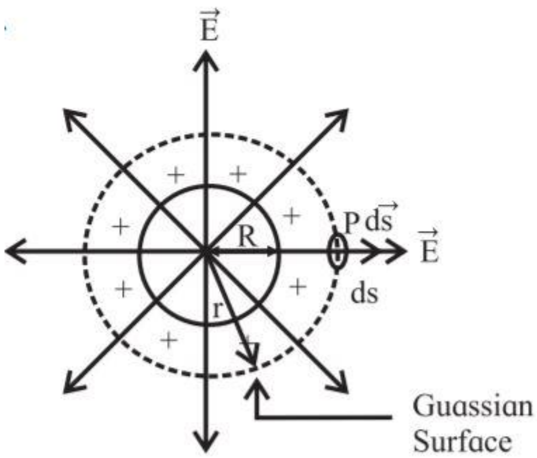
$$\sigma = \frac{q}{a}$$

3. Electric flux:

i. $\phi = \int \vec{E}.\overrightarrow{ds} = Es\ cos\theta$

ii. $\phi = \frac{q}{\epsilon_0}$

iii. $\phi = \frac{q}{k\epsilon_0}$



4. Dielectric constant of a medium:

$$k = \frac{\epsilon}{\epsilon_0}$$

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5. Electric intensity:

$$E = \frac{1}{4\pi k\epsilon_0}\frac{q}{r^2}$$

6. Electric intensity at a point outside a charged spherical conductor:

i. $E_{medium} = \frac{q}{4\pi k\epsilon_0 r^2} = \frac{\sigma R^2}{k\epsilon_0 r^2} \ldots.(r > R)$

ii. $E_{vaccum} = \frac{q}{4\pi \epsilon_0 r^2} = \frac{\sigma R^2}{\epsilon_0 r^2} \quad \ldots.(r > R)$

where, $\sigma = \frac{q}{4\pi R^2}$

iii. $E_{inside} = 0 \qquad \ldots.(r > R)$

7. Electric intensity at a point outside a charged cylindrical conductor:

i. Cylinder in any medium,

$$E = \frac{\lambda}{2\pi\epsilon r} = \frac{\lambda}{2\pi k\epsilon_0 r} = \frac{\sigma R}{k\epsilon_0 r} \ldots.(r > R)$$

ii. cylinder in free space or vacuum,

$$E = \frac{\lambda}{2\pi\epsilon_0 r} = \frac{1}{4\pi\epsilon_0}\frac{2\lambda}{r} \ldots.(r > R)$$

iii. Inside the cylinder.

$E = 0 \qquad \ldots.(r < R)$

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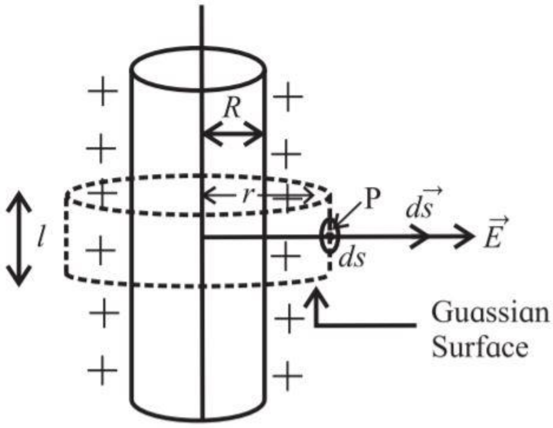


8. Electric intensity at a short distance from a charged conductor of any shape:

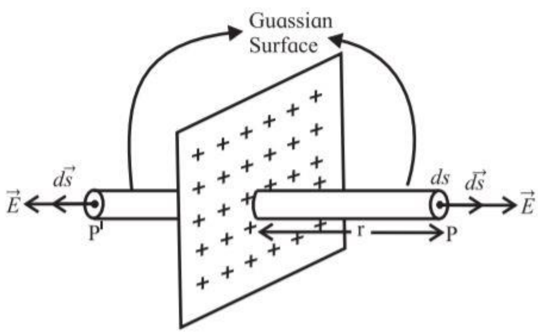
i. $E = \frac{\sigma}{k\epsilon_0}$

ii. conductor in free space or air or vacuum,

$$E_0 = \frac{\sigma}{\epsilon_0} = KE$$

9. Electric intensity at a point outside a uniformly charged infinite plane sheet:

$$E = \frac{\sigma}{2\epsilon}$$



10. Work done:

i. W = qV

ii. W = q $(V_b - V_a)$

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11. Torque on a dipole:

i. $\tau = \vec{p}\,\mathrm{x}\,\vec{E}$

ii. $\tau = pE\ \sin\theta$

iii. for $\theta = 90^{o}$,$\tau_{max} = pE$

iv. for $\theta = 0$, $\tau_{min} = 0$

12. Work done by the external torque on dipole:

W= $\int_{\theta_0}^{\theta} \tau_{ext}(\theta)d\theta = \int_{\theta_0}^{\theta} pE\ sin\theta d\theta$

13. Potential energy of electric dipole in external electric field:

U (θ) – U (θ_0) = pE (cos θ_0 - cos θ)

14. Capacity of condenser:

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

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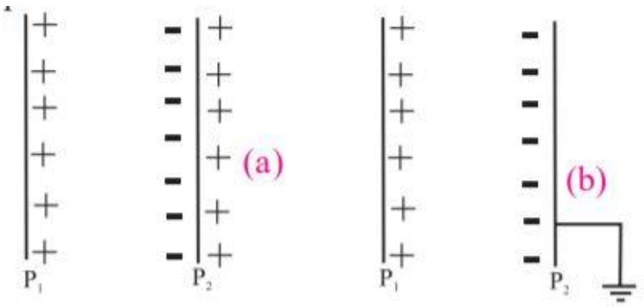
15. Parallel plate condenser:



i. Intensity between the plates,

$$E = \frac{\sigma}{\epsilon} = \frac{Q}{A\epsilon} = \frac{\sigma}{k\epsilon_0} = \frac{Q}{Ak\epsilon_0}$$

ii. Potential difference between,

V = Ed

iii. Capacity between the plates,

$$C = \frac{A\epsilon}{d} = kC_0$$

iv. Capacity of vacuum,

$$C_0 = \frac{A\epsilon_0}{d}$$

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16. Capacitance of capacitor with dielectric:

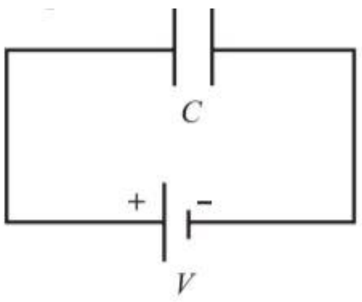
$$C_d = C_0 \frac{E_0}{E_d}$$

Where, C_0 is original capacitance

E_0 is original electric field

E_d is electric field with dielectric

17. Energy stored in a charged capacitor:



U = $\frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}CV^2 = \frac{1}{2}QV$

18. Series combination of ‘n’ condenser:

i. V = $V_1 + V_2 + V_3$ .... + V_n

ii. Q = $Q_1 = Q_2 = Q_3$ =....... = Q_n

iii. $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots \ldots . + \frac{1}{C}$

19. Parallel combination of ‘n’ condenser:

i. Q = $Q_1 + Q_2 + Q_3$ .... + Q_n

ii. V = $V_1 = V_2 = V_3$ = ... = V_n

iii. C = $C_1 + C_2 + C_3$ +....... + C_n