Physics Formula Sheet

Chapter by chapter, topic by topic. Written by the PadhoNa team for quick revision.

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CHAPTER 18

Electrostatics

Coulomb's law and electric field

$$F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}, \qquad \vec{E} = \frac{\vec{F}}{q_0}, \qquad E = \frac{kq}{r^2}\ \left(k = \frac{1}{4\pi\varepsilon_0}\right)$$

LINE OF CHARGE

$$E = \frac{\lambda}{2\pi\varepsilon_0 r}\ (\text{infinite})$$

RING (ON AXIS)

$$E = \frac{kQx}{(R^2 + x^2)^{3/2}}, \qquad E_{\max} \text{ at } x = \frac{R}{\sqrt{2}}$$

SHEET AND PLATES

$$E = \frac{\sigma}{2\varepsilon_0}\ (\text{sheet}), \qquad E = \frac{\sigma}{\varepsilon_0}\ (\text{between oppositely charged plates})$$

FIELD OF A SPHERE

$$\text{conducting/shell: } 0\ (r < R),\ \frac{kQ}{r^2}\ (r \geq R); \qquad \text{solid (uniform): } \frac{kQr}{R^3}\ (r < R)$$

Gauss's law and flux

$$\phi = \oint \vec{E} \cdot d\vec{A} = \frac{q_{\text{enc}}}{\varepsilon_0}$$

Electric potential and energy

$$V = \frac{kq}{r}, \qquad \vec{E} = -\nabla V, \qquad E = -\frac{dV}{dr}$$

POTENTIAL ENERGY

$$U = \frac{kq_1q_2}{r}, \qquad W = q\,\Delta V$$

SPHERE

$$V = \frac{kQ}{R}\ \text{(inside a conductor)}; \qquad \text{solid sphere centre } \frac{3kQ}{2R}$$

Electric dipole

$$\vec{p} = q\,\vec{d}; \qquad E_{\text{axial}} = \frac{2kp}{r^3}, \qquad E_{\text{equatorial}} = \frac{kp}{r^3}$$

$$V = \frac{kp\cos\theta}{r^2}, \qquad \vec{\tau} = \vec{p} \times \vec{E}, \qquad U = -\vec{p}\cdot\vec{E}$$

Conductors

$$E_{\text{inside}} = 0; \qquad \text{charge sits on the surface;} \qquad E_{\text{surface}} = \frac{\sigma}{\varepsilon_0}$$

CONNECTED SPHERES

$$\frac{q_1}{q_2} = \frac{r_1}{r_2}, \qquad \frac{\sigma_1}{\sigma_2} = \frac{r_2}{r_1}$$

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