Formula Sheet for first Midterm Exam 172

WQ 2009

Coulomb's laws: $|\vec{F}| = k\frac{|Q_1||Q_2|}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{|Q_1||Q_2|}{r^2}$; like charges repel unlike charges attract

Electric field: $\vec{E} = \frac{\vec{F}}{q}$ $\quad \varepsilon_0 = 8.85\cdot10^{-12}\frac{N\,m^2}{C^2}$

point charge: $|\vec{E}| = k\frac{|Q|}{r^2}$; away from charge for $q>0$

$$\vec{E}_{total} = \sum_{i=1}^{n}\vec{E}_{indiv.,i}$$

Dipole: $p = Q\ell$; points from neg. to pos. charge

Electric flux: $\Phi_E = \int \vec{E}\cdot d\vec{A}$; if area is flat and $\vec{E}$ uniform: $\Phi_E = \vec{E}\cdot\vec{A}$

Gauß' law: $\oint \vec{E}\cdot d\vec{A} = \frac{Q_{enclosed}}{\varepsilon_0}$

Electric potential: $V_{ba} = \frac{U_b - U_a}{q}$; $\Delta U = q\,V_{ba}$ · dist. between a & b

$$V_{ba} = -\int_a^b \vec{E}\cdot d\vec{\ell}$$; for uniform field: $V_{ba} = -Ed$

Equipotential lines: perp. to $\vec{E}$, same potential

Point charge: $V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$

Electric field (from potential): $E_x = -\frac{\partial V}{\partial x}$; $E_y = -\frac{\partial V}{\partial y}$; $E_z = -\frac{\partial V}{\partial z}$

Capacitance: $C = \varepsilon_0\frac{A}{d}$; plate capacitor

$$Q = CV$$

Equivalent capacitance: parallel capacitors: $C_{eq} = C_1 + C_2 + C_3 + \dots$

cap. in series: $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots$

Energy stored: $U = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$ **Dielectric:** $\varepsilon_0 \to K\varepsilon_0 \equiv \varepsilon$

energy density: $u = \frac{1}{2}\varepsilon_0 E^2$