

## **Formula Sheet (2<sup>nd</sup> Midterm)**

$$V = \frac{EPE}{q_0}; \quad \Delta(EPE) = -W_{AB}; \quad V = \frac{kq}{r} \text{ but } [k = 8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2]; \quad E = -\frac{\Delta V}{\Delta s};$$

$$q = CV \text{ (Capacitor); } \quad \frac{1}{2}mv_i^2 + EPE_i = \frac{1}{2}mv_f^2 + EPE_f \text{ (Energy conservation);}$$

$$C = \frac{\kappa\epsilon_0 A}{d} \text{ (Parallel plate capacitor filled with a dielectric)}$$

$$E = \frac{1}{2}CV^2 \text{ (Energy storage in a capacitor);}$$

$$I = \frac{\Delta q}{\Delta t} \text{ (Definition of current); } \quad V = IR \text{ (Ohm's law);}$$

$$R = \rho \frac{L}{A} \text{ (Resistance and resistivity); } \quad \frac{R_1}{R_2} = \frac{I_2}{I_1} \text{ (In a parallel circuit)}$$

$$\rho = \rho_0 [1 + \alpha(T - T_0)]; \text{ and } R = R_0 [1 + \alpha(T - T_0)] \text{ (Temperature dependence of resistance)}$$

$$P = IV \text{ (Electric power); } \quad V = V_0 \sin 2\pi ft \text{ and } I = I_0 \sin 2\pi ft \text{ (Alternating current);}$$

$$V_{rms} = \frac{V_0}{\sqrt{2}} \text{ and } I_{rms} = \frac{I_0}{\sqrt{2}} \text{ (Root mean square); } \quad R_{eq} = R_1 + R_2 + \dots \text{ (Series)}$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \dots \text{ (Parallel); } \quad V_T = Emf - Ir \text{ and } I = \frac{Emf}{R_{total} + r} \text{ (Internal resistance)}$$

$$C_{eq} = C_1 + C_2 + \dots \text{ (Parallel); } \quad \frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \dots \text{ (Series);}$$

$$q = q_0 [1 - \exp(-t/(RC))] \text{ (Capacitor charging);}$$

$$q = q_0 \exp(-t/(RC)) \text{ (Capacitor discharging);}$$

$$F = q_0 v B \sin \theta \text{ (Lorentz force); } \quad F = IB\ell \sin \theta \text{ (Ampere's force);}$$

$$\tau = NIAB \sin \phi \text{ (Torque on the current-carrying coil)}$$

$$B = \frac{\mu_0 I}{2\pi r} \text{ (Long, straight wire); } \quad B = N \frac{\mu_0 I}{2R} \text{ (Center of a circular loop);}$$

$$B = \mu_0 nI \text{ (Interior of a long solenoid);}$$

### Constants

$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 / (\text{N} \cdot \text{m}^2)$  (Permittivity of free space);

$\mu_0 = 4\pi \times 10^{-7} \text{ T} \cdot \text{m} / \text{A}$  (Permeability of free space);

### Appendix

M (mega)	$\times 10^6$
k (kilo)	$\times 10^3$
m (milli)	$\times 10^{-3}$
$\mu$ (micro)	$\times 10^{-6}$

### Right- and Left-Hand Laws

