Physics 51

Formulas for Chapters 21, 22, and 23 (13th ed.)

$$F = k\frac{q_1 q_2}{r^2}$$

$$\vec{E} = \frac{\vec{F}}{q} \quad \text{or} \quad \vec{F} = q\vec{E}$$

$$|d\vec{E}| = k\frac{dq}{r^2}, \quad |\vec{E}| = \int |d\vec{E}|$$

$$|\vec{E}| = k\frac{Q}{r^2}$$

$$\oint \vec{E} \cdot d\vec{a} = \frac{Q_{in}}{\epsilon_0}$$

$$W_{a \to b} = -\Delta U = -(U_b - U_a) = \int_a^b \vec{F} \cdot d\vec{l}$$

$$U = k\frac{q_1 q_2}{r}$$

$$V = \frac{U}{q} \quad \text{or} \quad U = qV$$

$$dV = k\frac{dq}{r}, \quad V = \int dV$$

$$V = k\frac{Q}{r}$$

$$V_b - V_a = -\int_a^b \vec{E} \cdot d\vec{l}$$

$$E_x = -\frac{\partial V}{\partial x}, \quad E_y = -\frac{\partial V}{\partial y} \quad E_z = -\frac{\partial V}{\partial z}$$

$$\vec{\tau} = \vec{p} \times \vec{E} \qquad U = -\vec{p} \cdot \vec{E}$$

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CH. 24, 25, 26, 27

$Q = CV$, $W = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$

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

$C_p = C_1 + C_2$, $1/C_s = 1/C_1 + 1/C_2$

$u = \frac{1}{2}\epsilon_0 E^2$

$\vec{J} = nq\vec{v}$

$V = RI$, $P = VI$

$R = \rho \frac{L}{A}$, $R_s = R_1 + R_2$, $1/R_p = 1/R_1 + 1/R_2$

$\rho(T) = \rho(T_0)\left[1 + \alpha(T - T_0)\right]$

$\sum V = 0$, $\sum I = 0$

$R\frac{dQ}{dt} + \frac{Q}{C} = \mathcal{E}$, $Q = C\mathcal{E}(1 - e^{-t/\tau})$, $\tau = RC$

$R\frac{dQ}{dt} + \frac{Q}{C} = 0$, $Q = Q_0 e^{-t/\tau}$ $\tau = RC$

$\vec{F} = q\vec{v} \times \vec{B}$, $d\vec{F} = I\,d\vec{l} \times \vec{B}$

$R = \frac{mv}{qB}$, $\omega = \frac{qB}{m}$ $\omega = 2\pi f = 2\pi/T$

$\vec{\tau} = \vec{\mu} \times \vec{B}$ $\vec{\mu} = I\vec{A}$

$U = -\vec{\mu}\cdot\vec{B}$

CH. 28, 29, 30, 31

$$\vec{B} = \frac{\mu_0}{4\pi}\frac{q\vec{v}\times\hat{r}}{r^2}, \quad |\vec{B}| = \frac{\mu_0}{4\pi}\frac{|q|v\sin\theta}{r^2}$$

$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\,d\vec{l}\times\hat{r}}{r^2}, \quad |d\vec{B}| = \frac{\mu_0}{4\pi}\frac{I\,dl\sin\theta}{r^2}$$

$$\frac{F}{L} = \frac{\mu_0 I I'}{2\pi d}$$

$$\int \vec{B}\cdot d\vec{l} = \mu_0 I$$

$$\mathcal{E} = -\frac{d\Phi_B}{dt}$$

$$\Phi_B = \int \vec{B}\cdot d\vec{A}$$

$$V_L = L\frac{di}{dt} \qquad L = \frac{N\Phi}{i}$$

$U = \frac{1}{2}LI^2$ total energy

$u = \frac{B^2}{2\mu_0}$ energy density

$$L\frac{di}{dt} + Ri = \mathcal{E}$$

$$i = \frac{\mathcal{E}}{R}(1-e^{-t/\tau}) \qquad \tau = \frac{L}{R}$$

$$L\frac{di}{dt} + Ri = 0$$

$$i = i_0 e^{-t/\tau} \qquad \tau = \frac{L}{R}$$

$$i = I\cos\omega t$$

$$v = V\cos(\omega t + \phi)$$

$$\omega = 2\pi f = 2\pi/T$$

$$V = RI \qquad X_R = R$$

$$V = L\omega I \qquad X_L = L\omega$$

$$V = \frac{1}{C\omega}I \qquad X_C = 1/C\omega$$

$$\phi_R = 0, \quad \phi_L = +\pi/2 \quad \phi_C = -\frac{\pi}{2}$$

$$P_{av} = \frac{1}{2}VI\cos\phi$$

$$P_{av} = V_{rms}I_{rms}\cos\phi$$