

## Formulas, PHYSICS 244

$$\Delta t = \frac{\Delta t(\text{proper})}{\sqrt{1 - v^2/c^2}}, \quad \ell = \sqrt{1 - v^2/c^2} \ell_0(\text{proper length}), \quad \Delta t = \frac{Lv/c^2}{\sqrt{1 - v^2/c^2}}.$$

$$\mathbf{p} = \frac{m\mathbf{v}}{\sqrt{1 - v^2/c^2}}, \quad E = \frac{mc^2}{\sqrt{1 - v^2/c^2}}, \quad \frac{v}{c} = \frac{pc}{E}, \quad K = E - mc^2, \quad E^2 = (pc)^2 + (mc^2)^2.$$

$$\mathbf{F} = \frac{m\mathbf{a}}{\sqrt{1 - u^2/c^2}}, \quad a_{\text{circular}} = v^2/r, \quad \text{Work done} = \int_i^f \mathbf{F} \cdot d\mathbf{r} = E_f - E_i.$$

$$\mathbf{F} = q(\mathbf{E} + \mathbf{v} \times \mathbf{B}), \quad U = kqq'/r, \quad K \approx \frac{1}{2}mv^2 = p^2/(2m)$$

$$c = 3 \times 10^8 \text{ m/s}, \quad e = 1.6 \times 10^{-19} \text{ C}, \quad 1 \text{ eV} = 1.6 \times 10^{-19} \text{ J},$$

$$N_A = 6.022 \times 10^{23} \text{ objects/mole}, \quad ke^2 = 1.44 \text{ eV} \cdot \text{nm} = 1.44 \text{ MeV} \cdot \text{fm}.$$

$$m_e c^2 = 511000 \text{ eV}, \quad 1u = 931.5 \text{ MeV}/c^2, \quad h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}, \quad E_R = 13.6 \text{ eV}.$$

$$E = hf, \quad hc = 1240 \text{ eV} \cdot \text{nm}, \quad \text{De Broglie's matter wave: } \lambda = h/p.$$

$$\hbar\omega = hf, \quad \hbar k = h/\lambda, \quad v_{\text{phase/wave}} = \omega/k = E/p, \quad v_{\text{group/packet}} = d\omega/dk = dE/dp.$$

$$\psi(x) \sim e^{i(kx - \omega t)}, \quad |\psi(x)|^2 \text{ probability density}, \quad d \sin \theta = \text{path diff.},$$

$$(\Delta x)(\Delta p) \geq \frac{1}{2}\hbar, \quad (\Delta E)(\Delta t) \geq \frac{1}{2}\hbar.$$

$$\text{1-d rigid box: } a = n\lambda/2, \quad E_n = \frac{\hbar^2 \pi^2 n^2}{2ma^2}$$

$$\hbar \equiv \frac{h}{2\pi}, \quad mvr = n\hbar, \quad \frac{mv^2}{r} = \frac{ke^2}{r^2}, \quad E_R = \frac{1}{2} \left( \frac{ke^2}{\hbar c} \right)^2 m_e c^2, \quad E_n = -Z^2 E_R / n^2.$$

$$|L| = \sqrt{\ell(\ell + 1)}\hbar, \quad L_z = -\ell\hbar, \dots, +\ell\hbar, \quad n > \ell \geq |m|, \quad s_z = \pm \frac{1}{2}\hbar, \quad \mathbf{J} = \mathbf{L} + \mathbf{S}.$$

$$\boldsymbol{\mu} = -\frac{e}{2m_e} \mathbf{L}, \quad \Delta E = -\boldsymbol{\mu} \cdot \mathbf{B} = \frac{e\hbar}{2m_e} mB, \quad \mu_B = \frac{e\hbar}{2m_e} = 5.79 \times 10^{-5} \text{ eV/T}$$

$$m_{\text{nuc}} = Zm_p + Nm_n - B/c^2, \quad m_p c^2 = 938.3 \text{ MeV}, \quad m_n c^2 = 939.6 \text{ MeV},$$

$$\frac{dN}{dt} = -rN, \quad N = N_0 e^{-rt}, \quad \tau = \frac{1}{r}, \quad t_{\frac{1}{2}} = \frac{\ln 2}{r}, \quad R = (1.07 \text{ fm}) A^{\frac{1}{3}}, \quad N = \sigma N_{\text{inc}} N_{\text{tar}} / A$$

$$\Delta \ell = \pm 1, \quad \Delta j = 0, \pm 1, \quad \Delta s = 0, \quad \Delta m = 0, \pm 1, \quad 1 \text{ fm} = 10^{-15} \text{ m}, \quad 1 \text{ barn} = 10^{-24} \text{ cm}^2.$$