

Equations Test 1 – PHYS 3313

$$c = 3.0 \times 10^8 \text{ m/s}$$

$$m_{\text{electron}} = 0.511 \text{ MeV}/c^2 = 9.11 \times 10^{-31} \text{ kg}$$

$$m_{\text{proton}} = 938 \text{ MeV}/c^2 = 1.67 \times 10^{-27} \text{ kg} \approx m_{\text{neutron}}$$

$$e = 1.6 \times 10^{-19} \text{ Coulomb}$$

$$h = 6.63 \times 10^{-34} \text{ J.s} = 4.14 \times 10^{-15} \text{ eV.s}$$

$$R = 1.097 \times 10^7 \text{ m}^{-1}$$

$$\phi_{(\text{Work function})} :$$

$$\text{Platinum} = 6.4 \text{ eV}$$

$$\text{Silver} = 4.6 \text{ eV}$$

$$\text{Potassium} = 2.2 \text{ eV}$$

$$a_0 = r_1 = 0.529 \times 10^{-10} \text{ m}$$

$$E_1 = -13.6 \text{ eV}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N.m}^2/\text{C}^2$$

$$\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2}$$

Lorentz Transform S' moving relative to S

$$x' = \gamma(x - vt)$$

$$y' = y$$

$$z' = z$$

$$t' = \gamma\left(t - \frac{vx}{c^2}\right)$$

Velocity addition

$$v_x = \frac{v_{x'} + v}{1 + \frac{v \cdot v_{x'}}{c^2}}$$

$$p = \gamma mv$$

$$E = \gamma mc^2 = KE + mc^2$$

$$v = \frac{pc^2}{E}$$

$$KE = \frac{mv^2}{2} = \frac{p^2}{2m} \text{ (non-relativistic)}$$

$$W = qV = -\int F dx \quad P = \text{Energy/Time}$$

$$E_{\text{particle}} = \sqrt{(mc^2)^2 + (pc)^2}$$

$$E = pc \text{ if } m = 0$$

$$E = h\nu \text{ (photons)}$$

$$\hbar = \frac{h}{2\pi}$$

$$v = \nu\lambda \quad v = c \text{ for EM waves}$$

$$KE_{\text{max}} = h\nu - h\nu_0 = h\nu - \phi = eV_0 \text{ (photoelectric)}$$

$$x\text{-rays } \lambda_{\text{min}} = \frac{hc}{eV_0}$$

$$\text{Compton } \lambda' - \lambda = \lambda_c(1 - \cos\theta); \quad \lambda_c = \frac{h}{mc}$$

$$\lambda = \frac{h}{p} \quad \Delta x \Delta p \geq \frac{\hbar}{2} \quad \Delta E \Delta t \geq \frac{\hbar}{2}$$

$$v_p = \frac{\omega}{k} \quad v_g = \frac{\partial \omega}{\partial k} \quad \omega = 2\pi\nu \quad k = \frac{2\pi}{\lambda}$$

$$F_e = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$$

$$E_n = \frac{E_1}{n^2} \quad r_n = r_1 n^2$$

$$\frac{1}{\lambda} = R \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) \text{ (emitted photon)}$$

$$\hat{p} = \frac{\hbar}{i} \frac{\partial}{\partial x} \quad \hat{E} = i\hbar \frac{\partial}{\partial t}$$

Schrodinger's Equation :

$$i\hbar \frac{\partial \Psi}{\partial t} = -\frac{\hbar^2}{2m} \frac{\partial^2 \Psi}{\partial x^2} + U\Psi$$

Time-independent Schrodinger's Equation :

$$\frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} + \frac{\partial^2 \psi}{\partial z^2} + \frac{2m}{\hbar^2} (E - U)\psi = 0$$

$$\hat{G}\psi_n = G_n\psi_n$$

$$\hat{H} = -\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} + U \quad \int_{-\infty}^{\infty} |\psi|^2 dx = 1$$

$$\langle G(x) \rangle = \int \psi^* G(x) \psi dx$$

$$\text{Particle in a box } E_n = \frac{n^2 \pi^2 \hbar^2}{2mL^2}$$

Harmonic oscillator :

$$E_n = \left(n + \frac{1}{2}\right) \hbar\nu \quad n = 0, 1, 2, 3, \dots$$

$$\sin^2 \theta = \frac{(1 - \cos 2\theta)}{2}$$

$$\sin \alpha \sin \beta = \frac{1}{2} [\cos(\alpha - \beta) - \cos(\alpha + \beta)]$$