Exam 3 Equations

Mechanics

$\vec{F} = m\vec{a}$

$F_{centripetal} = m\frac{v^2}{R}$

$F_G = mg = \frac{Gm_1m_2}{r_{12}^2}$

$W = F_x\Delta x = \Delta KE + \Delta U$

$KE = \frac{1}{2}mv^2$

$PE = mgh$

Kinematics

$\Delta x = v_x\Delta t + \frac{1}{2}a_x(\Delta t)^2$

$\Delta x = \frac{1}{2}(v_f + v_0)\Delta t$

$v_f = v_{0x} + a_x\Delta t$

$v_{fx}^2 = v_{0x}^2 + 2a_x\Delta x$

Circuits

$I = \frac{\Delta q}{\Delta t}$

$V = IR$

$\sum V_{aroound\ loop} = 0$

$\sum I_{in} = \sum I_{out}$

$P = \frac{\Delta U_E}{\Delta t} = \frac{q\Delta V}{\Delta t}$

$P = I\Delta V = I^2R = \frac{\Delta V^2}{R}$

Electrostatics

$F_E = qE = \frac{kQq}{r^2}$ $\quad E = \frac{F_E}{q} = \frac{kQ}{r^2}$

$\Delta V = \frac{\Delta U_E}{q} = -\frac{kQ}{r}$ $\quad \Delta V = -Ed$

$W = F_Ed = qEd = -\Delta U_E = -q\Delta V$

$\Delta U = -F_Er = -\frac{kQq}{r}$

Magnetic Fields

$\vec{F} = q\vec{v}\times\vec{B} \Rightarrow F = qvB\sin\theta$

$\vec{F} = I\vec{L}\times\vec{B} \Rightarrow F = ILB\sin\theta$

$v_{selected} = \frac{E}{B} = \frac{E}{B} = \frac{\Delta V/d}{B}$

$\tau_{loop} = NIAB\sin\theta$

$B_{straight\ wire} = \frac{\mu_0 I}{2\pi r}$

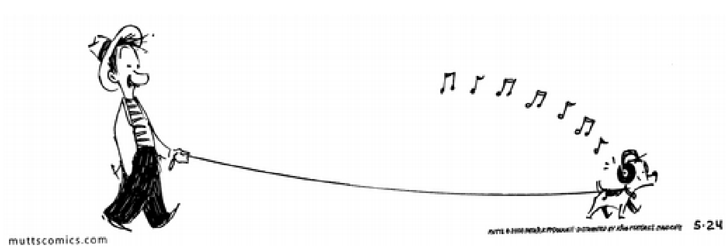
$B_{loop} = \frac{\mu_0 NI}{2r}$ $\quad B_{solenoid} = \frac{\mu_0 NI}{L}$

$\Phi = AB_\perp = A_\perp B = AB\cos\theta$

$\mathcal{E} = -N\frac{\Delta\Phi}{\Delta t}$

$\frac{\mathcal{E}_1}{\mathcal{E}_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$

$\mathcal{E}_{motional} = vBL$



Optics

$$v = \lambda f = \frac{c}{n}$$

$$\lambda = \frac{\lambda_0}{n} = \frac{\lambda_{vacuum}}{n}$$

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$

$$m = -\frac{q}{p}$$

$$I = I_0 \cos^2\theta$$

$$\theta_i = \theta_r$$

$$n_i \sin\theta_i = n_t \sin\theta_t$$

$$\sin\theta_c = \left(\frac{n_t}{n_i}\right)$$

$$\tan\theta_B = \left(\frac{n_t}{n_i}\right)$$

$$d\sin\theta = m\lambda$$

$$d\sin\theta = \left(m + \frac{1}{2}\right)\lambda$$

$$a\sin\theta = m\lambda$$

$$a\sin\Delta\theta \geq 1.22\lambda_0$$

Dr. Jahnke's Equations

$$(m + \tfrac{1}{2})\lambda = (d_2 - d_1) + (\phi_2 - \phi_1)$$

$$m\lambda = (d_2 - d_1) + (\phi_2 - \phi_1)$$

$$(m + \tfrac{1}{2})\lambda_{film} = \left(\frac{2t}{\cos\theta}\right) + \Delta\phi$$

$$m\lambda_{film} = \left(\frac{2t}{\cos\theta}\right) + \Delta\phi$$

Nuclear

$$E = mc^2$$

$$E_B = \Delta mc^2$$

$$\Delta m = m_{final} - m_{initia}$$
$$= m_{parts} - m_{nucleus}$$
$$= (m_{protons} + m_{neutrons}) - m_{nucleus}$$

$$\tau = \frac{1}{\lambda} = \frac{T_{1/2}}{\ln 2}$$

$$R = N\lambda = R_0 e^{-t\lambda} = R_0 e^{-t/\tau}$$

$$N = N_0 e^{-t\lambda} = N_0 e^{-t/\tau} = N_0\left(\frac{1}{2}\right)^{t/T_{1/2}} = N_0 (2)^{-t/T_{1/2}}$$

Constants to know and love:

- $k = 9 \times 10^9$ N-m^2/C^2
- $G = 6.67 \times 10^{-11}$ N-m^2/kg^2
- $e = 1.60 \times 10^{-19}$ C
- $m_e = 9.11 \times 10^{-31}$ kg
- $m_p = 1.67 \times 10^{-27}$ kg
- $c = 3.0 \times 10^8$ m/s
- $N_A = 6.02 \times 10^{23}$ things/mole
- $\epsilon_0 = 8.85 \times 10^{-12}$ C^2/N-m^2
- $\mu_0 = 4\pi \times 10^{-7}$ T-m/A
- m_n=1.0086649 u
- m_p=1.0072765 u
- m_e=0.0005486 u
- 1 u = 931.494 MeV/c^2
- c^2 =931.494 MeV/u
- 1 Ci =3 x 10^{10} Bq