PHYS 125 **Formula Sheet** Spring 2015

In showing work, these formulas may be used without derivation.

CONSTANTS

$v = 343\,\text{m/s}$ $c = 2.998 \times 10^8\,\text{m/s}$

$\rho_{\text{air}} = 1.21\,\text{kg/m}^3$

$e = 1.602 \times 10^{-19}\,\text{C}$

$m_e = 9.11 \times 10^{-31}\,\text{kg}$

$m_p = 1.67 \times 10^{-27}\,\text{kg}$

$k = 8.99 \times 10^9\,\text{Nm}^2/\text{C}^2$

$\varepsilon_0 = 8.85 \times 10^{-12}\,\text{C}^2/\text{Nm}^2$

MATH

sphere: $4\pi R^2$ $\frac{4}{3}\pi R^3$

cylinder : $2\pi RL$ $\pi R^2 L$

$$\frac{d}{dx}\sin(kx) = k\cos(kx)$$

$$\int \sin(kx)\,dx = \frac{-1}{k}\cos(kx)$$

$$\int \frac{dx}{x} = \ln x$$

$$\int \frac{dx}{\sqrt{x^2+a^2}} = \ln\left(x + \sqrt{x^2+a^2}\right)$$

$$\int \frac{x dx}{\sqrt{x^2+a^2}} = \sqrt{x^2+a^2}$$

$$\int \frac{dx}{(x^2+a^2)^{3/2}} = \frac{x}{a^2\,(x^2+a^2)^{1/2}}$$

$$\int \frac{x\ dx}{(x^2+a^2)^{3/2}} = \frac{-1}{(x^2+a^2)^{1/2}}$$

$$\vec{A} \times \vec{B} = (A_yB_z - A_zB_y)\hat{\imath} + (A_zB_x - A_xB_z)\hat{\jmath} + (A_xB_y - A_yB_x)\hat{k}$$

MECHANICS

$$x(t) = x_0 + v_0t + \tfrac{1}{2}at^2$$

$$v(t) = v_0 + at$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

WAVES

$$y(x,t) = y_m \sin(kx - \omega t + \phi_0)$$

$$k = \frac{2\pi}{\lambda} \qquad f = \frac{\omega}{2\pi} = \frac{1}{T}$$

$$v = \frac{\omega}{k} = \lambda f \qquad v = \sqrt{\frac{\tau}{\mu}}$$

$$P_{\text{avg}} = \frac{1}{2}\mu v \omega^2 y_m^2$$

$$\frac{\Delta\phi}{2\pi} = \frac{\Delta L}{\lambda} \qquad \frac{\Delta\phi}{2\pi} = \frac{\Delta t}{T}$$

$$\Delta\phi = 2m\pi \qquad \Delta\phi = (2m+1)\pi$$

$$y' = \left[2y_m \cos\left(\frac{\phi_0}{2}\right)\right] \sin\left(kx - \omega t + \frac{\phi_0}{2}\right)$$

$$y' = [2y_m \sin kx] \cos \omega t$$

$$f = \frac{v}{2L}n \qquad f = \frac{v}{4L}n$$

SOUND

$$v = \sqrt{\frac{B}{\rho}} \qquad \Delta p_m = (v\rho\omega)s_m$$

$$s = s_m \cos(kx - \omega t)$$

$$\Delta p = \Delta p_m \sin(kx - \omega t)$$

$$I = \frac{P}{A} \qquad I = \frac{P}{4\pi r^2} \qquad I = \frac{1}{2}\rho v \omega^2 s_m^2$$

$$\beta = (10\ \text{dB}) \log \frac{I}{I_0} \qquad I_0 = 10^{-12}\,\text{W/m}^2$$

$$f' = f\left(\frac{v \pm v_D}{v \pm v_S}\right)$$

LIGHT

$$v = \frac{c}{n} \qquad \lambda_n = \frac{\lambda}{n}$$

$$N_2 - N_1 = \frac{L}{\lambda}(n_2 - n_1) \qquad y_m = \frac{m\lambda D}{d}$$

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

$$\frac{2L}{\lambda_n} = m \qquad \frac{2L}{\lambda_n} = m + \tfrac{1}{2}$$

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ELECTROSTATICS

$$\vec{F} = k\frac{q_1 q_2}{r^2}\hat{r} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}\hat{r}$$

$$\vec{F} = q_0\vec{E} \qquad \vec{E} = k\frac{q}{r^2}\hat{r}$$

$$\vec{p} = q\vec{d} \qquad \vec{E} = -k\frac{\vec{p}}{x^3} \qquad \vec{E} = 2k\frac{\vec{p}}{z^3}$$

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

$$\lambda = \frac{Q}{L} \qquad \sigma = \frac{Q}{A} \qquad \rho = \frac{Q}{V}$$

$$\Phi = \vec{v}\cdot\vec{A} = vA\cos\theta$$

$$\Phi_E = \int \vec{E}\cdot d\vec{A}$$

$$\varepsilon_0\Phi_E = \varepsilon_0\oint \vec{E}\cdot d\vec{A} = q_{\text{enc}}$$

PHYS 125 **NOT on the Formula Sheet** Spring 2015

TO BE MEMORIZED unless otherwise indicated

CONSTANTS

metric prefixes G, M, k, c, m, μ, n

$$\lambda_{\text{visible}} \approx 500 \text{ nm}$$

$$n_{air} \approx 1.000$$

MATH

circle: $2\pi R \quad \pi R^2$

right triangle: $C^2 = A^2 + B^2$

$$\vec{A} \cdot \vec{B} = A_x B_x + A_z B_z + A_z B_z = AB\cos(\theta)$$

$$|\vec{A} \times \vec{B}| = AB\sin(\theta)$$

Right Hand Rule

$$ds = r d\theta$$

$$\frac{d}{dx}(x^n) = nx^{n-1} \qquad \int x^n dx = \frac{x^{n+1}}{n+1}$$

$$\frac{d}{dx}\cos(kx) = -k\sin(kx)$$

$$\int \cos(kx)\, dx = \frac{1}{k}\sin(kx)$$

MECHANICS

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

WAVES

transverse velocity from $u = \frac{dy}{dt}$

$$\mu = \frac{m}{L} \qquad \rho = \frac{m}{V}$$

$$f_{\text{beat}} = |f_1 - f_2|$$

Supplied if Necessary, Need NOT Memorize

Any electric field that can be obtained by integration, unless the question is intended to test your ability to perform that integration.