Physics 103 Final Exam Formulas

$\rho = \frac{m}{V}$ $V_{cube} = a^3$ $A_{circle} = \pi r^2$ $A_{sphere} = 4\pi r^2$ $V_{sphere} = \frac{4}{3}\pi R^3$ $V_{cyl} = \pi r^2 h$

1 nm = 10^{-9}m 1μ = 10^{-6}m 1L = 10^{-3}m stress: $\sigma = F/A$ strain: $\varepsilon = \frac{\Delta L}{L}$ $\sigma = E\varepsilon$

Fluids: $p = F/A$ $p_h = \rho g h$ $F_B = \rho g V$ $A_1 v_1 = A_2 v_2$ Av -volume flow rate,

$p_1 + 1/2\rho v_1^2 + \rho g h_1 = p_2 + 1/2\rho v_2^2 + \rho g h_2$ horizontal pipe: $p_1 + 1/2\rho v_1^2 = p_2 + 1/2\rho v_2^2$

Heat: $T(^0C) = \frac{5}{9}[T(^0F) - 32]$; $T(^0F) = \frac{9}{5} T(^0C) + 32$; $T(K) = [T(^0C) + 273]$

$L - L_0 = \alpha L_0 (T - T_0)$; $A - A_0 = 2\alpha L_0 (T - T_0)$; $V - V_0 = \beta V_0 (T - T_0)$ $V - V_0 = 3\alpha V_0 (T - T_0)$

$\sigma = E\alpha (T - T_0)$ ideal gas: $PV = nRT$ $R = 8.313$ J/mol·K

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$; $n = \frac{\text{mass}}{\text{molecular} - \text{mass}}$ $N = nN_{av}$ $N_{Av} = 6.02\text{x}10^{23}$ / mole

$Q = mc(T - T_0)$, $Q = mL_F$, heat lost = heat gained $Q = kA\frac{T_1 - T_2}{L}t$

$Q = A\frac{T_1 - T_2}{\sum R_i}t$ $R = L/k$ $\frac{Q}{t} = e\sigma A(T^4 - T_0^4)$ $\frac{Q}{t} = e\sigma AT^4$

$\Delta U = Q - W$ $W = P\Delta V$ $Q_h = W + Q_c$ $e = \frac{W}{Q_h}$ $e = \frac{T_h - T_c}{T_h}$ $COP = \frac{Q_c}{W}$

$COP = \frac{T_c}{T_h - T_c}$ Oscillations: $F = -kx$ $x = A\cos(\omega t)$ $v = -\omega A\sin(\omega t)$ $\omega = 2\pi f$

$\omega = \frac{2\pi}{T}$ $f = \frac{1}{T}$ $\omega = \sqrt{\frac{k}{m}}$ period: $T_{spring} = 2\pi\sqrt{\frac{m}{k}}$; $T_{pend} = 2\pi\sqrt{\frac{L}{g}}$

$v_{max} = A\omega$ $E = ½ mv^2 + ½ kx^2$; $E = ½ kA^2$;

waves: $v = \lambda \cdot f$ linear mass $\mu = \frac{m}{L}$ $v = \sqrt{\frac{F}{\mu}}$

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standing waves on string: $f = \frac{v}{2L}n$ $\lambda = \frac{2L}{n}$ $n = 1, 2, 3, \ldots\ldots$

sound: $v_{300\,K} = 343$ m/s $v = 331\ \text{m/s}\sqrt{\frac{T}{273K}}$ $I_0 = 10^{-12}\ W/m^2$

$I = \frac{P}{4\pi R^2}$ $E = Pt$ $\beta = 10dB\log\frac{I}{I_0}$ $\beta_2 - \beta_1 = 10dB\log\frac{I_2}{I_1}$ **Doppler Effect:**

$$f = f_o\frac{v + v_o}{v - v_s}$$

standing waves: in open pipe at both ends: $n = 1, 2, 3.,$ $f = \frac{v}{2L}n$ $\lambda = \frac{2L}{n}$

in pipe closed at one end: $n = 1, 3, 5, \ldots$ $f = \frac{v}{4L}n$ $\lambda = \frac{4L}{n}$

Electric charge: $q = Ne$ $F = k\frac{q_1 q_2}{r^2}$ $E = k\frac{q}{r^2}$ $k = 8.99\text{x}10^9\ Nm^2/C^2$

$F = qE$ $qE = ma$ $\Delta U = q\Delta V$ $q\Delta V + \Delta KE = 0$ $KE = \frac{1}{2}mv^2$ $\Delta V = Ed$

Current: $R = \rho\frac{L}{A}$; $V = I*R$ $I = \frac{\Delta q}{\Delta t} = \frac{Ne}{t}$ $P = \frac{E}{\Delta t}$ $P = I^2R$ $P = \frac{V^2}{R}$

$P = I*V$; $V = V_m\sin\omega t$ $V_{rms} = \frac{V_m}{\sqrt{2}}$ $I_{rms} = \frac{I_m}{\sqrt{2}}$ $P_{avg} = \frac{V_{rms}^2}{R}$ $P_{avg} = I_{rms}^2R$

Circuits: in series : $R_{eq} = R_1 + R_2 + \ldots + R_n$ **in parallel:** $R_{eqv} = (\frac{1}{R_1} + \frac{1}{R_2})^{-1}$ $\Sigma V = 0$ $\Sigma I = 0$

Light: $n = \frac{c}{v}$ $\lambda = \lambda_0/n$ $c = 3\ \text{x}10^8$ m/s $n_1\sin\theta_1 = n_2\sin\theta_2$ $n_1\sin\theta_{cr} = n_2\sin 90^0$

mirror and lens equations $\frac{1}{f} = \frac{1}{do} + \frac{1}{d_i}$ $m = \frac{h_i}{h_o} = -\frac{d_i}{do}$

lensmaker's equation $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$

Interference: $d\sin\theta = m\lambda$ $y = L\tan\theta$ **small angles:** $y_{bright} = L\frac{m\lambda}{d}$

Thin films interference: $2\,n\,t = (m + \frac{1}{2})\lambda_v$ $m = 0, 1, 2 \ldots$ $2\,n\,t = m\lambda_v$ $m = 1, 2\ldots$

$1\mu m = 10^{-6}m$ $1\mu C = 10^{-6}C$