PHYS 201 Formula Sheet

Chapters 1—5 (Exam 1)

Constant acceleration equations:

$v_x = v_{0x} + a_x t \qquad x = x_0 + v_{0x}t + \tfrac{1}{2}a_x t^2 \qquad v_x^2 = v_{0x}^2 + 2a_x(x - x_0) \qquad x - x_0 = \left(\dfrac{v_{0x} + v_x}{2}\right)t$

$g = 9.80\ \text{m/s}^2 \qquad w = mg$

$\sum F_x = ma_x \qquad \sum F_y = ma_y \qquad f_k = \mu_k n \qquad f_s \le \mu_s n \qquad F_{spr} = -kx$

quadratic formula: The equation $ax^2 + bx + c = 0$ has solutions $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Chapters 6—8 (Exam 2)

$a_{rad} = \dfrac{v^2}{R} \qquad v = \dfrac{2\pi R}{T}$

$F_g = G\dfrac{m_1 m_2}{r^2} \qquad G = 6.67\times10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2 \qquad T = \dfrac{2\pi r^{3/2}}{\sqrt{Gm_E}}$

$W = F_{\parallel}s = (F\cos\phi)s \qquad W_{total} = K_f - K_i = \Delta K \qquad U_{grav} = mgy \qquad K = \tfrac{1}{2}mv^2$

$U_{el} = \tfrac{1}{2}kx^2 \qquad K_f + U_f = K_i + U_i + W_{other} \qquad P_{av} = \dfrac{W}{t} \qquad P = F_{\parallel}v$

$\vec{p} = m\vec{v} \qquad \Delta\vec{p} = \vec{F}_{av}(t_f - t_i) = \vec{J} \qquad M\vec{v}_{cm} = \vec{P}$

$x_{cm} = \dfrac{m_A x_A + m_B x_B + m_C x_C + \ldots}{m_A + m_B + m_C + \ldots} \qquad y_{cm} = \dfrac{m_A y_A + m_B y_B + m_C y_C + \ldots}{m_A + m_B + m_C + \ldots}$

$v_{cm,x} = \dfrac{m_A v_{A,x} + m_B v_{B,x} + m_C v_{C,x} + \ldots}{m_A + m_B + m_C + \ldots} \qquad v_{cm,y} = \dfrac{m_A v_{A,y} + m_B v_{B,y} + m_C v_{C,y} + \ldots}{m_A + m_B + m_C + \ldots}$

Chapters 9—11 (Exam 3)

For constant α:

$\omega = \omega_0 + \alpha t \qquad \omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0) \qquad \theta - \theta_0 = \omega_0 t + \tfrac{1}{2}\alpha t^2 \qquad \theta - \theta_0 = \left(\dfrac{\omega + \omega_0}{2}\right)t$

$s = r\theta \qquad v = r\omega \qquad a_{tan} = r\alpha \qquad a_{rad} = v^2/r = r\omega^2$

$K = \tfrac{1}{2}I\omega^2 \qquad I = m_A r_A^2 + m_B r_B^2 + \ldots. \qquad U = Mgy_{cm} \qquad K_{total} = \tfrac{1}{2}Mv_{cm}^2 + \tfrac{1}{2}I_{cm}\omega^2$

$\tau = Fl \qquad \sum\tau = I\alpha \qquad \Delta W = \tau\Delta\theta \qquad P = \tau\omega \qquad L = I\omega \qquad \sum\tau = \dfrac{\Delta L}{\Delta t} \qquad L = mvl$

first and second conditions for equilibrium:

$\sum F_x = 0$, $\sum F_y = 0$ and $\sum\tau = 0$ (any axis)

$Y = \dfrac{F_\perp / A}{\Delta l / l_0} \qquad B = -\dfrac{\Delta p}{\Delta V / V_0} \qquad S = \dfrac{F_\parallel / A}{x/h} = \dfrac{F_\parallel / A}{\phi}$

$F_x = -kx \qquad a_x = -\frac{k}{m}x \qquad \omega = 2\pi f \qquad f = \frac{1}{T} \quad U_{el} = \frac{1}{2}kx^2 \qquad K = \frac{1}{2}mv^2$

$x = A\cos\omega t \qquad v_x = -\omega A\sin\omega t \qquad \omega = \sqrt{\frac{k}{m}} \qquad f = \frac{1}{2\pi}\sqrt{\frac{k}{m}} \qquad T = 2\pi\sqrt{\frac{m}{k}}$

$f = \frac{1}{2\pi}\sqrt{\frac{g}{L}} \qquad T = 2\pi\sqrt{\frac{L}{g}}$

Chapters 12, 14—16 (Exam 4)

$v = f\lambda \qquad v = \sqrt{\frac{F_T}{\mu}} \qquad y(x,t) = A\sin\left[2\pi f\left(t - \frac{x}{v}\right)\right] = A\sin\left[2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right)\right]$

$f_n = n\left(\frac{v}{2L}\right),\ n = 1,2,3,... \qquad f_n = n\left(\frac{v}{4L}\right),\ n = 1,3,5,...$

$I = \frac{P}{4\pi r^2} \qquad \beta = (10\text{ dB})\log\left(\frac{I}{I_0}\right) \qquad f_{\text{beat}} = f_1 - f_2 \qquad f_L = \left(\frac{v + v_L}{v + v_S}\right)f_S$

$T_F = \frac{9}{5}T_C + 32° \qquad T_C = \frac{5}{9}(T_F - 32°) \qquad T_K = T_C + 273.15° \qquad 1\text{ C}° = \frac{9}{5}\text{ F}°$

$\Delta L = \alpha L_0 \Delta T \qquad \Delta V = V_0 \beta \Delta T \qquad \frac{F}{A} = -Y\alpha\Delta T$

$Q = mc\Delta T \qquad Q = \pm mL \quad H = kA\frac{T_H - T_C}{L} \qquad H = Ae\sigma T^4$

$\sigma = 5.67\times10^{-8}\text{ W/(m}^2\cdot\text{K}^4) \qquad N = 6.022\times10^{23}\text{ molecules/mol} \qquad m_{\text{total}} = nM$

$pV = nRT \qquad \rho = \frac{pM}{RT} \qquad R = 8.314\text{ J/(mol}\cdot\text{K)} \qquad k = 1.381\times10^{-23}\text{ J/molecule}\cdot\text{K}$

$K_{tr} = \frac{3}{2}nRT \qquad K_{av} = \frac{1}{2}m(v^2)_{av} = \frac{3}{2}kT \qquad pV = NkT \quad v_{rms} = \sqrt{\frac{3kT}{m}} = \sqrt{\frac{3RT}{M}}$

$Q = nC\Delta T \quad W = p\Delta V \qquad W = nRT\ln\left(\frac{V_2}{V_1}\right) \qquad \Delta U = Q - W$

$C_p = C_V + R \qquad p_1V_1^\gamma = p_2V_2^\gamma \qquad T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1} \qquad \gamma = C_p / C_V$

$W = Q = |Q_H| - |Q_C| \qquad e = \frac{W}{Q_H} = 1 - \left|\frac{Q_C}{Q_H}\right| \qquad K = \frac{Q_C}{|W|} = \frac{|Q_C|}{|Q_H| - |Q_C|}$

Carnot: $\frac{Q_C}{Q_H} = -\frac{T_C}{T_H} \qquad e_{\text{Carnot}} = 1 - \frac{T_C}{T_H} \qquad \Delta S = \frac{Q}{T}$

Chapter 13

$\rho = \frac{m}{V} \qquad p = \frac{F_\perp}{A} \qquad p_0 = p_{atm} + \rho gh$