

## Physics 131 Equations – chapters 1-8

### Chapter 2: Motion in One Dimension

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} \quad \bar{a} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$$

$$v = v_o + at \quad \Delta x = v_o t + \frac{1}{2}at^2 \quad v^2 = v_o^2 + 2a\Delta x$$

### Chapter 3: Vectors and Two-Dimensional Motion

$$\bar{v}_{avg} = \frac{\Delta \vec{r}}{\Delta t} \quad \bar{a}_{avg} = \frac{\Delta \vec{v}}{\Delta t} \quad v_x = v_{ox} + a_x t \quad \Delta x = v_{ox} t + \frac{1}{2}a_x t^2 \quad v_x^2 = v_{ox}^2 + 2a_x \Delta x$$
$$v_y = v_{oy} + a_y t \quad \Delta y = v_{oy} t + \frac{1}{2}a_y t^2 \quad v_y^2 = v_{oy}^2 + 2a_y \Delta y$$

### Chapter 4; The Laws of Motion

$$\Sigma \vec{F} = m\vec{a} \quad F_g = G \frac{m_1 m_2}{r^2} \quad w = mg \quad \vec{F}_{12} = -\vec{F}_{21} \quad f_s \leq \mu_s n \quad f_k = \mu_k n$$

### Chapter 5: Energy

$$W = F(\cos\theta)\Delta x \quad W_{net} = \Delta KE \quad KE = \frac{1}{2}mv^2 \quad PE_g = mgy \quad PE_s = \frac{1}{2}kx^2$$
$$KE_i + PE_i + W_{nc} = KE_f + PE_f \quad P_{av} = \frac{W}{\Delta t} \quad P_{av} = Fv_{av}$$

### Chapter 6: Momentum and Collisions

$$\vec{p} = m\vec{v} \quad \vec{I} = \vec{F}\Delta t = \Delta \vec{p} \quad \vec{p}_i = \vec{p}_f \quad \text{elastic: } KE_i = KE_f \text{ and } v_{1i} - v_{2i} = -(v_{1f} - v_{2f})$$

### Chapter 7: Rotational Motion and the Law of Gravity

$$\omega_{av} = \frac{\Delta \theta}{\Delta t} \quad \alpha_{av} = \frac{\Delta \omega}{\Delta t} \quad \omega = \omega_i + \alpha t \quad \Delta \theta = \omega_i t + \frac{1}{2}\alpha t^2 \quad \omega^2 = \omega_i^2 + 2\alpha \Delta \theta$$

$$\theta = \frac{s}{r} \quad v_t = r\omega \quad a_t = r\alpha \quad a_c = \frac{v^2}{r} \quad F = G \frac{m_1 m_2}{r^2}$$

### Chapter 8: Rotational Equilibrium and Rotational Dynamics

$$\tau = rF \sin \theta \quad \Sigma \vec{F} = 0 \quad \Sigma \vec{\tau} = 0 \text{ or } \tau_{cw} = \tau_{ccw} \quad I = \Sigma mr^2 \quad \Sigma \tau = I\alpha$$

$$KE_r = \frac{1}{2}I\omega^2 \quad (KE_t + KE_r + PE)_i = (KE_t + KE_r + PE)_f$$

## Chapters 9-14

### Chapter 9: Solids and Fluids

$$\rho = \frac{M}{V} \quad P = \frac{F}{A} \quad P = P_o + \rho gh \quad P_o = 1.013 \times 10^5 \text{ Pa}$$

$$B = \rho_{\text{fluid}} V_{\text{fluid}} g \quad A_1 v_1 = A_2 v_2 \quad P_1 + \frac{1}{2} \rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2} \rho v_2^2 + \rho g y_2$$

### Chapter 10: Thermal Physics

$$T_C = T - 273.15 \quad T_F = \frac{9}{5} T_C + 32 \quad \Delta L = \alpha L_o \Delta T \quad \Delta A = 2\alpha A_o \Delta T$$

$$\Delta V = \beta V_o \Delta T \quad PV = nRT \quad U = \frac{3}{2} nRT$$

### Chapter 11: Energy in Thermal Processes

$$Q = mc\Delta T \quad \Sigma Q_k = 0 \quad Q = \pm mL$$

### Chapter 12: The Laws of Thermodynamics

$$W = -P\Delta V \quad \Delta U = Q + W \quad \Delta U = nC_v \Delta T \quad Q = nC_p \Delta T \quad PV^\gamma = \text{const}$$

### Chapter 13: Vibrations and Waves

$$F_s = -kx \quad a = -\frac{k}{m}x \quad PE_s = \frac{1}{2}kx^2 \quad T = 2\pi\sqrt{\frac{m}{k}} \quad \omega = 2\pi f = \sqrt{\frac{k}{m}}$$

$$x = A\cos(2\pi ft) \quad v = -\omega A\sin(2\pi ft) \quad a = -\omega^2 A\cos(2\pi ft)$$

$$T = 2\pi\sqrt{\frac{L}{g}} \quad v = f\lambda \quad v = \sqrt{\frac{F}{\mu}}$$

### Chapter 14: Sound

$$v = (331\text{m/s})\sqrt{\frac{T}{273\text{K}}} \quad I = \frac{\text{power}}{\text{area}} = \frac{P}{A} \quad \beta = 10\log\left(\frac{I}{I_o}\right) \quad I = \frac{P_{\text{av}}}{4\pi r^2}$$

$$f_o = f_s \left( \frac{v + v_o}{v - v_s} \right) \quad f_n = nf_1 = \frac{n}{2L} \sqrt{\frac{F}{\mu}} \quad n = 1, 2, 3, \dots$$

$$f_n = n \frac{v}{2L} = nf_1 \quad n = 1, 2, 3, \dots \quad f_n = n \frac{v}{4L} = nf_1 \quad n = 1, 3, 5, \dots$$