

## Formula Sheet for Physics 1B03

### Constants

$$\rho_{air} = 1.29 \text{ kg/m}^3$$

$$P_{atm} = 1.013 \times 10^5 \text{ Pa}$$

$$g = 9.81 \text{ m/s}^2$$

### Area

$$A = \pi R^2, \quad A = 4\pi R^2, \quad A = 2\pi R h$$

### Volume

$$V = \frac{4}{3}\pi R^3, \quad V = \pi R^2 h$$

### Other

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

### Kinematics

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

$$x(t) = v_0 t + \frac{1}{2} at^2$$

$$v_f^2 = v_i^2 + 2a(x_f - x_i)$$

### Newton's Laws

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

$$f_s = \mu_s F_N$$

$$f_k = \mu_k F_N$$

$$\vec{F}_s = -kx$$

### Work and Energy

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

$$U_g = mgh, \quad U_s = \frac{1}{2}kx^2$$

$$E = K + U_g + U_s$$

$$E_f = E_i + W$$

$$W = \int \vec{F} \cdot d\vec{x}$$

$$W = \vec{F} \cdot \vec{x}, \text{ constant force}$$

$$P = \frac{dW}{dt}$$

$$P = \vec{F} \cdot \vec{v}, \text{ constant force}$$

### Momentum

$$\vec{p} = m\vec{v}$$

$$\vec{p} = \int \vec{F} dt = \Delta \vec{p}$$

$$\vec{p} = \vec{F} t, \text{ constant force}$$

$$\sum \vec{p}_i = \sum \vec{p}_f$$

$$v_{1f} \left( \frac{m_1 + m_2}{m_1 - m_2} \right) = v_{1i} \left( \frac{2m_2}{m_1 + m_2} \right) + v_{2i}$$

### Simple Harmonic Motion

$$a = -\omega^2 x$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$$\omega^2 = \frac{k}{m}$$

$$\omega^2 = \frac{g}{l}$$

$$x(t) = A \cos(\omega t + \phi)$$

$$v(t) = -\omega A \sin(\omega t + \phi)$$

$$a(t) = -\omega^2 A \cos(\omega t + \phi)$$

$$E = \frac{1}{2}kA^2$$

### Travelling Waves

$$k = \frac{2\pi}{\lambda}$$

$$v_\omega = f\lambda = \frac{\omega}{k}$$

$$v_\omega = \sqrt{\frac{T}{\mu}}$$

$$y(x, t) = A \sin(kx + \omega t + \phi)$$

### Interference

$$\delta = \text{path difference}$$

$$\delta = m\lambda, \quad (m + \frac{1}{2})\lambda, \quad m = 0, \pm 1, \pm 2, \dots$$

$$\Delta \phi = k\delta$$

$$\delta = d \sin \theta, \quad d = \frac{x}{L}$$

$$\delta = 2nt$$

“low to high, phase shift of  $\pi$ ”

$$n = \frac{\lambda_0}{\lambda_n}$$

### Fluids

$$m = \rho V$$

$$R = A_1 v_1 = A_2 v_2$$

$$F = PA$$

$$P = P_0 + \rho gh$$

$$F_B = \rho_1 V_o g, \quad \rho_1 V_1 g$$

$$P_1 + \rho gh_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho gh_2 + \frac{1}{2}\rho v_2^2$$