Formula Sheet

Student Name:

Student ID:

$$\text{Average speed} = \frac{\text{overall distance traveled}}{\text{Overall time}}$$

$$\text{average velocity } v_{av} = \frac{x_f - x_i}{t_f - t_i}$$

$$\text{average acceleration } a = \frac{v_f - v_i}{t_f - t_i}$$

motion with constant acceleration

1- $\Delta x = (\frac{v_i + v_f}{2}) \times t$

2- $v_f = v_i + at$

3- $v_f^2 = v_i^2 + 2a\Delta x$

4- $\Delta x = v_i t + \frac{1}{2}at^2$

5- $\Delta x = v_f t - \frac{1}{2}at^2$

$$\vec{A} = A_x \hat{x} + A_y \hat{y}$$

$$|\vec{A}| = \sqrt{A_x^2 + A_y^2}$$

$$\theta = \tan^{-1}(\frac{A_y}{A_x})$$

$$work = force \times \text{distance} \times \cos\theta = F\, d \cos\theta$$

$$\text{Kinetic Energy } K.E = \frac{1}{2}mv^2$$

$$\text{Gravitational Potential Energy } P.E_g = mgh$$

$$\text{Elastic Potential Energy } P.E_s = \frac{1}{2}kx^2$$

$$\text{Mechanical Energy} = K.E + P.E$$

work − energy theorem:

$$\sum W = K.E_f - K.E_i = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

conservation of mechanical energy:

$$P.E_{g_i} + P.E_{s_i} + K.E_i + W_{NC} = P.E_{g_f} + P.E_{s_f} + K.E_f$$

Hook's Law: $F_s = -kx$

$$power(P) = \frac{work}{time} = \frac{W}{t}$$

$$power(P) = Force \times speed = Fv$$

$$\text{momentum} \quad P = mv$$

$$\text{Impulse} \quad I = F.\Delta t = P_f - P_i$$

$$\text{acceleration } a = \frac{net\ force}{mass} = \frac{\sum F}{m}$$

The Universal Law of Gravity:

$$F = G\frac{m_1 m_2}{r^2}, \quad G = 6.67\text{x}10^{-11}\ \frac{\text{N.m}^2}{kg^2}$$

Force of friction:

$$f_{s,max} = \mu_s \text{N}$$

$$f_k = \mu_k \text{N}$$

weight: $w = mg$

$$\text{acceleration of gravity } |g| = 9.8\frac{m}{s^2}$$

conservation of momentum

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

Perfectly inelastic collision

$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2)v_f$$

Perfectly inelastic collision

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$\frac{1}{2}m_1 v_{2i}^2 + \frac{1}{2}m_1 v_{2i}^2 = \frac{1}{2}m_1 v_{2f}^2 + \frac{1}{2}m_2 v_{2f}^2$$

$$v_{1i} + v_{1f} = v_{2i} + v_{2f}$$

$$\text{average angular speed } \omega_{av} = \frac{\theta_f - \theta_i}{t_f - t_i}$$

$$\text{average angular acceleration } \alpha = \frac{\omega_f - \omega_i}{t_f - t_i}$$

Relation between linear and angular quantities

$$\Delta x = r\,\Delta\theta$$

$$v = r\,\omega$$

$$a = r\,\alpha$$

motion with constant angular acceleration

1- $\Delta\theta = \left(\frac{\omega_i + \omega_f}{2}\right) \times t$

2- $\omega_f = \omega_i + \alpha t$

3- $\omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$

4- $\Delta\theta = \omega_i t + \frac{1}{2}\alpha t^2$

5- $\Delta\theta = \omega_f t - \frac{1}{2}\alpha t^2$

$$\text{Centrpetal acceleration } a_c = \frac{v^2}{r} = r\omega^2$$

$$\text{Tangential acceleration } a_t = \frac{v_f - v_i}{t_f - t_i} = r\alpha$$

$$\text{Total acceleration} = \sqrt{a_c^2 + a_t^2}$$

$$\text{Centrpetal force } F_c = ma_c = m\frac{v^2}{r}$$

$$\text{Torque } \tau = rF\sin\theta$$