PHYS 1050 Tutorial 2: Formula Sheet

Mathematics

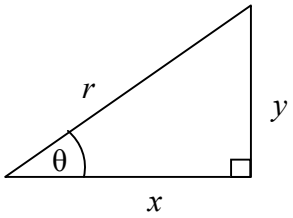
Quadratic equation:

$$ax^2 + bx + c = 0$$

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

Trigonometry:

2π rad = 360° $\quad x^2 + y^2 = r^2$



$$\sin\theta = y/r$$
$$\cos\theta = x/r$$
$$\tan\theta = y/x$$

Vectors:

$$a \cdot b = ab\cos\theta$$
$$= a_x b_x + a_y b_y + a_z b_z$$

Calculus:

$$\frac{d}{dt}\left(t^n\right) = nt^{n-1} \qquad \int x^n dx = \frac{x^{n+1}}{n+1}$$

Constants and Units

k = 10^3, μ = 10^{-6}, n = 10^{-9}
g = 9.80 m/s^2
1 N = 1 kg m/s^2

Translational Kinematics

One dimension:

$$v_{\text{avg}} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1} \qquad v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

$$a_{\text{avg}} = \frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{t_2 - t_1} \qquad a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$$

Three dimensions:

$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

$$\vec{v}_{\text{avg}} = \frac{\Delta \vec{r}}{\Delta t} = \frac{\vec{r}_2 - \vec{r}_1}{t_2 - t_1} \qquad \vec{v} = \frac{d\vec{r}}{dt}$$

$$\vec{a}_{\text{avg}} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{t_2 - t_1} \qquad \vec{a} = \frac{d\vec{v}}{dt}$$

Constant acceleration in one dimension:

$$x = x_0 + v_0 t + \tfrac{1}{2} a t^2$$
$$v = v_0 + at$$
$$v^2 = v_0^2 + 2a(x - x_0)$$

Projectile motion (a_y = -g):

$$v_{0x} = v_0 \cos\theta_0$$
$$v_{0y} = v_0 \sin\theta_0$$
$$x = x_0 + v_{0x} t$$
$$y = y_0 + v_{0y} t - \tfrac{1}{2} g t^2$$
$$v_y = v_{0y} - gt$$
$$v_y^2 = v_{0y}^2 - 2g(y - y_0)$$

Uniform circular motion:

$$a = \frac{v^2}{r} \qquad T = \frac{2\pi r}{v} = \frac{2\pi}{\omega} = \frac{1}{f} \quad \text{period}$$

Relative Motion

$$\vec{v}_{AC} = \vec{v}_{AB} + \vec{v}_{BC}$$
$$\vec{v}_{AB} = -\vec{v}_{BA}$$
(AB means A relative to B, etc.)

Particle Dynamics

$$\vec{F} = m\vec{a} \qquad W = mg \quad \text{weight}$$

$$\vec{F}_{12} = -\vec{F}_{21}$$