

## FORMULA SHEET

- Vectors:

$$\vec{A} \cdot \vec{B} = AB \cos \theta$$

$$|\vec{A} \times \vec{B}| = AB \sin \theta$$

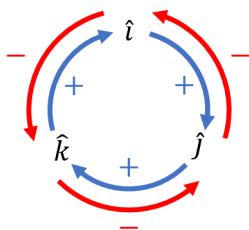


Figure 1: Cyclic permutations for cross product

- Kinematics:

$$g = 9.8 \text{ m/s}^2$$

$$\Delta x = v_0 t + \frac{1}{2} a t^2$$

$$v = v_0 + a t$$

$$v^2 = v_0^2 + 2a \Delta x$$

- Forces:

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

$$W = m g$$

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

$$f_k = \mu_k N$$

- Circular Motion:

$$a_c = \frac{v^2}{r}$$

$$v = \frac{2\pi r}{T}$$

- Gravity:

$$G = 6.67 \times 10^{-11} \frac{\text{Nm}^2}{\text{kg}^2}$$

$$F_g = G \frac{mM}{r^2}$$

$$a_g = G \frac{M}{r^2}$$

$$T^2 = \frac{4\pi^2}{GM} a^3 \quad (\text{Kepler's third law})$$

- Work & Energy:

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

$$U_g = mgy$$

$$W = F\Delta x \cos \theta$$

$$W_{tot} = \Delta K$$

$$W_{cons} = -\Delta U$$

$$W_{other} = \Delta E$$

$$K_i + U_i + W_{nc} = K_f + U_f$$

$$P = \frac{\Delta E}{\Delta t}$$

$$P = Fv \text{ (at constant velocity)}$$

- Linear Momentum:

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

$$\sum \vec{F}_{ext,sys} \frac{\Delta \vec{p}_{sys}}{\Delta t}$$

$$m_A \vec{v}_{Ai} + m_B \vec{v}_{Bi} = m_A \vec{v}_{Af} + m_B \vec{v}_{Bf}$$

$$v_{1i} - v_{2i} = v_{2f} - v_{1f} \text{ (elastic collisions)}$$

$$\vec{J} = \vec{F}_{av} \Delta t$$