

# Equation Sheet for PHYS-114 (Knight)

## Descriptions of Motion

$$\Delta \vec{r} = \vec{r}_f - \vec{r}_i \quad \vec{v}_{\text{avg}} = \frac{\Delta \vec{r}}{\Delta t} \quad v_x = \frac{dx}{dt} \quad \vec{a}_{\text{avg}} = \frac{\Delta \vec{v}}{\Delta t} \quad a_x = \frac{dv_x}{dx}$$

## Kinematic Equations of Motion

$$v_{xf} = v_{xi} + a_x \Delta t \quad x_f = x_i + v_{xi} \Delta t + \frac{1}{2} a_x \Delta t^2 \quad v_{xf}^2 = v_{xi}^2 + 2a_x(x_f - x_i)$$
$$v_{yf} = v_{yi} + a_y \Delta t \quad y_f = y_i + v_{yi} \Delta t + \frac{1}{2} a_y \Delta t^2 \quad v_{yf}^2 = v_{yi}^2 + 2a_y(y_f - y_i)$$

## Forces and Motion

$$\sum \vec{F} = m\vec{a} \quad f_s = \mu_s n \quad f_k = \mu_k n \quad w = mg \quad \vec{F}_{\text{AonB}} = -\vec{F}_{\text{BonA}}$$

## Momentum and Impulse

$$\vec{p} = m\vec{v} \quad \vec{J} = \int_{t_1}^{t_2} F(t) dt = \Delta \vec{p} = \vec{p}_f - \vec{p}_i$$

## Kinetic and Potential and Energy

$$K = \frac{1}{2}mv^2 \quad U_g = mgy \quad F = -k\Delta x \quad U_{\text{sp}} = \frac{1}{2}k\Delta x^2$$

## Work and Energy

$$W_{\text{net}} = \Delta K \quad W_c = -\Delta U \quad W_{\text{net}} = W_c + W_{\text{nc}}$$

$$W_{\text{nc}} = W_{\text{diss}} + W_{\text{ext}} \quad W_{\text{diss}} = -\Delta E_{\text{therm}}$$

$$W = \vec{F} \cdot \Delta \vec{r} = F \Delta s \cos \theta \quad W = \int_{\vec{r}_i}^{\vec{r}_f} \vec{F} \cdot d\vec{r}$$

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

## Rotational Kinematics

$$\theta = \frac{s}{r} \quad \omega = \frac{d\theta}{dt} = \frac{v_t}{r} \quad \alpha = \frac{a_t}{r} \quad a_r = \frac{v_t^2}{r} = \omega^2 r$$

$$\omega_f = \omega_i + \alpha \Delta t \quad \theta_f = \theta_i + \omega_i \Delta t + \frac{1}{2} \alpha \Delta t^2 \quad \omega_f^2 = \omega_i^2 + 2\alpha \Delta \theta$$

## Torque and Moment of Inertia

$$\vec{\tau} = \vec{r} \times \vec{F} \quad \tau = rF \sin \phi \quad I = \beta mr^2 \quad \sum \tau = I\alpha$$

## Rotational Kinetic Energy and Angular Momentum

$$K = \frac{1}{2}I\omega^2 \quad \mathbf{L} = I\omega$$

## Math Equations

$$\text{If } at^2 + bt + c = 0 \text{ then } t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\vec{A} \cdot \vec{B} = AB \cos \theta = A_x B_x + A_y B_y + A_z B_z$$