Physics 250 Final Equation Sheet

Velocity and acceleration: $v_{av} = \frac{\Delta x}{\Delta t}$ $a_{av} = \frac{\Delta v}{\Delta t}$

Constant velocity: $x_B = x_A + v_{AB}\Delta t_{AB}$

Constant acceleration: $v_B = v_A + a_{AB}\Delta t_{AB}$

$$x_B = x_A + v_A\Delta t_{AB} + \frac{a_{AB}}{2}\Delta t_{AB}{}^2$$

$$v_B^2 = v_A^2 + 2a_{AB}\Delta x_{AB}$$

$$x_B = x_A + \left(\frac{v_A + v_B}{2}\right)\Delta t_{AB}$$

Circular motion: $a_{rad} = {v^2}/{r}$ $F_{rad} = {mv^2}/{r}$

Forces: $\vec{a} = {\overrightarrow{F_{net}}}/{m}$ $w = mg$ $f_s \leq \mu_s n$ $f_k = \mu_k n$ $f_r = \mu_r n$

$$f_{spring} = -kx$$

Energy: $W_{net} = \int \overrightarrow{F_{net}} \cdot \overrightarrow{ds} = \int_{x_A}^{x_B} \overrightarrow{F_{net}} \cdot \left(\hat{\imath} + \frac{dy}{dx}\hat{\jmath}\right) dx$

$$W_{net} = \Delta K \qquad E_f = E_i + W_{other}$$

$$\Delta U = -W_{Cons} \qquad K = \frac{1}{2}mv^2 \qquad U_g = mgh \qquad U_s = \frac{1}{2}kx^2$$

$$P = \frac{dW}{dt} = \vec{F} \cdot \vec{v}$$

Momentum: $\vec{p} = m\vec{v}$ $\vec{J} = \vec{F}\Delta t$ $\vec{J} = \Delta\vec{p}$

Rigid body rotation in a plane:

Linear Quantity	Angular Quantity	Link/ definition
s	θ	$s = r\Delta\theta$
v	ω	$v_{tan} = r\omega$
a	α	$a_{tan} = r\alpha$
M	I	$I_{point} = mr^2$
F	τ	$\tau = rFsin(\theta)$
P	L	$L = I\omega = rmvsin(\theta)$
F=ma	$\tau = I\alpha$	n/a

Moments of inertia of shapes about axes will be given in problems if needed.

Rotation in 3D: $\vec{\tau} = \vec{r} \times \vec{F}$ $\vec{L} = \vec{r} \times \vec{p}$ $\vec{\tau} = \frac{d\vec{L}}{dt}$

Simple Harmonic Motion:

$x = A\cos(\omega t + \varphi)$ $\omega = 2\pi f = 2\pi/T$ $\omega = \sqrt{k/m}$

Waves:

$y(x,t) = A\sin(kx \pm \omega t + \varphi)$ $k = 2\pi/\lambda$ $v = \sqrt{F/\mu}$

$f_n = \frac{n}{2L}\sqrt{F/\mu}$ $v = f\lambda$ $v = \omega/k$

Constants: $g = 9.80\ m/s^2$