Study Guide for Test 3

Energy-Related Definitions:

(Kinetic energy) $= K = \frac{1}{2}m|\vec{v}|^2$

(Gravitational potential energy) $= U_g = mgy$

(Spring potential energy) $= U_s = \frac{1}{2}kx^2$, where $k = |F_x/x|$

For any position-dependent force $\vec{F}$, $F_x = -dU/dx$

Work $= W = \vec{F} \cdot \vec{\Delta x} = |\vec{F}||\vec{\Delta x}| \cos\theta$

$$\text{Power} = \frac{\text{energy converted}}{\text{time elapsed}}$$

1 calorie = (energy to raise temperature of 1 g water by 1°C) = 4.186 J

Energy-Related Theorems:

Energy conservation: $E_{\text{final}} = E_{\text{initial}}$ (for any isolated system, if *all* forms of energy are included)

Mechanical energy conservation: $K_f + U_f = K_i + U_i$ (if no other forms of energy are involved, in particular, no fuels consumed or thermal energy created)

Work-energy theorem: $\sum W = K_f - K_i$

Rotational motion

You should understand the table of analogies, and be able to use it to remember relations among angular variables.

Linear Motion	Rotational Motion
t	t
x	θ
v_x	ω
a_x	α
m	I
F_x	τ
$\sum F_x = ma_x$	$\sum \tau = I\alpha$
$p_x = mv_x$	$L = I\omega$
$K_{\text{trans}} = \frac{1}{2}mv_x^2$	$K_{\text{rot}} = \frac{1}{2}I\omega^2$

You should also know the following relations between linear and rotational quantities, where t indicates the tangential component of a vector and the sums run over all parts of the object or system:

$$\omega = \frac{v_t}{r} \qquad \alpha = \frac{a_t}{r} \qquad I = \sum_i m_i r_i^2 \qquad \tau = r\,F_t \qquad L = \sum_i r_i\,p_{t,i}$$