Physics 2305 23 February, 2000
Study Guide for Exam 2

Exam 2 will have a format similar to the previous exam (it might have fewer questions). The exam will cover Chapters 7 through 13, which is a great deal of material.

A good start to your preparation would be to read the Review and Summary sections at the end of each chapter. The exam will once again include an equation sheet, but without an explanation of the limits and use for each equation. Equations and concepts with which you should be particularly familiar are:

Chapter 7

Work (variable force)	$W = \int \mathbf{F}(\mathrm{r})\bullet \mathrm{d}\mathbf{r}$
Work (constant force)	$W = \mathbf{F} \bullet \mathbf{d}$
Kinetic Energy	$K = ½\ m\ v^2$
Hooke's Law	$\mathbf{F} = -k\ \mathbf{d}$
Work-Energy Principle	$W = \Delta K$
Power	$P = \mathrm{d}W/\mathrm{d}t$
Power (constant force)	$P = \mathbf{F} \bullet \mathbf{v}$

Chapter 8

Potential Energy	$\Delta U = -W$	
Gravitational Potential Energy	$U_g = m\ g\ h$	(you can derive this)
Elastic Potential Energy	$U_e = ½\ k\ x^2$	(you can derive this)
Conservation of Energy	$E_1 = E_2$	

You should thoroughly understand the principle of conservation of energy, including the energy dissipated by non-conservative forces.

Chapter 9

Location of Center of Mass	$\mathbf{r}_{\mathrm{cm}} = \Sigma\ m_i\ \mathbf{r}_{\mathrm{i}} / \Sigma\ m_i$
Velocity of Center of Mass	$\mathbf{v}_{\mathrm{cm}} = \Sigma\ m_i\ \mathbf{v}_{\mathrm{i}} / \Sigma\ m_i$
Linear Momentum	$\mathbf{p} = m\ \mathbf{v}$
General Form of Newton's 2d Law	$\Sigma\ \mathbf{F} = \mathrm{d}\mathbf{p}/\mathrm{d}t$

Chapter 10

The key to the chapter: *momentum is always conserved in collisions.* (Energy is only conserved in elastic collisions, which is a special case.)

Impulse	$\mathbf{J} = \Delta\mathbf{p} = \int \mathbf{F}(t)\, dt$
Conservation of Momentum	$\mathbf{p}_i = \mathbf{p}_f$

You should understand the significance of completely inelastic collisions.

For general elastic collisions, the following three equations hold. They will appear on the equation sheet with no explanation.

$v_{1i} - v_{2i} = v_{2f} - v_{1f}$;

$v_{1f} = (m_1 - m_2)(v_{1i}/M) + 2m_2 (v_{2i}/M)$;
$v_{2f} = 2m_1 (v_{1i}/M) + (m_2 - m_1)(v_{2i}/M)$;

where $M = m_1 + m_2$.

For elastic collisions with a stationary target ($v_{2i} = 0$), the algebra is a little simpler, and you should be familiar with (or be able to derive) the results for the following special cases:

$m_1 = m_2$;
$m_1 >> m_2$;
$m_1 << m_2$.

Chapter 11

Rotation	Translation	Definition	Relation (rad)
$\theta = (½)\,\alpha t^2 + \omega_o t + \theta_o$	$x = (½)\,at^2 + v_o t + x_o$		$s = \theta\, r$
$\omega = \alpha t + \omega_o$	$v = at + v_o$	$\omega = d\theta/dt$	$v = \omega\, r$
$\omega^2 = \omega_o^2 + 2\alpha(\theta-\theta_o)$	$v^2 = v_o^2 + 2a(x-x_o)$	$\alpha = d\omega/dt$	$a_t = \alpha\, r$

Centripetal acceleration (radians)	$a_r = v^2/r = \omega^2 r$
Angular frequency	$\omega = 2\pi/T$
Moment of inertia	$I = \Sigma\, m_i\, r_i^2$
Parallel axis theorem	$I = I_{cm} + Mh^2$

Rotational inertias in Table 11-2 will be provided as needed on the exam.

Chapter 12

Torque	$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$
Angular Momentum	$\mathbf{l} = \mathbf{r} \times \mathbf{p}$

From these, several more equations can be derived (in radians). These are listed below with their translational analogs.

$K = (½)\, I\omega^2$	$K = (½)\, mv^2$
$\sum \tau = I\alpha$	$\sum F = ma$
$\sum \tau = d\mathbf{l}/dt$	$\sum \mathbf{F} = d\mathbf{p}/dt$
$W = \int \tau \, d\theta$	$W = \int F \, dx$
$P = \tau\omega$	$P = Fv$

Rotating rigid body about fixed axis (radians)	$L = I\omega$
Rolling motion (radians)	$v_{cm} = \omega R$
Kinetic energy for rolling (radians)	$K = (½)\, I\omega^2 + (½)\, mv^2$

You should understand the principle of conservation of angular momentum.

Chapter 13

Section 13-1 defines the conditions for equilibrium and static equilibrium. Sections 13-1 to 13-4 introduce no new physics, only the application of what we have already learned to situations in equilibrium.