Exam 3 Study Tips

1. Elastic Collisions

Memorize the 3 head-on elastic collision cases described here (http://hyperphysics.phy-astr.gsu.edu/hbase/colsta.html).
And the glancing collision case described here (http://www.education.com/science-fair/article/linear-momentum-find-perfect-90/).

2. Rotational Motion

Memorize all of the following equations:

	Linear Motion	Rotational Motion	
Position	x	θ	Angular position
Velocity	v	ω	Angular velocity
Acceleration	a	α	Angular acceleration
Motion equations	$x = \bar{v}t$	$\theta = \bar{\omega}t$	Motion equations
	$v = v_0 + at$	$\omega = \omega_0 + \alpha t$	
	$x = v_0 t + \frac{1}{2}at^2$	$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$	
	$v^2 = v_0^2 + 2ax$	$\omega^2 = \omega_0^2 + 2\alpha\theta$	
Mass (linear inertia)	m	I	Moment of inertia
Newton's second law	$F = ma$	$\tau = I\alpha$	Newton's second law
Momentum	$p = mv$	$L = I\omega$	Angular momentum
Work	Fd	$\tau\theta$	Work
Kinetic energy	$\frac{1}{2}mv^2$	$\frac{1}{2}I\omega^2$	Kinetic energy
Power	Fv	$\tau\omega$	Power

3. Torque

Memorize and understand the formula for torque

$$\vec{\tau} = \vec{r} \times \vec{F}$$

4. Cross Products and Right Hand Rules

Understand how to apply the Right-Hand Rule to obtain the direction of torque.
Understand how to use your right hand to determine the direction of rotation given the direction of the angular velocity vector.

5. Understand the difference between tangential and radial acceleration

Imagine a spot on a rotating platter.

The spot's tangential acceleration α

Is 0 if the angular velocity is constant
Points in a direction perpendicular to the radial line between the spot and the platter's spindle.
Is given by

$$\alpha = \frac{a_{\tan}}{r}$$ where $a_{\tan}$ is the spot's instantaneous linear acceleration

The spot's radial acceleration

Is 0 only if the angular velocity is 0
Is the same as centripetal acceleration, i.e.

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

6. Understand levers and pulleys.

See posts for Week 9 on Blackboard

7. Understand Moment of Inertia (*I*)

The farther mass is distributed away from the axis of rotation, the higher is *I*
The moment of inertia of simple of objects is given by $I = \beta MR^2$.
The bigger the β, the slower it rolls.
For a hoop, $I = MR^2$.

8. Bonus and Insurance Knowledge:

* Angular momentum of *non*-rotating object about point:

$$\vec{L} = \vec{r} \times \vec{p}$$ where r is the displacement of the object from the point in question, and p is the object's linear momentum.

* Calculation of the rate of precession of a gyroscope.

Follows from the alternative expression of Newton's Law for rotating objects,

$$\vec{\tau} = \frac{\Delta \vec{L}}{\Delta t}$$, and trigonometry. See your textbook.

***** Calculation of speed of rolling objects