

## Unit 6: Rotational Mechanics

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**Text:**

Chapter 11 &amp; 12.

*Questions (p. 309-10)*

17, 18, 21

*Exercises & Problems (p. 310-18)*

#1: 5, 7, 11, 15, 19, 21

*rotational variables*

#2: 27, 31, 32, 35, 41

*linear and angular*

#3: 45, 47, 50, 51, 52, 54, 57\*

*rotational inertia and kinetic energy*

#4: 60, 63, 65, 67, 69, 73

*torque*

#5: 78, 80, 82, 86

*work and energy**Questions (p. 344-45)*

4, 11, 12, 17, 18

*Exercises & Problems (p. 345-52)*

#6: 2, 3, 10, 13

*rolling*

#7: 28, 42, 44, 52, 60

*angular momentum***Vocabulary:**

Moment of Inertia, rotational inertia, radian, linear vs. angular measurements, torque, precession, radial acceleration, tangential acceleration, angular momentum, stability

**Math:**

definitions:

$$\omega = \frac{d\theta}{dt} \quad \alpha = \frac{d\omega}{dt} \quad s = r\theta \quad \vec{\tau} = \vec{r} \times \vec{F}$$

$$\vec{L} = \vec{r} \times \vec{p} \quad I = \sum mr^2 = \int r^2 dm$$

derived formulas:

$$\bar{\omega} = \frac{\omega_i + \omega_f}{2} \quad v = r\omega \quad a_t = r\alpha \quad a_c = r\omega^2$$

$$K = \frac{1}{2} I\omega^2 \quad \sum \tau = I\alpha \quad L = I\omega \quad W = \int \tau d\theta$$

$$\Omega = \frac{rMg}{I\omega}$$

skills:

cross products

**Key Objectives:**

- be able to show/derive the derived formulas listed above.
- be able to solve a variety of word problems involving angular position, velocity and acceleration and their linear counterparts.
- be able to apply Newton's Second Law in angular form to a variety of situations.
- be able to calculate the moment of inertia for a given situation. (be prepared for a choice: one requiring calculus and one using just algebra. You will be given the chart from page 297 of the book.)
- be able to apply energy principals to solve a variety of word problems.
- be able to apply the conservation of angular momentum to a variety of situations.
- be able to explain/use/understand the vocabulary and formulas listed above.
- be able to solve word problems numerically and symbolically.
- be able to use the right hand rules discussed in class.
- be able to explain why a gyroscope precesses. (the rotating bicycle wheel hanging from the ceiling is an example of this.)
- be able to explain why an object is much more stable when rotating/rolling than non-rotating.

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