Lecture 08

Chapter 5: Using Newton’s Laws

- Using Second Law of Newton
- Multiple Objects
- Circular Motions
First Law of Newton
Example 1: No Motion (Static)

An adventurous hiker crosses between two cliffs by slowly going hand over hand along a rope. The rope will break if the tension in it exceeds 25,000N and the hiker’s mass is 90 kg. If the angle is 10.0°, find the tension in the rope.

Concept: Tension
Example 2

A 75.0 kg wrecking ball hangs from a uniform heavy duty chain having a mass of 26-kg. (a) Find the maximum and minimum tension in the chain; (b) What is the tension at a point ¾ of the way up from the bottom of the chain?
Second Law of Newton
Example 3  (Circular Motion)

A ball is on a 2.1-m string which makes an angle of $44^\circ$ with the vertical as it moves around the pole in a horizontal plane. If the mass of the ball is 1.3-kg, what is ball’s speed?

A. 3.7 m/s  
B. 2.9 m/s  
C. 3.4 m/s  
D. 4.2 m/s  
E. None of above
Example 4  (Circular Motion)

A jet plane flies at a constant speed in a vertical circular loop. At what point in the loop does the seat exert the greatest force on the pilot? The least force?
Clicker Question 1

The reason an astronaut in an earth orbit satellite feels weightless is that

A. The astronaut is beyond the range of the Earth’s gravity.
B. The astronaut and the satellite are falling
C. The astronaut is at a point in space where the effects of Moon’s gravity and Earth’s gravity cancel.
D. The astronaut’s acceleration is zero
E. None of above.
Clicker Question 2

An object moves in a circle. If the radius is reduced to one third, the speed halved, and the mass unchanged, then the centripetal force must change by a factor of:

A. 6  
B. 3/2  
C. 3/4  
D. 9/2  
E. 9/4
Example 5

Three books (X, Y, Z) rest on a table. The weight of each book is indicated. The forces of book Z on book Y is.

A. 0
B. 5 N
C. 9 N
D. 14 N
E. 19 N

Concept: Normal force
Example 6

Block A, with a mass of 10.0-kg, rest on a 30° incline. The attached string is parallel to the frictionless incline and passes over a massless, frictionless pulley at the top. Block B, with a mass of 8.0-kg, is attached to the dangling end of the string. The acceleration of B is:

Block A and block B move in the same speed!
**SUMMARY**

**Common forces:**
- Gravity
- Tension: in a rope, string, cable...
- Normal force: perpendicular to surface
- Friction: between surfaces
- Restoring force: spring, elastic material

**Typical Motions:**
- Static state \((v=0)\); circular motions; multiple objects