Crate on a ramp

Do Now #1

- Given a crate with mass = 80 kg
- Crate is resting on horizontal ground
- Draw the Free Body Diagram for this crate

Crate on ground

- Fg = 80 x 9.8 = 784 N (down)
- Fn = 784 N (up)

Crate on a ramp

- Crate with mass = 80 kg
- At rest on a ramp
- Ramp makes angle of 30 degrees above horizontal
- Draw Free Body Diagram

- Fg = mg = 80 x 9.8 = 784 N (down)
- Fg (perpendicular to the ramp) = mg cos 30 =
- 80 x 9.8 x 0.866 = 679 N (down)
- Fn (perpendicular to the ramp) = 6 79 N (up)
- Fg (parallel to the ramp) = mg sin 30 =
- 80 x 9.8 x 0.50 = 392 N (down)
- Ff static must be at least 392 N; otherwise, the crate will start to slide down the ramp !!!

Ramp Procedure

- 1. Establish the ramp as X – axis (up is positive; down is negative)
- 2. Establish perpendicular as Y – axis (up is positive; down is negative)
- 3. Fg = mg (straight down)
- 4. Fg(perpendicular to ramp) = mg cos(angle)
- 5. Fn = mg cos (angle) (N) (positive)
- 6. Fg(parallel to ramp) = mg sin(angle)

Example

- Given a crate with mass = 25 kg
- At rest on a ramp
- Ramp makes angle of 15 degrees above the horizontal
- Determine Fg, Fn, F(parallel).

Solution to Example

- 1. Establish ramp as X axis
- 2. Establish perpendicular as Y axis
- 3. Fg = mg = 25 x 9.8 = 245 N (down)
- 4. Fn = mg cos(angle) = 245 cos (15) = 237 N
- 5. F(parallel) = mg sin(angle) = 245 sin(15) = 63 N

Group Activity

- Given a crate with mass = 25 kg
- Crate is at rest on a ramp.
- Ramp makes various angles above the horizontal.
- Determine Fg, Fn, F(parallel)
- 1. 25 degrees above horizontal
- 2. 35 degrees above horizontal
- 3. 45 degrees above horizontal
- 4. 55 degrees above horizontal

Answers to Group Activity

- Fg = mg = 25 x 9.8 = 245 N
- 1. 245 N; 222 N; 104 N
- 2. 245 N; 201 N; 141 N
- 3. 245 N; 173 N; 173 N
- 4. 245 N; 141 N; 201 N