Dynamics Problems with Non-collinear Forces (no friction)

1. A mule pulls a frictionless 500.0 kg cart with a constant force of 460 N, exerted at an angle of 30° above horizontal.
   a) Draw the free-body diagram of the cart, with all forces labeled and calculated.
   b) What is the acceleration of the cart?

2. Bif and Hap both want the 12.0 kg file cabinet. Bif pulls to the left with a force of 200 N. Hap exerts a force of 200 N to the right, at an angle of 30° above horizontal.
   a) Draw the free-body diagram of the cabinet, with all forces labeled and calculated.
   b) What is the speed and direction of the cabinet 2.0 s after they both start pulling?

3. A worker pushes a 110 kg box, initially at rest, across a frictionless floor. She exerts a 400 N force on the box, at an angle of 45° below horizontal. How long does it take for the box to slide 5.0 meters?

4. A 1.0 kg cart, initially at rest, slides down a frictionless 30.0° ramp which is 5.0 m long. How fast is the cart going at the bottom of the ramp?
5. A 2.0 kg ball is returning up a 45° ramp at the bowling alley. The ramp is 1.3 m long.
   a) Draw the free-body diagram of the ball, with all forces labeled and calculated.
   b) What was the initial velocity of the ball if it came to a complete stop at the top?

6. A 0.50 kg frictionless puck is shot up a ramp at time t = 0 seconds. It travels 6.0 m up along the ramp, then slides back down to the starting point. The entire event lasts 3.6 s.
   a) From kinematics, determine the acceleration of the puck.
   b) Draw the free-body diagram of the puck, with all forces labeled and calculated.
   c) What was the ramp angle?

7. A frictionless chute is set at a 15° angle. A 9.0 kg trunk is accelerated down the chute by a force of $F_A = 20.0$ N applied to the trunk handle, and acting parallel to the ramp surface. The trunk slides down the chute in 1.0 second. How long is the chute?