Dynamics Problems with Collinear Forces (no friction)

1. A 120 kg crate, initially at rest, is pushed across a frictionless floor with a horizontal applied force of $F_A = 65 \text{ N}$.
   a) Draw the free-body diagram, with all forces labeled and calculated.
   b) Calculate the acceleration of the crate.
   c) How long does it take for the crate to travel 10.0 m?

2. A cart is initially moving at 10.0 m/s. It speeds up at a constant rate such that 2.0 s later, its velocity is 22.0 m/s. An 85.0 kg box is positioned against the back of the cart. Draw the free-body diagram, with all forces labeled and calculated. (Hint: two $F_N$s act on the box.)

3. Mama is trying to push Papa’s ugly 40.0 kg recliner off a cliff, but Papa is trying to get it back in the house. Mama pushes due east with a force of 200.0 N. How hard did Papa push if the chair accelerates to the west at 0.50 g’s?

4. A fisherman carrying a 1.4 kg fish on a line gets into an elevator. The elevator accelerates upward at 3.0 m/s². What is the force of tension in the fishing line as the elevator ascends?
5. A 32.0 kg crate is resting on the floor of an elevator. A 10.0 kg dog sits on the crate.
   a) The elevator is traveling upward with a constant velocity of 4.5 m/s. Draw the free
      body diagram of the crate and calculate all the forces.
   b) Now the elevator accelerates upward at 2.5 m/s². What forces act on the dog?

6. A boy in an elevator has a weight of F_g = 300 N and a normal force of F_N = 200 N.
   a) Calculate his mass and acceleration.
   b) The elevator could be traveling up or down. Explain how this is possible.

7. Poor Mildred has a mass of only 44.0 kg (she eats like a bird). She got on an elevator at a
   height of 75.0 m. But the out-of-control elevator accelerated downward at a high rate,
   reaching the ground level 5.20 seconds later.
   a) In her final moments, did Mildred feel heavier than usual or lighter?
   b) What was the normal force acting on her?

8. A 75,000 kg rocket is taking off straight up from its launch pad on Earth. The force of
   thrust on the rocket is 2.60 *10⁶ N. Inside the rocket is an 85.0 kg astronaut.
   a) How many g’s is the astronaut subjected to?
   b) What is his normal force?