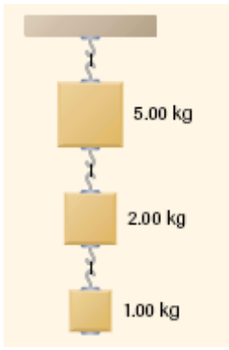
Forces Review Sheet

Instructions: Fold the answers over so you can't see them. In pairs for question 1, one of the pair will act as a scribe (writing what the other tells them to do), while the second will tell the first how to do the problem. If the person gets stuck, the scribe can coach as to how to do the next step. For question 2, alternate roles. Repeat this for all 10 questions.

1. A basketball is thrown so that it experiences projectile motion as it travels toward the basket. Air resistance is negligible. Draw an FBD of the ball
   a. as it is rising,
   b. as it arrives at the top of its flight, and
   c. as it moves downward.

2. A shark, of mass 95 kg, is swimming with a constant velocity of 7.2 m/s [32° above the horizontal]. What is the net force acting on the shark?

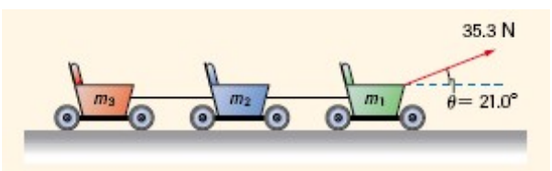
3. The figure to the right shows three masses (5.00 kg, 2.00 kg, and 1.00 kg) hung by threads.
   a. Draw an FBD for the bottom mass. Determine the magnitude of the tension in the lowest thread.
   b. Repeat (a) for the middle mass and the tension in the middle thread.
   c. Repeat (a) for the top mass and the tension in the highest thread.



4. Just after a space shuttle is launched, its acceleration is about 0.50*g* [up]. The shuttle's mass, including fuel, is approximately 2.0×10^6 kg.
   a. Calculate the approximate magnitude of the upward force on the shuttle.
   b. What causes the upward force?

5. Two boxes, of masses $m_1 = 35$ kg and $m_2 = 45$ kg, are hung vertically from opposite ends of a rope passing over a rigid horizontal metal rod. The system starts moving from rest. Assuming that friction between the rod and the rope is negligible, determine the magnitude of
   a. the acceleration of the boxes
   b. the tension in the rope
   c. the magnitude of each box's displacement after 0.50 s

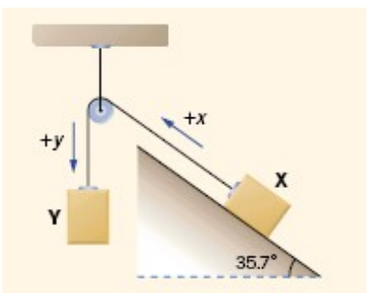
6. A store clerk pulls three carts connected with two horizontal cords to move products from the storage room to the display shelves. The masses of the loaded carts are: $m_1 = 15$ kg; $m_2 = 13.2$ kg; and $m_3 = 16.1$ kg. Friction is negligible. A third cord, which pulls on cart 1 and is at an angle of 21.0° above the horizontal, has a tension of magnitude 35.3 N. Determine the magnitude of
   a. the acceleration of the carts
   b. the tension in the last cord
   c. the tension in the middle cord



7. A hotel guest starts to pull an armchair across a horizontal floor by exerting a force of 91 N [15° above the horizontal]. The normal force exerted by the floor on the chair is 221 N [up]. The acceleration of the chair is 0.076 m/s^2 [fwd].
   a. Determine the mass of the chair.
   b. Determine the magnitude of the friction force on the chair.

8. A child on a toboggan slides down a hill with an acceleration of magnitude 1.5 m/s^2. If friction is negligible, what is the angle between the hill and the horizontal?

9. Blocks X and Y, of masses $m = 5.12$ kg and $m = 3.22$ kg, are connected by a fishing line passing over an essentially frictionless pulley (as shown)
   a. Show that block X slides up the incline with a positive acceleration. Determine the magnitude of that acceleration. Friction is negligible.
   b. Determine the magnitude of the tension in the fishing line.



10. A figure skater of mass $m = 56$ kg pushes horizontally for 0.75 s with a constant force against the boards at the side of a skating rink. Having started from rest, the skater reaches a maximum speed of 75 cm/s. Neglecting friction, determine the magnitude of
    a. the (constant) acceleration
    b. the force exerted by the skater on the boards
    c. the force exerted by the boards on the skater
    d. the displacement of the skater from the boards after 1.50 s

Answers: 2. 0 N 3. (a) 9.80 N (b) 29.4 N (c) 78.4 N 4. (a) 2.9 x10^7 N 5. (a) 1.2 m/s^2 (b) 3.9 x 10^{2}N (c) 0.15 m 6. (a) 0.744 m/s^2 (b) 12.0 N (c) 21.8 N 7. (a) 25 kg (b) 86 N 8. 8.8° 9. (a) 0.273 m/s^2 (b) 30.7 N 10. (a) 1.0 m/s^2 (b) 56 N (c) 56 N (d) 0.84 m