**NEWTON'S 1st LAW & EQUILIBRIUM - 2**

- **Newton's 1st law**: an object at rest remains at rest, and an object in motion continues in motion with constant velocity (that is, constant speed in a straight line) unless the object experiences a net external force.
- **Inertia** is the tendency of an object not to accelerate.
- Mass is a measure of inertia; the greater the mass of an object, the greater its inertia.
- Objects that are either at rest or moving with constant velocity are in equilibrium.
- **Equilibrium** is that state in which the net force on an object is zero.

For each of the problems below, carefully draw a free-body diagram of the forces before attempting to solve the problem.

1. Determine the tension in each cable in case A and case B.

   **Case A**  
   - 5 kg

   **Case B**  
   - 5 kg

2. Determine tension in each cable. (Hint: There is more than one way to define the system)

   - 7 kg
   - 4 kg
3. The object hung from the cable has a weight of 25 N.

[Diagram of a cable with a 30° angle]

a. Write the equation for the sum of the forces in the y-direction.

b. What is the tension in the cable?

c. Repeat the problem above with a 50° angle. How does the tension compare?

[Diagram of a cable with a 50° angle]

4. In the diagram above, the left cable exerts a force of 30 N.

a. Write the equation for the sum of the forces in the x-direction. What is the value of $T_2$?

b. Write the equation for the sum of the forces in the y-direction. What is the force of gravity acting on the ball?
5. The box on the frictionless ramp is held at rest by the tension force. The mass of the box is 20 kg. The angle of the ramp is \(30^\circ\).

![Diagram of a box on a frictionless ramp]

a. What is the value of the tension force?

b. What is the value of the normal force?

6. A man pulls a 55 kg box at constant speed across the floor. He applies a 210 N force at an angle of \(30^\circ\).

![Diagram of a person pulling a box]

a. Sum the forces in the x-direction. What is the value of the frictional force opposing the motion?

b. Sum the forces in the y-direction. What is the value of the normal force?
7. A man pushes a 2.0 kg broom at constant speed across the floor. The broom handle makes a 50.° angle with the floor. He pushes the broom with a 5.0 N force.

a. Sum the forces in the y-direction. What is the value of the normal force?

b. Sum of the forces in the x-direction. What is the value of the frictional force opposing the motion?

c. If the frictional force were suddenly reduced to zero, what would happen to the broom?