Newton's Second Law

1. Tabasco recently learned to play soccer by pushing a 0.50 kg ball with his nose.
    a. Draw a free body diagram for the ball being pushed by Tabasco (do not ignore friction). Label all the forces with appropriate variables and values.

    b. If Tabasco pushes on the ball with 1 N of force and the ball does not move, what must be the frictional force between the ball and the grass?

    c. Tabasco now pushes with 5 N of force and encounters a frictional force of 3 N. What is the resulting acceleration of the ball?

    d. How much time will it take for Tabasco to push the ball to the edge of the soccer field, 10.0 meters away?

    e. Assuming that the frictional force remains the same, how much time will it take for the ball to come to rest once Tabasco reaches the edge of the soccer field and stops pushing the ball?

    f. What is the frictional force acting on the ball when it comes to rest?

2. An elevator has a mass of 2000.0 kg and hangs at rest on the second floor from a single support cable.
    a. Draw a FBD for the elevator. Label all the forces with appropriate variables and values.

    b. Determine the weight of the elevator

    c. Determine the tension in the support cable

3. Two lawyers, each with a mass of 100.0 kg step onto the elevator.
    a. If the elevator and the lawyers begin accelerating upwards at 2.0 m/s2, what must be the tension in the support cable?

    b. After a few seconds, the elevator continues upwards at a constant speed. How would this sensation be different for the lawyers compared to the accelerating elevator? Compared to the elevator at rest?

    c. What must be the tension in the support cable while the elevator travels at constant speed?

    d. If the elevator now slows to a rest at -3.0 m/s2, what must be the tension in the support cable?

4. A crate has a mass of 35 kg. Determine the weight of the crate.
    a. Draw FBDs of the crate at rest on the sidewalk. Label all the forces with appropriate variables and values.

    b. Detemine the net force on the crate.

5. Suppose Maisie tries to push the crate by pushing with a horizontal force of 35 N. She is too little and the crate does not move.
    a. Draw FBDs of the crate. Label all the forces with appropriate variables and values.

    b. Determine the value of the frictional force acting on the crate in the scenario above and the type of frictional force.

    c. Determine the net force on the crate. The crate is in a state of

6. Suppose the crate is now pushed for 10 meters with a horizontal force of 180 N.
    a. If the crate moves at a constant velocity, determine the frictional force acting on the box.

    b. Draw FBDs for the scenario above. Label all the forces with appropriate variables and values.

    c. Determine the net force on the crate. The crate is in a state of_____

7. Now suppose the crate is pulled at a constant horizontal force of 250 N and experiences the same friction as in #6 above.
    a. Draw FBDs for the scenario above. Label all the forces with appropriate variables and values.

    b. Determine the net force on the crate.

    c. Determine the resulting acceleration of the crate

8. Yesterday I needed to put my rolley-chair back at my desk. Rather than simply put the chair back, I did some quick calculations and determined the following information:
    - The chair's mass was 15.0 kg
    - The force of static friction between the chair and the ground was 35.6 N
    - The force of kinetic friction between the chair and the ground was 30.0 N

    I got the chair up to 8.0 m/s and let it roll some distance (dX) to my desk. Miraculously it came to rest just as it completed its journey.
    a. Draw a FBD diagram for the chair AFTER it had left my hands

    b. What was the net force acting on the chair in the horizontal direction?

    c. What was the acceleration of the chair?

    d. How far away was my desk?