

Name: _____

Physics 11

Problem Set 2.3
Newton's Laws

Draw a Free Body Diagram for each of the following situations:

A book is at rest on a table.	A yo-yo dangles at the end of a string, not moving up or down.
A bar is suspended motionless from the ceiling by two ropes.	A skydiver falls at constant velocity with his chute unopened. Don't neglect air resistance.
An egg is free-falling from a nest in a tree. Neglect air resistance.	A sled is dragged to the left across the snow and is speeding up. Include friction.
A plane flies at a constant velocity. Don't neglect air resistance.	A football is moving upwards after being kicked. Ignore air resistance.
A rightward force is applied to a book, accelerating it across a desk.	A football is moving downwards after being kicked. Ignore air resistance.
A rightward force is applied to a book, moving it across a desk at constant velocity.	A car is coasting to the right and slowing down.

1. A student raises their 15 kg backpack from the floor at a constant velocity of 5 m/s. Gravity exerts a force of 147 N on the pack. How much force is the student applying? Draw a FBD.

2. Ernie pushes Bert on a toboggan across some frictionless snow. Bert and the toboggan have a total mass of 85 kg, and they are accelerating at 3 m/s^2 .
 - a. Draw a FBD for Bert and the toboggan (treating them as one object).

 - b. What force does Ernie apply to Bert?

 - c. What force does Bert apply to Ernie?

 - d. If they hit a bare patch of concrete that exerts a friction force of 0.18 kN on the sled, what will the new acceleration be? Draw a new FBD.

3. A physics teacher attaches a string to a 4 kg brick and pulls it upwards. The force of gravity on the brick is 39 N and the tension in the rope is 45 N.
 - a. Draw a FBD for the brick and find its acceleration.
 - b. What force does the brick exert on the string? What force does the string exert on the teacher? What force does the teacher exert on the string?
4. A 1350 kg crash test car strikes a cement wall at 24 m/s and bounces back at 8 m/s.
 - a. If it is in contact with the wall for 0.9 s, what is the average force that the wall exerts on the car?
 - b. If the same car had no crumple zones, then it would only be in contact with the wall for 0.08 seconds. What average force would the wall exert in this case?

5. A 1400 kg sleigh is traveling at 24 m/s when the reindeer break free. The sleigh eventually slides to a stop after 0.225 km. Draw a FBD for the sleigh. Find the force of friction acting on the sleigh.