Newton's Laws ♦ Tech Physics 1

Newton's Three Laws

1. In the absence of an unbalanced force acting on an object, the object will remain stationary or move at constant speed in a straight line.

2. If there is a net force ΣF on an object of mass m, the object will accelerate according to the equation $\Sigma F = ma$, where a is the acceleration of the object. The acceleration is in the same direction as the net force.

3. If object *A* exerts a force on object *B*, then *B* exerts an equal and opposite force on *A*. *Example:* If the sun exerts a force of magnitude *F* on the earth then the earth exerts a force of magnitude *F* on the sun in the opposite direction.

Symbols used:

Ceiling:

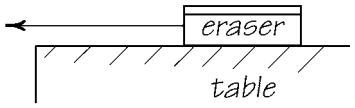
Weightless String:

600-Newton Weight: 600 N

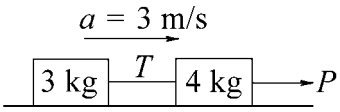
Note: The *weight* of an object is the force of gravity on it. When we say that an object is *weightless*, we mean that its weight is negligible compared to that of other objects under consideration. The tension in a weightless string is the force that each end of the string exerts (or, by Newton's third law, the force that is exerted *on* each end).

Problems:

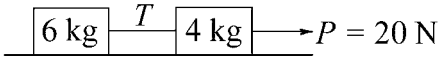
1. An eraser of mass 0.1 kg is being pulled to the left along a frictionless horizontal surface by a string. If the tension in the string is 20 N, what is the acceleration of the eraser?



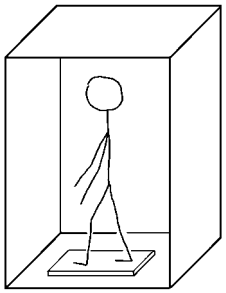
2. Two masses are being accelerated to the right at 3 m/s^2 along a frictionless horizontal surface by a force P. Find P and the tension T in the string.



3. Two masses are being accelerated to the right along a frictionless horizontal surface by a force P= 20 N. Find the mutual acceleration of the two blocks and the tension T in the string joining them.



4. A 60-kg man stands on a bathroom scale (calibrated in Newtons) in an elevator as shown to the right. Assume g = 10 m/s^2.



(a) What quantity does the scale always read?

(b) What is the reading of the scale when the elevator is stationary?

(c) What is the reading of the scale when the elevator rises with a constant velocity of 2 m/s?

(d) What is the reading of the scale when the elevator has an upward acceleration of 5 m/s^2?

(e) What is the reading of the scale when the elevator has an downward acceleration of 5 m/s^2?

(f) What is the reading of the scale when the cable breaks, and the elevator is in free fall?