Answers for Homework Handout 8

1. Newtons Law's:

   1) An object at rest or at constant velocity will remain at rest or constant velocity unless acted on by an unbalanced force.

   2) Acceleration is directly proportional to the net force and inversely proportional to the mass. The acceleration is in the same direction as the net force. $\vec{F}_{net} = m\vec{a}$

   3) Action and reaction: For every action (force) there is an equal and opposite reaction (force). (Forces come in pairs, each acting on a different object.)

2. Think on your own. Note that in everyday experience constant velocity is not common.

3. (d) Either a or b is possible. Think of an object thrown straight upward: The net force (the weight) is always downward, but the motion is upward, then downward.

4. The velocity is *not* constant because the direction is changing. Therefore there must be an acceleration (change in velocity over time) and a net force.

5. The weight ($\vec{F}_g = -mg\hat{y}$) acts straight down, and the tension ($\vec{F}_T$) points straight up.

6. The net force is the sum of the three forces, so $F_{net} = 1500\,$N. From $\vec{F}_{net} = m\vec{a}$, the mass of the car is 750 kg.

7. Find the acceleration (a = 5 m/s^2), then $F_{net} = 5000\,$N.

8. The scale measures the normal force, $F_N = 126\,$N.

9. Use $\vec{F}_{net} = m\vec{a}$ (separately in the x and y directions) and $F_f = \mu F_N$ to solve for the acceleration, a = 0.30 m/s^2.

10. Find the velocity at the bottom of the jump (v = 2 m/s downward), then the acceleration ($a = 2 \times 10^3$ m/s^2). Then it follows from $F = ma$ that $F = 1.4 \times 10^5\,$N.

Answers for Homework Handout 9

1. (graphical)

2. (graphical)

3. Use a 'tilted' coordinate system in which the x-axis is parallel to the incline and the y-axis is perpendicular to the incline. Then the normal force points in the $\hat{y}$ direction and the frictional force points in the $-\hat{x}$ direction. The weight ($F_g = mg$) points straight down, but *not* in a coordinate direction. The components of the weight in the tilted x and y directions are $F_{g,x} = mg\sin\theta$ and $F_{g,y} = -mg\cos\theta$. From $F_{net,y} = ma_y = 0$ (because $a_y = 0$) find F_N to use for the frictional force. Then from $F_{net,x} = ma_x$ find that a = 8.5 m/s^2.

4. Since the blocks move together, they have the same acceleration (a = 6.53 m/s^2). You can follow the hint, or realize that as long as the string can hold any tension, the tension is an internal force and thus might be ignorable. It turns out that the problem can be worked out as if there was just one 5-kg mass (2+3=5) and you will get the correct acceleration. If you needed to find the tension, just do the 2nd law on the second block with the knowledge of the acceleration ($F_T - F_f = m_1 a_x$).

5. There are three forces: $\vec{T}_1$, $\vec{T}_2$, and $\vec{F}_g = -mg\hat{y}$ that add up (vectorily) to zero. You need to find the x- and y-components of T_2 (T_1 points completely in the +x direction). There will be two equations, one for the x-direction and one for the y-direction, with two unknowns (the magnitudes of T_1 and T_2). $T_1 = 13.7\,$N, $T_2 = 32.4\,$N.