Newton's Laws Review

A) **Newton' First Law**

1. State Newton's first Law:

   A body in a constant state of motion will stay in its constant state of motion unless a net force is present. The two constant states of motion are at rest and constant velocity.

   When there is a net force present, then Newton's second law applies.

2. What is meant by an external force (net force)?

   When we say that a body experiences a net force, we are saying that the forces are not balanced, there is more force in one direction.

3. What is inertia and how is it measured?

   Inertia is resistance to changes in a state of motion and its measurement is mass. So a more massive body has more inertia which would make it harder to move.

4. Be able to explain the demonstrations from class. For example, why the dishes did not move when the tablecloth was pulled from under them.

   Things that demonstrate Newton's first law are things like why you keep moving when a car stops. Anything that resists chances in motion is an example of inertia. See the short video link below:

   Inertia

B) **Newton's Second Law**

1. Be able to draw free body diagrams for many situations. For example, an elevator moving upward at a constant velocity or accelerating up or down or a car with its brakes applied

2. Be able to write Fnet equations from your free body diagrams and solve for unknowns

   See Video: Free Body Diagrams and net force equations

3. Solve problems where you use the following equations: Fnet=ma & Vi, Vf, D, a, t

A 2.800 Kg cart starts from rest and accelerates through a distance of 5.2 m in 3.5 s. What is the net force acting on the cart?

$V_i = 0$
$V_f = *$
$d = 5.2$
$a =$
$t = 3.5$

#3

$d = \frac{1}{2} a t^2$

$5.2 = \frac{1}{2} a (3.5)^2$

$5.2 = 6.125a$

$a = 5.2/6.125 = 0.849$

$F_{NET} = ma$

$F_{NET} = 2.8(0.849)$

$= 2.38N$

A 4.5 kg cart is moving at 5.5 m/s when a net force of 2.5 N acts in the direction of movement. How fast will the cart be traveling after 15.0 s?

$V_i = 5.5$
$V_f = ?$
$d = *$
$a =$
$t = 15$

NEED To Find acceleration first

$F = ma \Rightarrow a = F/m$

$a = 2.5/4.5 = 0.56$

#1 $V_f = V_i + at$

$V_f = 5.5 + 0.56(15)$

$V_f = 13.8\ m/s$

4. Understand what terminal velocity is and how it is reached.

a. Who would be going faster when terminal velocity is reached (assuming the same surface area). Mr. Strzyinski 66 kg or Andre the Giant 300 kg. (why)

Andre would have a higher terminal velocity because he has a higher force of gravity acting on him due to his larger mass. Since Andre's force of gravity is higher he would need a higher air resistance to balance out the higher force of gravity. This would require him to have a faster speed.

b. Which if any would have a higher terminal velocity, a sky diver falling head down or one falling spread eagle and why.

Head down because they would have less drag force due to a smaller surface area. This would require a higher velocity in order to balance out the force of gravity.

~~5. A book is pushed across a table. If μ=0.30 find the force of friction between a book and the table. (m_{book} = 5 kg, m_{table} = 40 kg)~~

~~a. What force is required to keep the book moving at constant velocity?~~

~~b. What force is required to accelerate the book at 1.75 m/s^2~~

~~c. Find the new force of friction if you place a 2 kg mass on top of the book.~~

6. What is the difference between weight and the force of gravity?

   a. How much does a 588 N person weigh?

   588 N is the force of gravity which is weight, so weight = F_g = 588N

   b. What is the mass of a 588 N person? (Assuming we are on earth)

   $F_g = m \cdot g$
   $588 = m \cdot 9.8$ → $m = \frac{588}{9.8} = 60\ Kg$

   c. What is the mass of the same person on the moon?

   Mass is universal, so the person's mass on the moon is the same as their mass on earth which is 60 Kg

   d. What is the force of gravity of the same person on the moon where g=1.6 m/s^2

   $F_g = m \cdot g$
   $F_g = 60 \cdot 1.6 = 90N$

   e. A ping pong ball and a solid steel ball of the same size are dropped on the moon where there is no air resistance. Which experiences the greater force of gravity?

   The solid steel ball would have the greater force of gravity acting on it because it has more mass and Force of gravity is calculated by $F_g = m \cdot g$

   - Which of the two have the greater acceleration?

   They both have the same acceleration since $a = \frac{F_{net}}{m}$; however, the net force for a falling body is F_g , therefore $a = \frac{F_g}{m} = \frac{m \cdot g}{m} = g$ Since the mass cancels out, all falling bodies have the same acceleration in the absence of air.

C) **Newton's Third Law**

1. What is meant by the statement; "forces always act in pairs."

   A force cannot exist on its own, so every force applied to a body requires an equal and opposite force applied back to the body for the interaction to take place.

2. A bicycle and a car have a head on collision, which, if any which experiences the greatest force of impact, why?

   By Newton's 3rd law every action has an equal and opposite reaction, therefore the force between them is the same.

   - Which if any experiences the largest acceleration, explain why?

   Assuming the bicycle has m significantly lower mass it would experience a larger acceleration due to Newton's second law which states: $a = \frac{Force}{mass}$

3. You are pulling your little sister in a wagon, you need to pull on the wagon with a larger force than the wagon pulls on you in order to make it move. (True/False) Explain why.

   This is false, by Newton's 3rd law the interaction between you and the wagon are equal and opposite forces and therefore the same. You must push off the ground more than the wagon does so that the "wagon / person" system has a forward net force.

4. A 45 kg astronaut pushes off a 340 kg satellite for a time of 2.0 seconds. Afterwards, the satellite is moving 0.5 m/s, what is the velocity of the astronaut?

5. A force of 36 N gives one mass (m_1) an acceleration of 4 m/s^2. The same force gives a second mass (m_2) an acceleration of 12 m/s^2. What acceleration will this force give to the two masses if they are fastened together?