Science 8 Name: _____

LAB #05: FORCE AND ACCELERATION Date: _____

Force and Acceleration Lab #05

Discussion: Newton's 2nd Law shows the relationship between force, mass, and acceleration.

Purpose: Determine the relationship between force and acceleration given a constant mass.

Hypothesis: For a constant mass, as force increases acceleration should also increase.

Theory: The equation for Newton's 2nd Law is:

$$F_{net} = ma$$

where, for a constant mass, *m*, force and mass should vary directly.

Materials: cart spring scale meter stick string masking tape stop watch book (for mass)

Method:

1. Attach a loop of string to the cart. Place a textbook on the cart for added mass.
2. Using masking tape, mark off a two meter distance on the lab table.
3. Attach a 5 N spring scale to the loop of string so you can pull the cart with the scale.
4. Find the smallest force required to pull the cart at a slow, constant speed. Record this force as F_f on your data table.
5. Add 0.5 N to F_f. Use this force to accelerate the cart between the two tape marks (from Step #2). Record this force as F_1 on your data table.
6. Have a partner hold the cart while you pull the spring scale to the reading reported as F_1. Have another partner call out 1, 2, 3, go and time how long it takes to pull the cart two meters using F_1. Record the time for Trial 1 on your data table.
7. Repeat Step #6 twice more recording times for Trial 2 and Trial 3 on your data table.
8. Repeat Steps 5, 6, and 7 but this time add 1.0 N to F_f. Record the times for all three trials.
9. Repeat Steps 5, 6, and 7 twice more adding 1.5 N and 2.0 N to F_f. Record times for three trials for each force.

Data Collection and Processing:

Force (N) F_f =	*F*net (N) = $F - F_f$	Trial 1 Time (s)	Trial 2 Time (s)	Trial 3 Time (s)	Average Time (s)	Average Speed (m/s)	Final Speed (m/s)	Acceleration (m/s^2)
F_1 =								
F_2 =								
F_3 =								
F_4 =								

Analysis:

1. For each force, $F_1 - F_4$, calculate the F_{net}, average time, and average speed (2.0 m ÷ average time). Record the results on the data table.
2. The final speed will be twice the average speed. Calculate and record each final speed.
3. Use the equation at the top of the page and calculate and record the acceleration for each force.

Conclusions:

1. On the graph below, make a plot of acceleration vs. net force. If the line is straight, make a best fit line. Be sure to add a scale and axis labels for each axis. For acceleration = 0 we should also use $F_{net} = 0$. Explain why this is true.

Acceleration (m/s^2) vs. Force (N)

2. Which variable is the manipulated variable (independent variable)?

3. Which variable is the responding variable (dependent variable)?

4. Explain why we plotted acceleration on the *y*-axis and force on the *x*-axis.

5. According to your graph, how is pulling force (F_{net}) related to the acceleration of the cart?