Brady Kondek **2.08 Newton's Laws Lab**

Data Collection—Table 1:

Trial	Force used (N)	Time (s)	Distance (m) (fixed)	Acceleration (m/s^2)	Mass (kg)
1	50	9.5	**5.0**	0.11	450
2	200	4.7	**5.0**	0.45	440
3	300	3.9	**5.0**	0.66	450

Analysis

1. Using the equation $d = \frac{1}{2}at^2$, the value of 5.0 m for the distance, and the time that you recorded for wagon to reach the stop block, calculate the acceleration for each trial. Show your work. Fill in Table 1 with your answers.

   a = ?
   a = $\frac{2d}{t^2}$ (manipulated from given equation)

   Trial 1 – d = 5.0 m, t = 9.5 s
   2(5.0)/9.5^2 = 0.111
   a = 0.11 m/s^2

   Trial 2 – d = 5.0 m, t = 4.7 s
   2(5.0)/4.7^2 = 0.453
   a = 0.45 m/s^2

   Trial 3 – d = 5.0 m, t = 3.9 s
   2(5.0)/3.9^2 = 0.657
   a = 0.66 m/s^2

2. Using Newton's second law of motion, calculate the mass of the cart for each trial. Show your work. Fill in Table 1 with your answers.

   m = ?
   m = F/a (manipulated from a = F/m)

   Trial 1 – F = 50 N, a = 0.11 m/s^2
   50/0.11 = 454.55
   m = 450kg

   Trial 2 – F = 200 N, a = 0.45 m/s^2
   200/0.45 = 444.44
   m = 440kg

   Trial 3 – F = 300 N, a = 0.66 m/s^2
   300/0.66 = 454.55
   m = 450kg

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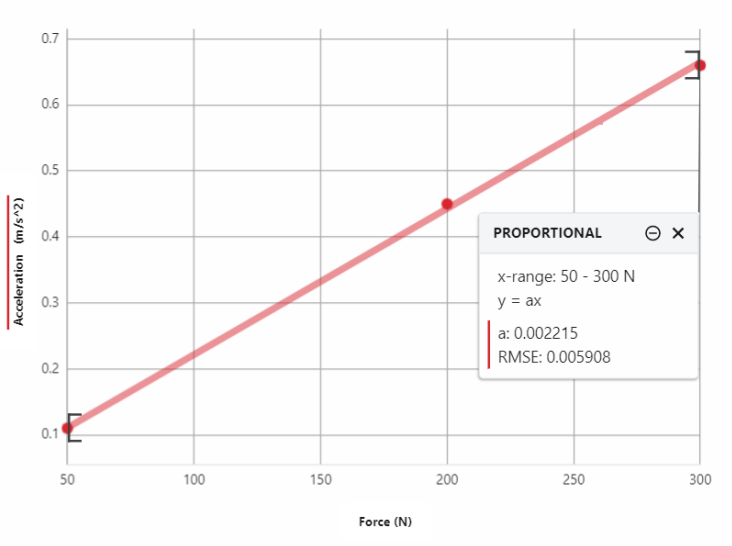
Questions

Answer questions in complete sentences.

1. Compare the accelerations for the three trials. Explain how Newton's second law was demonstrated in the simulation.

   The three accelerations found from the trials are 0.11 m/s^2 (trial 1), 0.45 m/s^2 (trial 2), and 0.66 m/s^2 (trial 3). The respective forces are 50 N (trial 1), 200 N (trial 2), and 300 N (trial 3).

   Newton's second law states that the acceleration of an object is directly proportional to the net force acting on the object; further, the acceleration increases as the force increases. This is seen with the results from the simulation in the graph below:



2. Describe how Newton's first and third laws would apply to this situation if this simulation was done in the real world.

   For Newton's first law, it states that a force is needed to change the motion of an object. That either an object moving at a constant speed will continue to move in that manner, or an object at rest will continue to stay at rest, unless an unbalanced force acts on it. In this case, it can be said that the rope will continue to go in the direction of the larger force, unless the other direction becomes larger (given people on two sides).

   Newton's third law states that every action has an equal and opposite reaction. So in the case of this simulation being done in the real world, it can be said that as someone is pulling on the rope with a certain amount of force, the rope is pushing back on them with an equal force.

3. Compare the masses that you calculated for the three trials. If the actual mass of the cart did not change (same cart for all trials), what measurement do you believe contributed the largest amount of error to that calculation? Explain your answer.

   The three masses found from the trials are 450kg (trial 1), 440kg (trial 2), and 450kg (trial 3). If the actual mass of the cart did not change, then force would have contributed the largest amount of error to that calculation. The amount of force being applied is what is contributing to the amount of time and the acceleration (as the distance is the same each time). Then from there, the acceleration is used to determine the mass along with force. Therefore, force is the variable that is in ultimate control of the outcome (given here that the distance remains the same).