Name: ___________________________

# Newton's 2nd Law Lab
SPH4C

Questions:

1. If the net force on an object increases, what happens to the acceleration of the object?

2. If the mass of an object increases, what happens to the acceleration of the object?

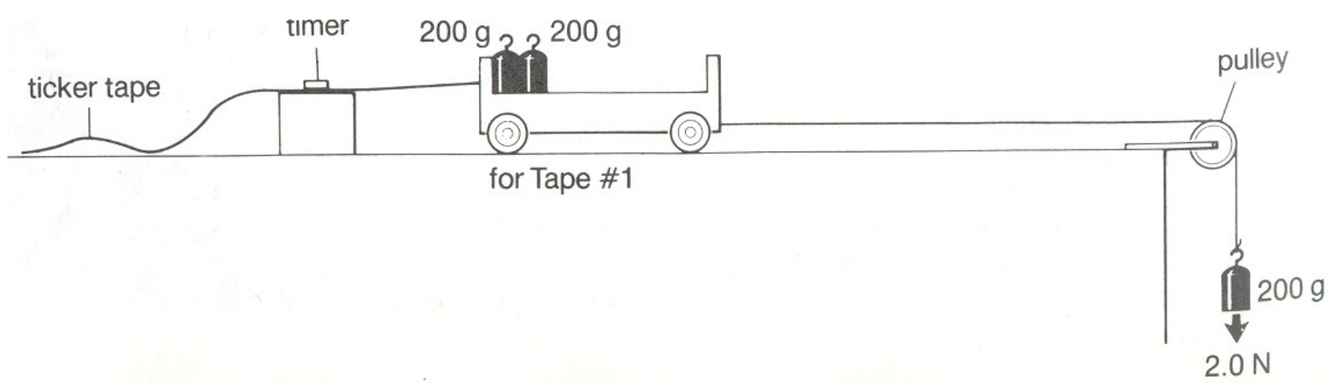
Hypothesis:

1. If the net force on an object increases, the acceleration of the object ____________________.

2. If the mass of an object increases, the acceleration of the object _______________________.

Materials:

- 3 dynamics carts
- nine 200 g masses
- ticker timer
- ticker tape
- sticky tape
- pulley and string
- clamp for pulley
- table

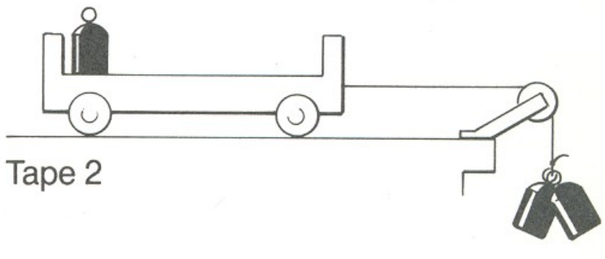



Procedure:

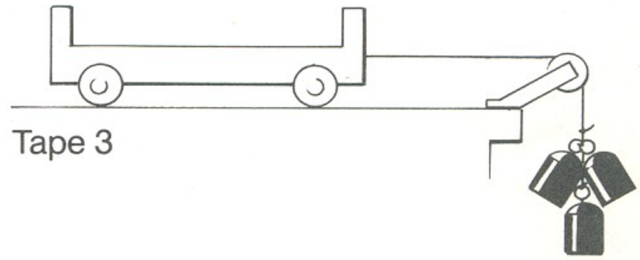
1. Set up the apparatus as shown in the diagram above. (Make sure that the length of paper tape is slightly less than the distance between the suspended 200 g mass and the floor.) Hold the cart until it is released.
2. Start the timer and release the cart. Catch the cart before it hits the pulley. Label the ticker tape "Tape #1."
3. Repeat Steps 2 and 3 to produce four more tapes. Use the cart and mass arrangements shown in the series of diagrams on the next page.

   *Note that for Tapes 2 and 3, the total mass of the system is the same as Tape 1, but the net force is greater.*

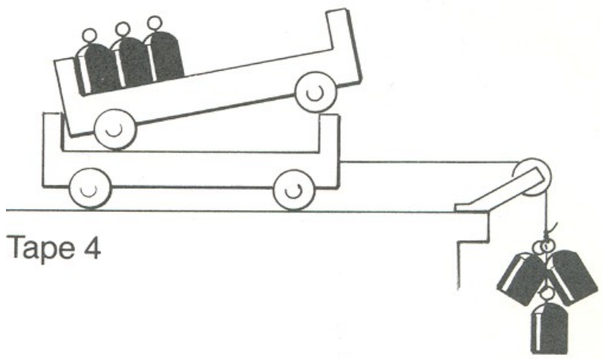
   *For Tapes 4 and 5, the unbalanced force is the same as for Tape 3, but the total mass of the system is increased.*



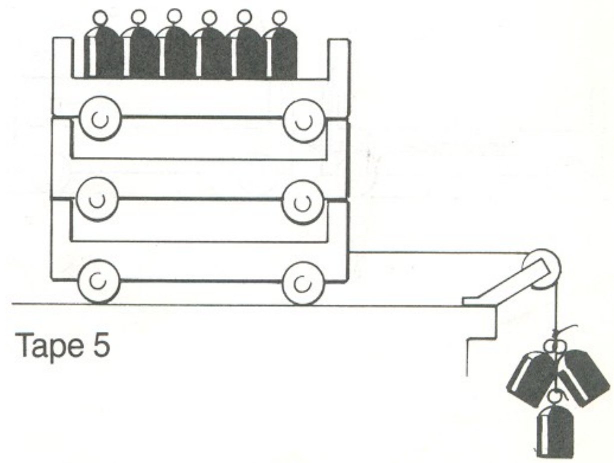
Tape 2



Tape 3



Tape 4



Tape 5

Data/Analysis:

1. Measure the total distance (in metres) from the first clear dot to the last for each of the tapes. This is the total displacement $\Delta d$ for that trial. Record the displacement in Table 1 below.

2. Count the number of dots from the first clear dot to the last. Calculate the time $\Delta t$ (in seconds) for each tape by dividing this number by 60. Record the number of dots and the time in Table 1 below.

3. Given that the final velocity is twice the average velocity or $v_2 = 2v_{avg} = 2\frac{\Delta d}{\Delta t}$ for $v_1 = 0$ , $a = \frac{v_2 - v_1}{\Delta t} = \frac{v_2}{\Delta t} = \frac{2\Delta d}{(\Delta t)^2}$ . Use this to calculate the acceleration of each of the tapes. Record the acceleration in Table 1 below.

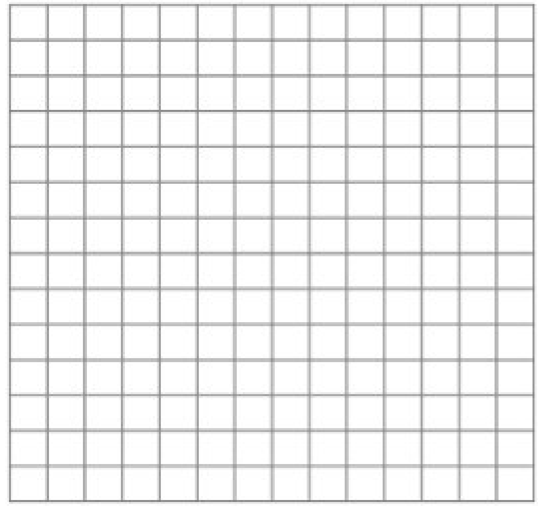
*Table 1: Displacement, Time, and Acceleration of the Dynamics Carts*

| Tape # | $\Delta d$ (m) | # of Dots | $\Delta t$ (s) | $a = \frac{2\Delta d}{(\Delta t)^2}$ (m/s$^2$) |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

4. Graph the acceleration of those tapes for which the mass was the same but the force was increased (Tapes 1 – 3). Force should be on the horizontal axis and acceleration on the vertical axis.

*Table 2: Acceleration of Ticker Tapes with Varying Force*

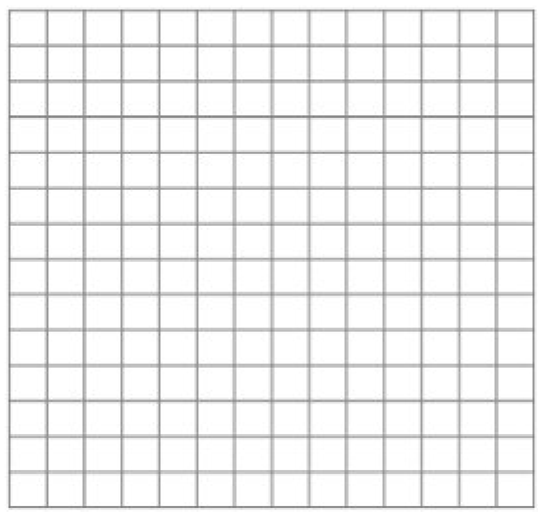
| Tape | 1 | 2 | 3 |
|---|---|---|---|
| Force (N) | 2.0 | 4.0 | 6.0 |
| Acceleration ($m/s^2$) *(from Table 1)* | | | |



5. Graph the acceleration of those tapes for which the force was the same but the mass was increased (Tapes 3 – 5). Mass should be on the horizontal axis and acceleration on the vertical axis.

*Table 3: Acceleration of Ticker Tapes when the Mass of the System was Varied*

| Tape | 3 | 4 | 4 |
|---|---|---|---|
| Mass (units of 1 cart + 600 g) | 1 | 2 | 3 |
| Acceleration ($m/s^2$) *(from Table 1)* | | | |



<u>Discussion</u>: Identify at least two sources of experimental error in this procedure:

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<u>Conclusion</u>:

1. If the net force on an object increased, the acceleration of the object ____________________.

2. If the mass of an object increased, the acceleration of the object ________________________.