



## Mass and Acceleration (The Pencil and the Cart)

## Lab #06

**Discussion:** Newton's 2<sup>nd</sup> Law shows the relationship between force, mass, and acceleration and Newton's 3<sup>rd</sup> Law says that for every action there is an equal and opposite reaction.

**Purpose:** Determine the relationship between force and acceleration given different mass.

**Hypothesis:** If a rubber band is used to launch a pencil from a book on a frictionless surface, hypothesize what should be true of the speeds and directions of the book and pencil.

**Theory:** The equation for Newton's 2<sup>nd</sup> Law is:  $F_{net} = ma$   
where, for a constant force,  $F$ , acceleration and mass should vary \_\_\_\_\_.

**Materials:** book rubber band pencil 4 marbles

### **Method:**

1. Hook a rubber band around the cart on an air track.
2. Turn on the air track.
3. Put the pencil in the rubber band and stretch the band.
4. Hold the cart and the pencil still.
5. Release both the cart and the pencil at the same time.
6. Record your observations about the motions (speed and directions) of both the cart and the pencil.
7. Return all materials as instructed.

### **Data Collection and Processing:**

1. Record your observations about the distances traveled by both the cart and the pencil in the same amount of time.

Cart: \_\_\_\_\_

Pencil: \_\_\_\_\_

2. Record your observations about the relative speeds of both the cart and the pencil.

Cart: \_\_\_\_\_

Pencil: \_\_\_\_\_

3. Record your observations about the relative mass of both the cart and the pencil.

Cart: \_\_\_\_\_

Pencil: \_\_\_\_\_

4. Record your observations about the relative directions of the paths of both the cart and the pencil.

Cart: \_\_\_\_\_

Pencil: \_\_\_\_\_

**Analysis:**

1. Write the equation associated with Newton's 2<sup>nd</sup> Law of Motion. Describe what should happen to the acceleration of an object if its mass increases and the force is constant.

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2. Based on your observations in this lab, describe what did happen to the acceleration of an object when its mass increased and the force was constant.

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3. Using Newton's 3<sup>rd</sup> Law of Motion, describe the directions the cart and the pencil should take in this investigation.

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4. Based on your observations in this lab, describe the directions the cart and the pencil did take in this investigation.

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**Conclusions:**

1. Explain how Newton's 3<sup>rd</sup> Law of Motion relates to the forces and directions of the cart and pencil in this investigation.

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2. Explain how Newton's 2<sup>nd</sup> Law of Motion relates to the acceleration and masses of the cart and pencil in this investigation.

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