Name ________________________________

Section ____________ **Date** ___________

Physics 211 PreLab #2: Force and Newton's Laws

Reading: **Tipler**

Chapter 4 - Newton's Laws

Chapter 5 - Applications of Newton's Laws

A Force To Be Reckoned With

Forces confront you every day, whether you're obsessing about your weight, which results from the earth's gravitational force, or using the table top to support your head during a quick nap in class. (Interestingly, such contact forces are actually electromagnetic in nature, as it is the strong electromagnetic interactions between the atoms in the table, ground, your head and feet, etc., which prevent one object from "slipping through" another).

The early Greeks, most notably Aristotle, speculated incorrectly that forces were needed to maintain the motion of an object. This misconception led to the incorrect conclusion that propulsive forces must be present to sustain rocks, arrows, and other objects in flight. The Aristotelian view of the relationship between force and motion was widely held until the early 17th century when Galileo argued that rather than causing the motion of an object, forces cause *changes* in an object's motion. This important shift in scientists' thinking ultimately led Newton to formulate his three laws of motion:

Newton's First Law of Motion: A body in motion tends to remain in motion, or to remain stopped if stopped, except insofar as acted on by an outside force.

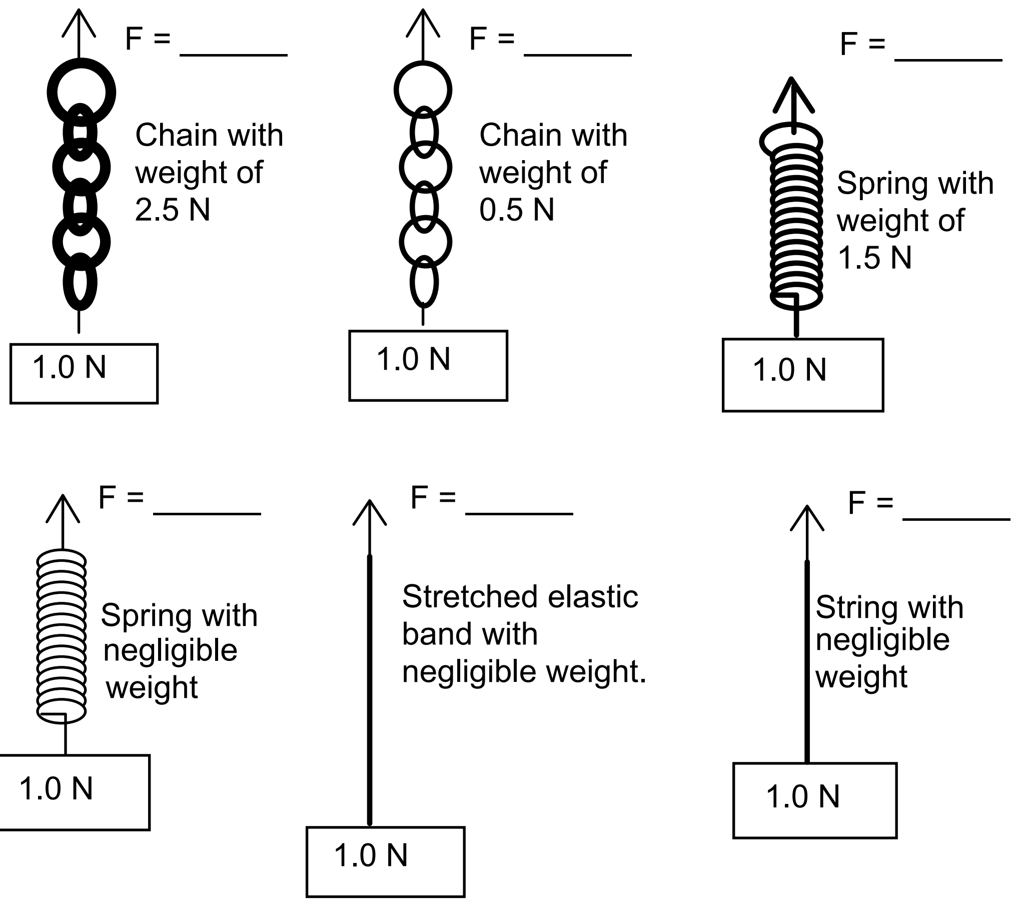
Newton's Second Law of Motion: The rate at which a body's momentum changes is equal to the net force acting on the body, $\mathbf{F}_{net} = d\mathbf{p}/dt$.

Newton's Third Law of Motion: For every action there is an equal and opposite reaction.

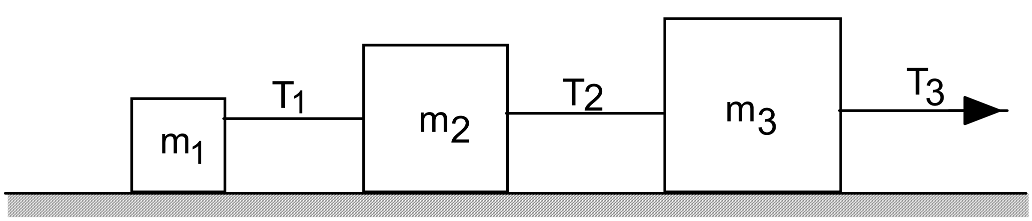
In Lab 2, you will investigate different forces and their relationship to motion. For example, in Investigation 1 of Lab 2, you will use a force probe to explore tension forces and the relationship between weight and mass.

Answer the following questions concerning Investigation 1.

Q1 - A 1.0 N weight is suspended as shown. In each case, write in the magnitude of the unknown force. All masses are at rest here (e.g., they are *not* bouncing).



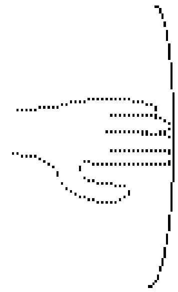
Q2 - Three blocks on a horizontal frictionless table are connected with strings as shown below. The three blocks are pulled to the right with a force T_3 = 60 N. If m_1 = 10 kg, m_2 = 20 kg, and m_3 = 30 kg, find the tensions T_1 and T_2.



Q3 -

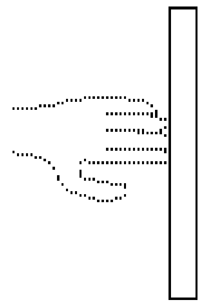
a. The hand pushes on a flexible metal sheet with a force of 5 N. The force exerted back on the hand by the sheet is (circle one)

A. Larger than 5 N.
B. Equal to 5 N.
C. Smaller than 5 N.
D. There is no force.



b. The hand pushes on a wall with a force of 5 N. The force exerted back on the hand by the wall is (circle one)

A. Larger than 5 N.
B. Equal to 5 N.
C. Smaller than 5 N.
D. There is no force.



c. The book weighs 5 N. The force exerted by the table on the book is (circle one)

A. Larger than 5 N.
B. Equal to 5 N.
C. Smaller than 5 N.
D. There is no force.

In Investigation 2 you will study the relationship between force and acceleration in two different situations. For example, you will study the tension and acceleration of a hanging mass tied by a string to a cart on a frictionless surface (see Figure 1).

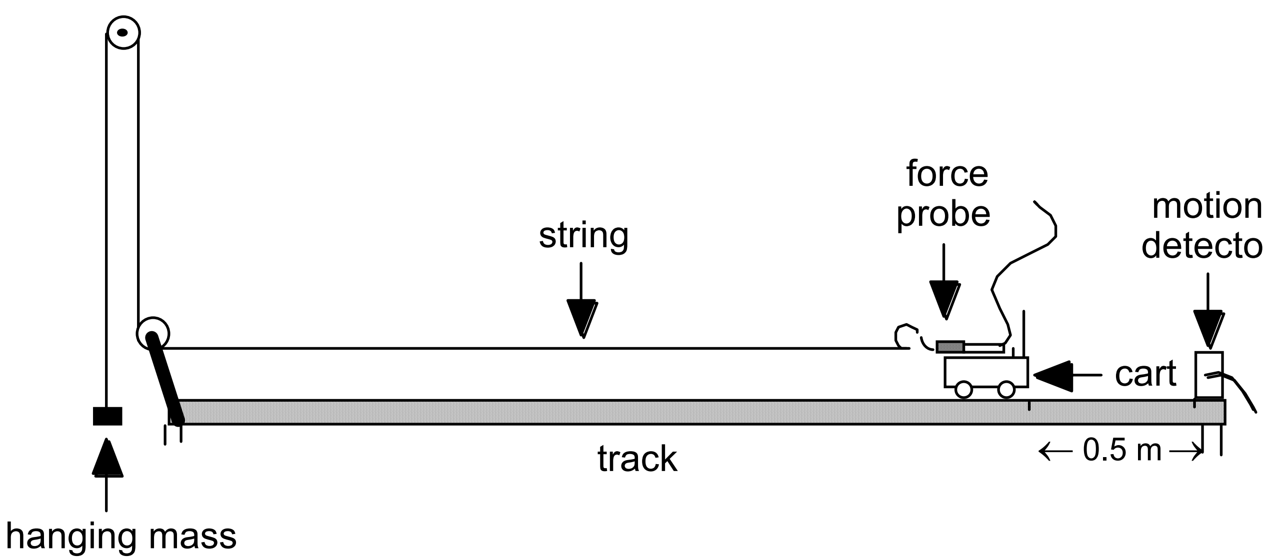
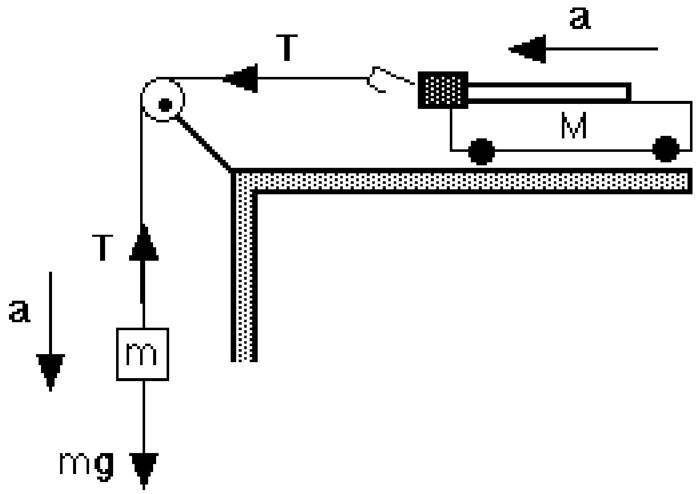


Figure 1. Experimental setup for Investigation 2 in Lab 2

Consider the following question related to this situation.

Q4 - For the accelerating two mass system shown below, determine the tension in the string, T, and the acceleration of the two masses, a, in terms of m, M, and g.



T = ____________

a = ____________

In Investigation 3 you will study the force exerted by a spring when it is compressed or extended away from its equilibrium length (see Figure 2). For a sufficiently small compression or extension, the spring force is directly proportional to the compression or extension distance (Hooke's law), $F_{spring} = -kx$, where k is a constant typically referred to as the spring constant.

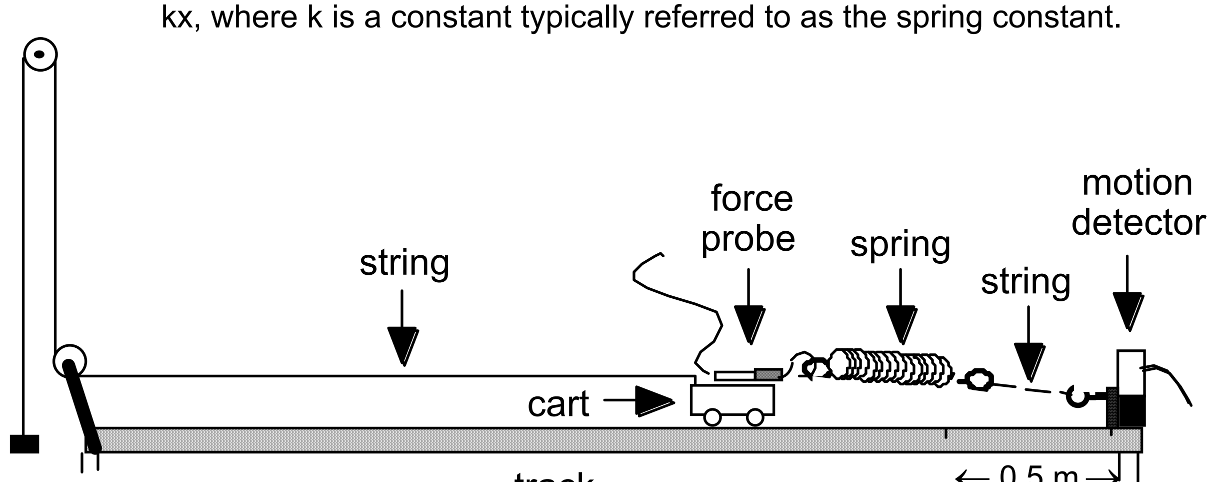


Figure 2. Experimental setup for Investigation 3

Consider the following question concerning Hooke's law.

Q5 - A 2 kg mass and a 3 kg mass are on a horizontal frictionless surface, connected by a massless spring with spring constant k = 140 N/m. A 15 N force is applied to the larger mass. How much does the spring stretch from its equilibrium length? The masses uniformly accelerate with no oscillations.