Hooke's Law Investigation

Name: _____ Date: _____

Purpose: To investigate and discover Hooke's Law: To describe the relationship between the force exerted on a spring and the resulting stretch. The amount of energy stored in the spring will also be determined.

Outcomes:

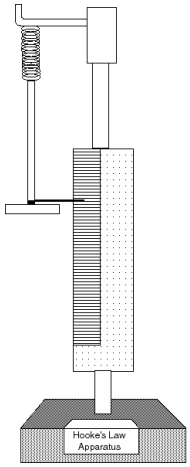
Student should be able to…

- Describe mathematically the relationship between the force and stretch of a spring
- Understand what is meant by spring constant and to be able to determine the spring constant.
- Determine the amount of energy stored in the stretched spring.

Apparatus:

- Spring
- Five 50g masses
- Stand

- Graph paper
- Ruler and pencil
- Calculator
- Textbook



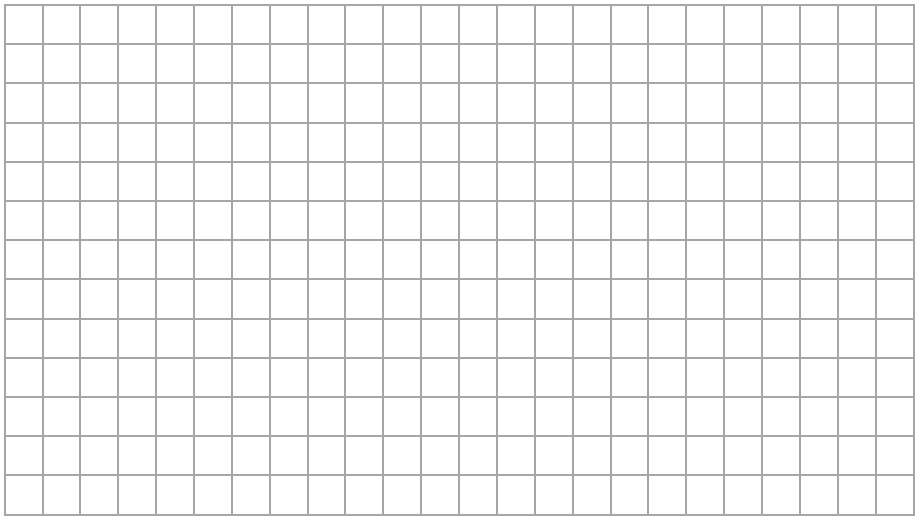
Procedure & Analysis:

1. Set up the Hooke's law apparatus.
2. Calibrate the marker so that it reads zero when no masses are attached to the spring. (Pinch the clamps at the back to adjust the scale).
3. Slowly add the 50g masses on, one at a time, and record the stretch in the spring in the table provided.
4. Complete the table.
5. On a piece of graph paper, plot the Force Applied, *F*, vs. the stretch, Δx . Draw a best-fit line through the data points. (Should it go through zero?).
6. Calculate the slope on the graph, including units!
7. Answer the discussion questions.

Table 1: Slot mass information and weight and the stretch resulting from the added weight.

Mass (kg)	Weight (N) [*F=mg*]	Stretch, Δx (m)

→ Plot the graph of Weight (N) vs. Stretch (Δx). Y-axis (weight) and X-axis (stretch).



Discussion Questions:

1. Describe the relationship between force and stretch of a spring?

2. The **spring constant** is the slope of the best-fit line and is given the symbol *k*. Different springs have different *k* values. What is the value and the units of *k* from your experiment?

   k=

3. Describe the amount of stretch you would expect if the same force were applied to a spring with a very small spring constant (slinky) and a spring with a very large spring constant (car suspension).

4. The general equation for the force of a spring as a function of stretch is:

$$F = -k\Delta x$$

Questions:

5. A spring has a spring constant of 250 N/m and is stretched 30 cm. What is the force acting on the spring?

6. A force of 20 N is applied to a 12.5 N/m spring. How much does the spring stretch?

ENERGY STORED IN THE SPRING

7. The **area under the curve** on the graph represents the **energy stored** in the spring at that given stretch. What is the amount of energy stored in the spring from your experiment when it is stretch 0.05 m.? **Hint:** Use the area of a triangle from 0 to 0.05 m.

8. The energy stored in the spring can also be determined mathematically. We will do the derivation correctly in class. For now the equation is given below.

$$E_s = \frac{1}{2}k\Delta x^2$$

9. Recalculate the energy stored in the spring in question 6 using the spring constant you calculated and a stretch of 0.05 m. How closely does this value compare with the value determined in question 6?

Questions:

10. A spring with a spring constant of 350 N/m is stretched 0.45 m. Determine the force of the spring and the amount of stored energy in the spring.

11. A spring is stretch 35 cm and the amount of energy stored in the spring was determined to be 160 J. Determine the spring constant of the spring.