Section 2.5: Hooke's Law

In this lesson you will carry out an experiment in which you will relate the extension of a spring to the applied force.

To be successful in this lesson, you have to know the difference between weight and mass.

Recall: weight = mass x gravitational field strength

$F_g = mg$

As well, you need to know what is meant by a **direct proportion.**

Direct Proportion - A *direct proportion* occurs when the quotient of two numbers is a constant.

For example, if you are paid by the hour then your earnings are directly proportional to the number of hours worked. The **quotient** of the earnings and the number of hours worked will always be the same number (in this case the hourly rate of pay).

Direct proportions are normally written as ***y* = *mx*** where ***x*** and ***y*** are the two quantities in proportion and m is the **common ratio** (that is, the quotient y/x is the constant "m").

The graph of ***y* vs. *x*** is a linear one with **slope *m***.

Examples of quantities in direct proportion include:
- wages and #hours worked - commissions and quantity of goods sold - amount of water in the tub and time the tap has been left on - distance and time (for uniform motion) - weight and mass.

https://www.cdli.ca/courses/phys2204/unit02_org01_ilo04/b_activity.html

Questions

1. Table of Force vs Stretch

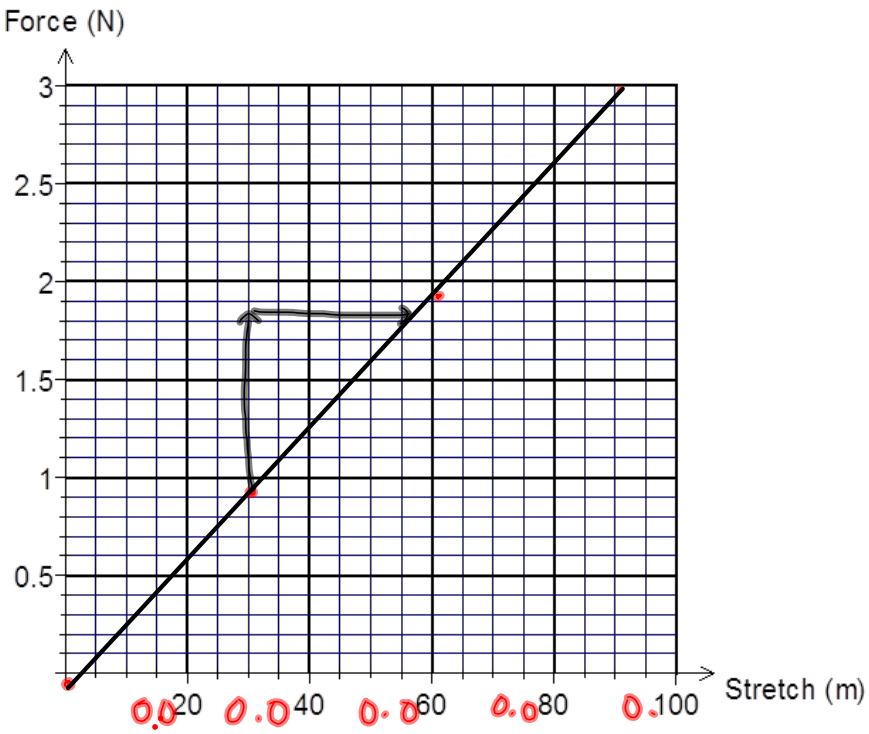
y (L_2) x (L_1)

Force (N)	Stretch (m)
0	0
0.98 N	0.030
1.96 N	0.060
2.94 N	0.090
3.92 N	0.115

Sample Calculation:

$F_g = (0.100 kg)(9.8 m/s^2) = 0.98$

2. Graph of Force vs Stretch



3. Construct the line of best fit. Use your calculator to perform a linear regression. Enter the stretch data in L_1 and enter the force data in L_2. At this point you can calculate the regression equation.

Stat → Calc → 4: Lin Reg. Enter L_1, L_2

Vars → y-Vars → Enter 3 times.

$y = mx + b$

$y = 33.75x$

$F = 33.75x$

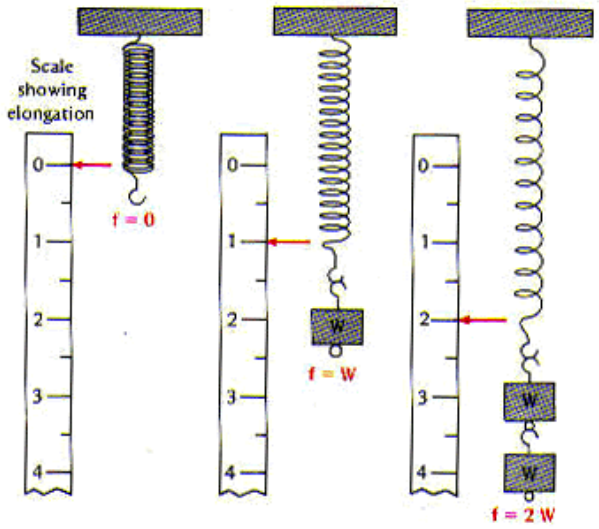
↑ spring constant (slope) (N/m)

4. Hooke's Law states that stretch is proportional to the applied force and suggests that the relation $\boldsymbol{F} = k\Delta\boldsymbol{x}$ can be used to relate the two, where k is the spring constant that is unique to the spring you are dealing with.

   Explain why Hooke's Law applies here.

   What is the value of k for the spring in the animation?

http://www.4physics.com/phy_demo/HookesLaw/HookesLaw.html



Hookes Law - Force proportional to Stretch