Hooke’s Law

PURPOSE
Determine the spring constant of a steel spring through application of Hooke’s Law
Determine the spring constant by observing the period of oscillation
Determine the spring "constant" of a rubber band

MATERIALS
Spring, masses, mass hanger, meter stick, rubber band, stopwatch, ring stand

PROCEDURE A
Set up the ring stand so that your spring is supported securely. Add a mass hanger to
the spring and record the height from the bottom of the hanger. Consider this the "zero"
point in the lab. Now add masses to the hanger in even increments. Note the total mass
(excluding hanger) and measure and record the new distance from the desk to the bottom
of the hanger in the data table for each trial. Determine how far the spring stretched from
the "zero" point for each trial in meters. Convert mass added in grams or kilograms into
newtons of force. Graph force vs. stretch, stretch on the horizontal axis. Determine the
slope of the graph, which is the spring constant. Call this value k1.

PROCEDURE B
With the spring securely supported, add enough mass so the rate of oscillation (bobbing
up and down) of the mass is about once per second. The exact value is not important, yet.
Record the total mass that you have added, including the mass hanger.
Measure and record the mass of the spring itself. Displace the mass slightly (less than 5
cm) from its resting position. Measure the total time for 10 oscillations, being careful to get
10 complete oscillations. Divide by 10 to get the period of your mass-spring system and
record this value. Calculate the spring constant, k2, using the equation:

\[ T = 2\pi \left( \frac{m}{k} \right)^{1/2} \]

Do a second calculation of the constant after you add 1/3 the mass of the
spring on to the mass. Call this value k3.

Which values compare best between k1 and either k2 or k3? Are they close? What
would having close values mean? What would having values that are fairly far
apart mean?

PROCEDURE C
Set up the ring stand so that your rubber band is supported securely. Add a
mass hanger and measure the distance from the desk to the bottom of the
hanger. Consider this the "zero" point in the lab. Now add masses to the hanger in even
increments. Note the total mass (excluding hanger) and measure and record the new
distance from the desk to the bottom of the hanger in the data table for each trial. Make
sure there is padding under the mass hanger. You can go to surprisingly high mass totals.
Determine how far the rubber band stretched from the "zero" point for each trial in meters. Convert mass added in grams or kilograms into newtons of force. Graph force vs. stretch, stretch on the horizontal axis. How is the graph for the rubber band similar to the graph for the spring, and how is it different?

We call materials that behave like the rubber band "plastic" whereas the spring is called "elastic". Strange!