Name: SPH 3U Date:

3.3 Elastic Potential Energy

Investigation

/8 K /23 C /16 A

What is elastic potential energy? How are force and displacement related to work and energy?

Today we will be investigating the answers to these questions by studying springs. This investigation can be done in groups but is to be submitted individually.

Procedure:

1. Set up the retort stand with clamp as shown by teacher
2. Select a spring (Spring 1) and hang it from the retort stand with a weight holder on the hanging end
3. Tape a metre stick to the side of the desk so the top of the ruler is at the same height as the weight holder
4. Add weights in equal increments and record the mass added (g) and displacement (cm) of the spring in your **observations** table. You should have a total of 6 values (including the first value of 0,0)
5. Convert the mass to force of gravity (N) and displacement from cm to m.
6. Repeat steps 2-4 for Spring 2
7. Complete **analysis** and **practice questions** sections.

Observations:

Spring 1 **[/5A]**

Description of spring:

Mass added (g)	Force of gravity (N)	Displacement (cm)	Displacement (m)

Spring 2 **[/5A]**

Description of spring:

Mass added (g)	Force of gravity (N)	Displacement (cm)	Displacement (m)

Analysis: **[/6A]**

1. **Create a Force-Displacement Graph:** Plot the displacement in metres (x-axis) vs force applied in Newtons (y-axis) for both springs below. Make sure to label the axes as well as the data for Spring 1 and Spring 2.

2. Describe the trend for the force-displacement graphs for each spring (linear, non-linear etc.). [/2C]

3. Draw a line of best fit for each spring. Make sure the line goes through the origin (0,0). [/2C]

4. For a spring, the slope of the force-displacement graph is called the **spring constant.** Calculate the spring constant for each spring. Include units. [/2C]

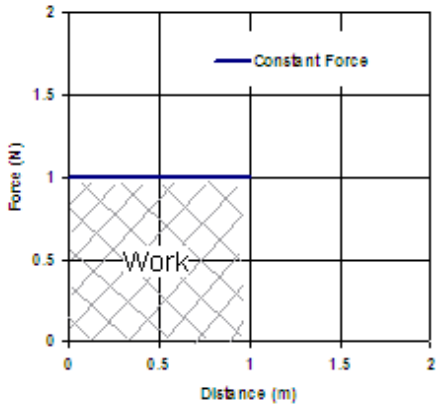
5. Compare the spring constant for each spring. What conclusion can you make about the spring constant in general? How will a spring with a high spring constant differ from a spring with a low spring constant? [/4C]

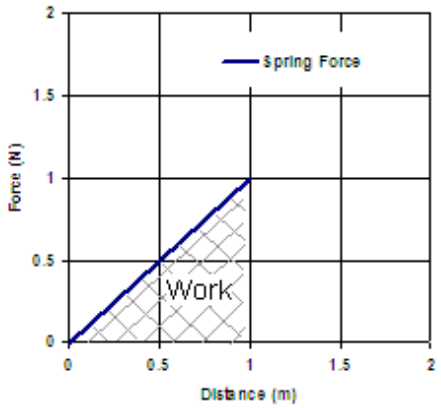
6. **Everything is a spring.** Describe what this means in your own words. How would the spring constant of a steel spring compare with the spring constant of a solid steel rod? [/3C]

7. The **area under the force-displacement graph** reveals a significant value as well: the work required to deform the spring. (Explanation on page 227 of your textbook). Use your line of best fit to calculate the work the 5 masses applied to the spring. [/4C]

8. How is *elastic potential energy* related to the work done on a spring? How much elastic potential energy were your springs able to store? [/3C]

9. We have defined work as $W = F\Delta d$ up until this point. How come we calculate work differently for a spring (area under the curve)? Explain your answer (the graphs are there to help you out!). [/3C]





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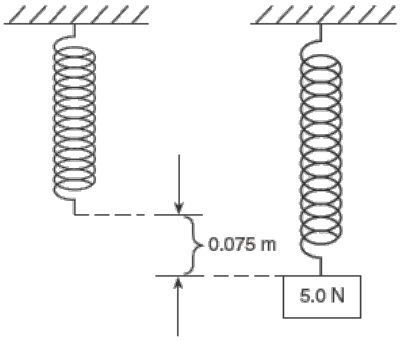
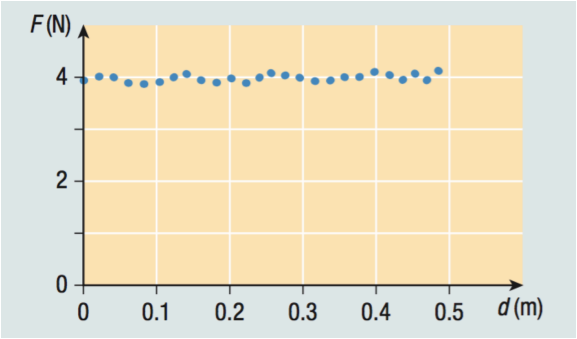
Practice Questions:

10. Calculate the spring constant for the spring below based on the deformation and applied force. Describe how this spring compare with the springs you used? [/2K]



11. Calculate the work done in each of the force-displacement graphs below. Show your work. [/6K]

1.



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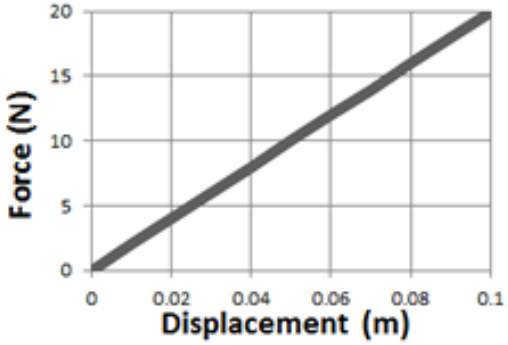

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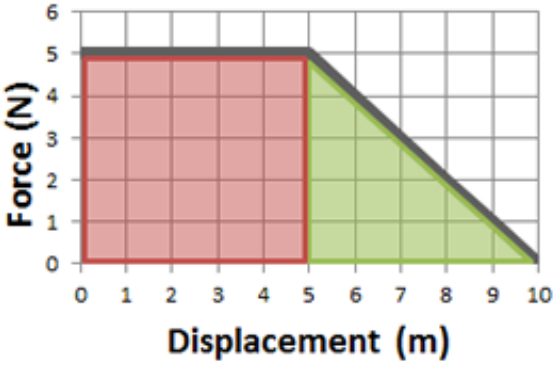

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