



PHYS 101

Lab. Exercise No.

Hooke's Law

Name : _____

ID No. _____

PERFORMANCE OBJECTIVES

Upon completion of this laboratory exercise the student will be able to:

- Investigate the deformation produced in the helical springs
- Measure the deformations produced in two springs and verify the Hooke's law

MATERIALS AND EQUIPMENT

Support base variable, support rod with hole (stainless steel, 100 mm), support rod (stainless steel, 600 mm), boss head, weight holder for slotted weights-10g, slotted weight-10g (4), slotted weight-50g (3), spring balance, transparent-1N, spring balance holder, helical spring 3N/m, helical spring 20 N/m, holding pin, measuring tape, $l = 2$ m

THEORETICAL CONCEPTS

When forces act on a solid body, the body is deformed. This resulting deformation depends largely on the material of the body. If the solid body regains its original shape after the removal of force, the material is called elastic. A helical spring is a very simple example of an elastic body. The elongation (deformation) produced in helical spring is proportional to the forces F_g exerted by the weights that are hanged by this spring. Mathematically we can write this as

$$F_g = k \Delta l \quad \text{or} \quad k = \frac{\Delta F_g}{\Delta l} \quad (\text{Equation 1})$$

Δl is the elongation produced in the spring due to a force F_g exerted by the weight hanging from the spring. Equation 1 gives the Hooke's law which states that the elongation Δl is proportional to the force F_g . The constant of proportionality k is called the "spring constant" of the helical spring that can be obtained by calculating the slope of the graph between the force F_g and the elongation Δl produced.

EXPERIMENTAL SETUP AND PROCEDURE

Part – 1

1. Hang the weight holder ($m = 20\text{g}$) on the hooked end of the spring and record the extension L (see the Figure 1)
2. Increase the mass in a step of 20g until a load of total of 200 g is reached. Record the corresponding changes in elongation L for each mass value at each step.
3. Calculate the weight (force) $F_g = m \times 980 \text{ dyne}$ for each mass.
4. Record all the values for the mass m and the extension L in Table 1.

Part – 2

Replace the helical spring 1 with the helical spring 2.

1. Move the measuring tape up or down until it's zero mark is at level with the lower end of the spring.
2. Hang the weight holder with a 20 g mass piece on the spring's hook and note the extension l . Determine the corresponding extensions in length.
3. Increase the mass in 20 g increments up to a total of 200 g and determine the corresponding extensions in length.
4. Calculate the weight (force), $F_g = m \times 9.8 \text{ N}$. for each mass
5. Record these values in Table 2.



Observations:

For given helical spring 1

Table 1

[03 Marks]

| Obs. No. | Mass "m" (g) | Mass "m" (kg) | Weight (Force) $F_g = m \times 9.80$ (N) | Elongation in Spring 1 "l ₁ " (cm) | Elongation in Spring 1 "l ₁ " (m) |
|----------|--------------|---------------|--|---|--|
| 1 | 20 | | | | |
| 2 | 40 | | | | |
| 3 | 60 | | | | |
| 4 | 80 | | | | |
| 5 | 100 | | | | |
| 6 | 120 | | | | |
| 7 | 140 | | | | |
| 8 | 160 | | | | |
| 9 | 180 | | | | |
| 10 | 200 | | | | |

For given helical spring 2

Table 2

[03 Marks]

| Obs. No. | Mass “ <i>m</i> ” (g) | Mass “ <i>m</i> ” (kg) | Weight (Force) $F_g = m \times 9.80$ (N) | Elongation in Spring 2 “ <i>l</i> ₂ ” (cm) | Elongation in Spring 2 “ <i>l</i> ₂ ” (m) |
|----------|-----------------------|------------------------|--|---|--|
| 1 | 20 | | | | |
| 2 | 40 | | | | |
| 3 | 60 | | | | |
| 4 | 80 | | | | |
| 5 | 100 | | | | |
| 6 | 120 | | | | |
| 7 | 140 | | | | |
| 8 | 160 | | | | |
| 9 | 180 | | | | |
| 10 | 200 | | | | |

Graph between the force (F_g) and the elongation (l)

Use the values obtained in Table 1 to plot a graph between the force F_g and the elongation of spring 1 (l_1). Use the values obtained in Table 2 to plot another curve between the force F_g and the elongation of spring 2 (l_2). Graph is given in Figure 2.

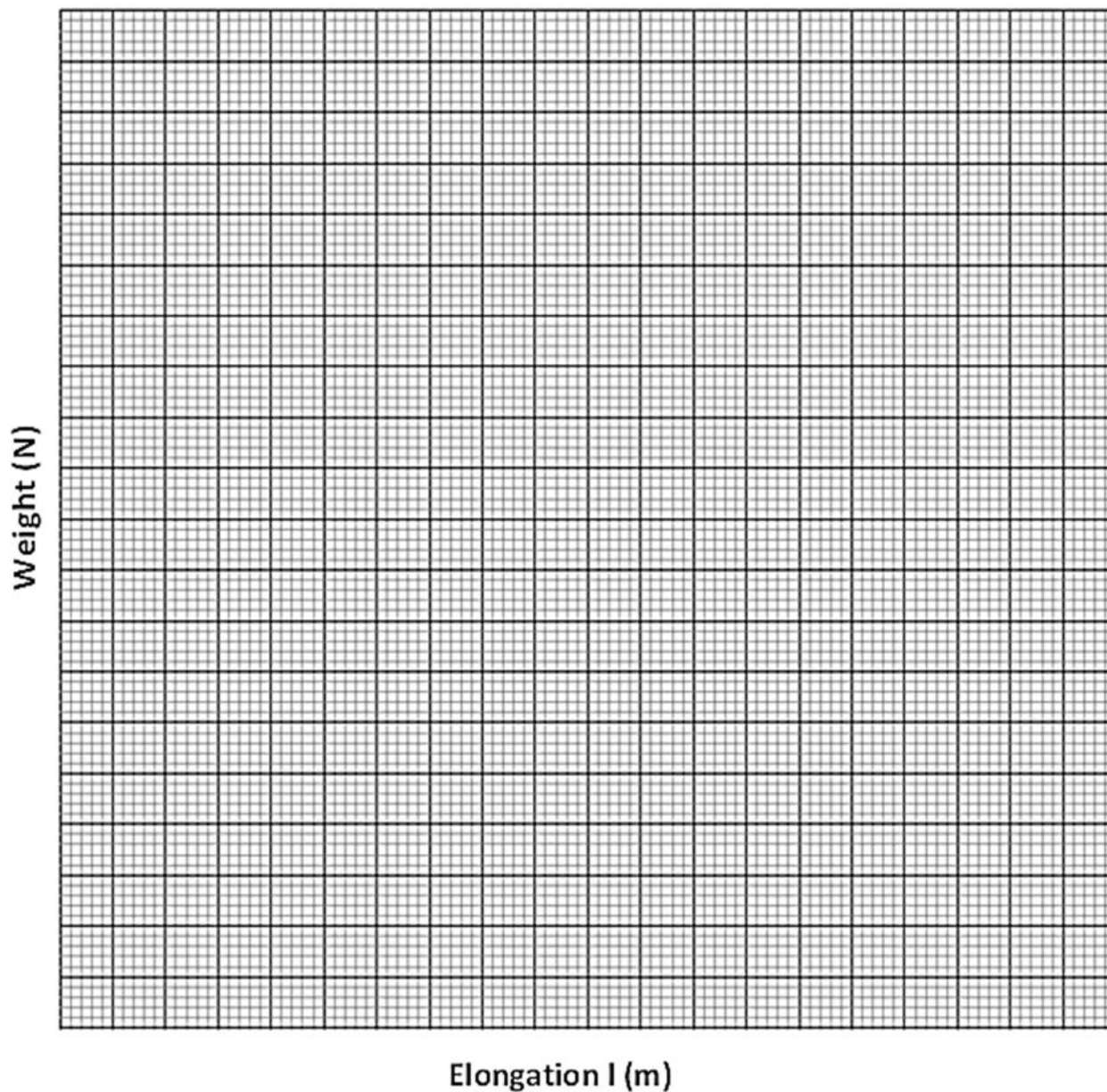


Figure 2: Plot a graph between the force F_g (y-axis) and the elongations l_1 (x-axis)
[02 Marks]

ANALYSIS

Determine the proportionality factor (k) from the slopes of the two curves obtained in Figure 2.
 (Don't forget to use the correct units!)

$$k_1 = \frac{F_{g1}}{\Delta l_1} \quad k_2 = \text{-----} \quad N/m$$

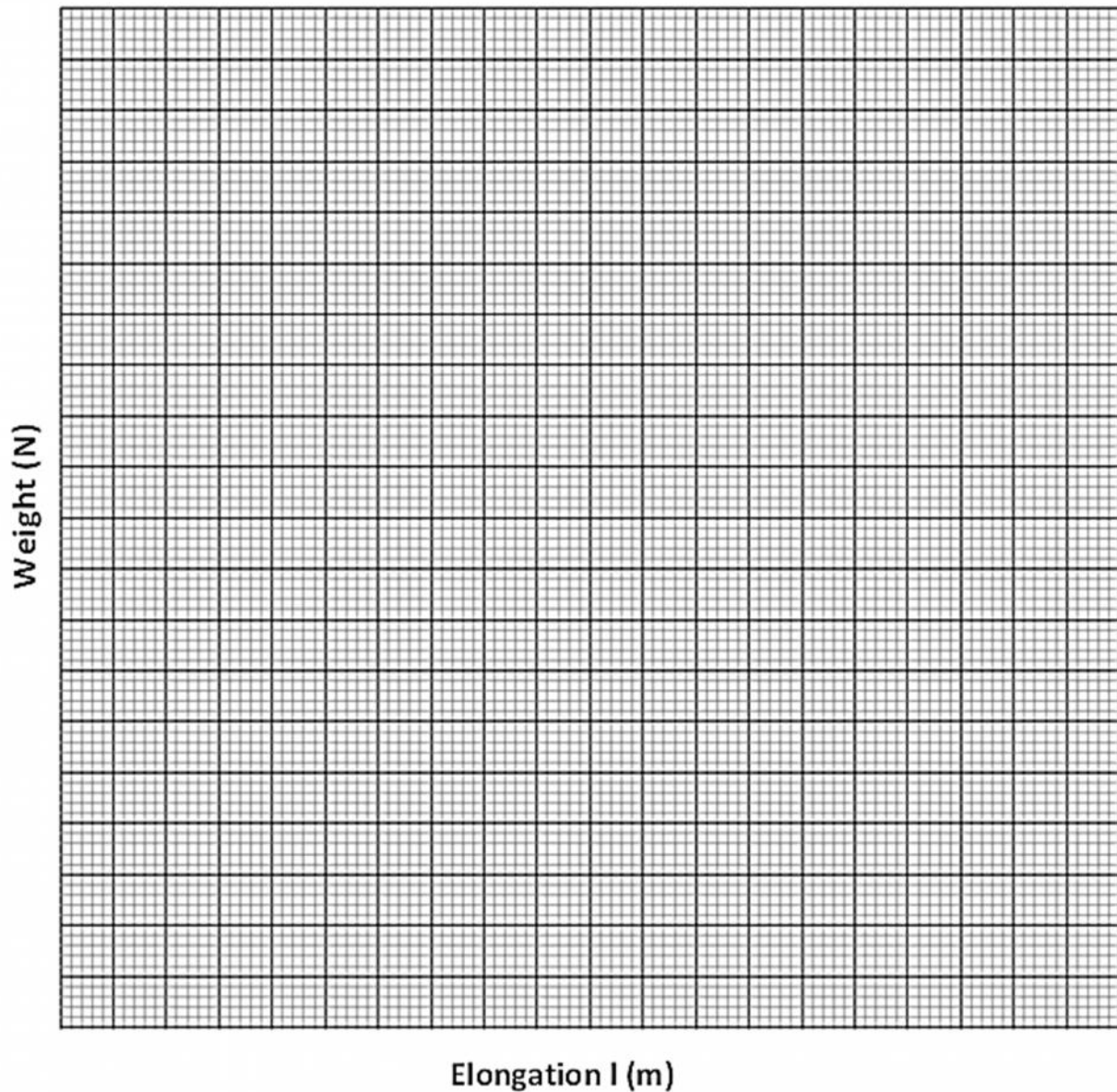


Figure 3: Plot a graph between the force F_g (y-axis) and the elongations l_2 (x-axis)

ANALYSIS

[02Mark]

Determine the proportionality factor (k) from the slopes of the two curves obtained in Figure 2. (Don't forget to use the correct units!)

$$k_2 = \frac{F_{g2}}{\Delta l_2} \quad k_2 = \text{-----} \quad N/m$$

End of the Lab Exercise