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Exp-1-SPRING MASS SYSTEM

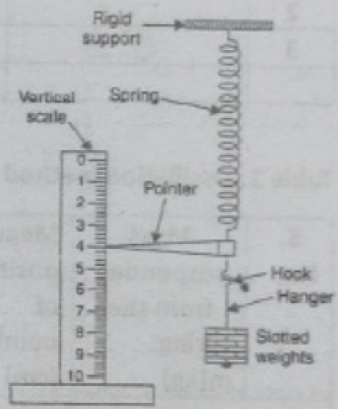
Aim: To determine the force constant of a helical spring from its load-extension and by the method of oscillation.

Apparatus: Light weight helical spring, slotted weights, stopwatch, Scale etc.

Simulation software:

Online simulation link: https://phet.colorado.edu/sims/html/masses-and-springs/latest/masses-and-springs_all.html

Formula used:



Load-extension

$F = kx$ or $k = \frac{F}{x}$

Oscillation method

$$T = 2\pi\sqrt{\frac{m}{k}} \quad \text{or} \quad k = 4\pi^2\frac{m}{T^2} \quad k = \frac{4\pi^2}{Slope\ of\ graph}$$

Procedure:

1. Suspend the helical spring from a rigid point support, as shown in Fig. Set the metre scale close to the spring vertically.
2. Record the initial position of the pointer on the metre scale, without any slotted mass suspended from the hook.
3. Suspend the slotted mass on the hanger gently. Wait for some time for the load to stop oscillating so as to attain equilibrium (rest) position, or even hold it to stop. Record the position of the pointer on the metre scale.
4. Repeat the procedure with different mass.
5. Compute the force and force constant using given formula.
6. Plot the graph by referring given reference graph, calculate slope and the force constant compare with the calculated value.
7. For oscillation method, suspend the mass and measure the time period using stopwatch.
8. Compute the force constant using given formula.
9. Plot the graph by referring given reference graph, calculate slope and the force constant compare with the calculated value.
10. Compare the calculated force constant using both its load-extension and by the method of oscillation.

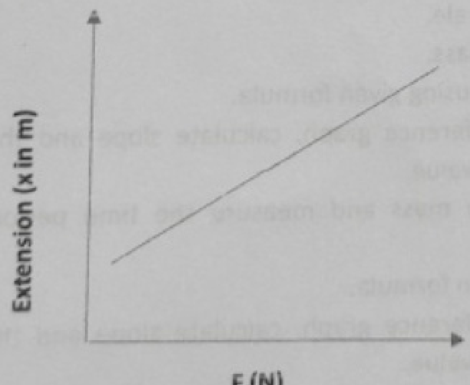
Note: Use excel tool or python code for the graph plotting calculations.

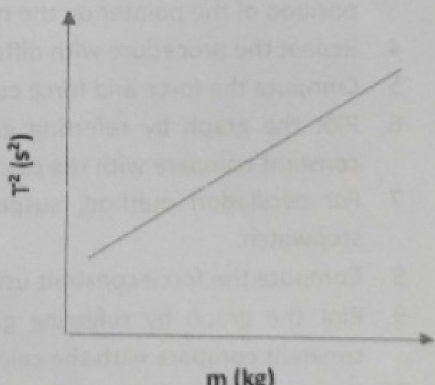
Table 1: Load-extension method

S. No.	Mass suspended from the spring, m(kg)	Force, F = mg	Position of the pointer	Extension, X(m)	Spring constant, K (= F/x)
1	0.1	0.98	0.48	0.15	6.533333
2	0.2	1.96	0.48	0.32	6.125
3	0.3	2.94	0.48	0.47	6.2553191

Table 1: Oscillation method

S. No.	Mass suspended from the spring, m(kg)	Mean position of pointer, x (cm)	No. of oscillations, (n)	Time for (n) oscillations, t (s)				Time period, T = t/n (s)	T^2
				1	2	3	Mean t (s)		
1	0.1	0.48	10	8	8.1	7.8	7.9667	0.79667	0.6346
2	0.2	0.48	10	11.96	11.63	10.21	11.2667	1.12667	1.2693
3	0.3	0.48	10	13.92	13.6	13.65	13.723	1.3723	1.8832





Excel graph/Python code:

Results:

Force constant using Load-extension method = 6.32 **N/m**

Force constant using oscillation method = 6.32 **N/m**

Note: Students are directed use excel or python tool for calculations and graph submit the filled (manually) worksheet along with excel/python file to LMS for evaluation.