Springs Set

P3-3605

INSTRUCTIONAL GUIDE

Contents

- 5 Springs of different spring constants (2.5, 5, 10, 15, and 25 N/m)
- Instructional Guide

Required for activities:

- Digital Newton Meter (01-7000)
  Or
- Hooked Mass, Set of 9 (91-1000)
- Meter Stick (P1-7072)
- Buret Clamp (66-8002)
- Ring Stand (66-4220)

Background

A spring constant is a useful value in any application a spring is needed such as simple harmonic motion experiments. It is unique for every spring and is defined in units of Newtons per meter of stretch. In other words, it tells how much force is required to stretch a particular spring one meter. Robert Hooke, a 17th century natural philosopher and scientist was the first to describe the proportional relationship between the length of springs and the force applied to them. That is why the relationship is called “Hooke’s Law.” It can be defined mathematically as:

$$k = \frac{F}{d}$$

where k is the spring constant and F is the force required to stretch the spring a certain distance, d. Springs exhibit this behavior unlike other elastic substances such as rubber bands or bungee cords where the relationship is not linear and often dependent on temperature.

Introduction

Hooke’s Law can be modeled ideally with this five-spring set. Each student team can be given a set of 5 springs or move through stations where each different type of spring is tested. The students can place various masses on the springs, collect data and graph force vs. elongation. The pre-stress has been removed to give accurate results.

Activity

Setup:
Use a clamp on a ring stand to fasten a meter stick vertically. Then use another clamp as a hook to hang each spring close enough to the meter stick so the red indicators can be read easily. Measurements can be made in one of two ways. A digital Newton meter can be used to directly

measure the force required to stretch each spring a certain distance, or hooked masses can be hung from the spring. The latter requires some math to convert the mass being pulled by gravity to units of force. This serves as a great reminder of mass versus weight relationships and can be a great place to introduce simple harmonic motion.

Finding Spring Constant with Digital Newton Meter:

1. With the first spring attached to the clamp, hang the Digital Newton Meter from the hook on the spring.
2. Tare the Newton Meter so it reads zero Newtons and record the position indicated by the red point on the side of the scale.
3. Grasp the Newton Meter and pull straight downwards until the red indicator has moved 20 cm. Record the reading on the side of the Newton Meter.
4. Divide this reading by 0.20 m (the distance the red indicator moved) to find the spring constant.
5. Repeat this several times for each spring, pulling the spring to get different values for d.
6. Plot the results for each spring on a graph of force over distance and find the slope of the best fit line (you should have 5 different graphs). The slope is the spring constant!

Finding Spring Constant with Hooked Masses:

1. With the first spring attached to the clamp, record the value on the meterstick indicated by the red point on the spring.
2. Hang a mass from the hook on the spring and record the new value indicated on the meter stick.
3. Multiply the mass used by 9.81 m/s^2 to find its weight in Newtons.
4. Divide the weight in Newtons by the difference in meter stick readings to find the spring constant.
5. Repeat this several times for each spring using different masses to get different values of F.
6. Plot the results for each spring on a graph of force over distance and find the slope of the best fit line (you should have 5 different graphs). The slope is the spring constant!

Related Products

Slotted Mass Set (P1-1073) Easily portable and quick to put away this slotted weight set is supplied on a stand with a handle.

Spring Scales (Complete Set) (01-6970) Clear plastic bodies reveal these scales' inner workings. Printed in grams and Newtons. 6 options include 5000g, 3000g, 2000g, 1000g, 500g, 250g. Color-coding makes it easy to find the right scale for the task.