

TAP 303-1: Loaded spring oscillator

Context

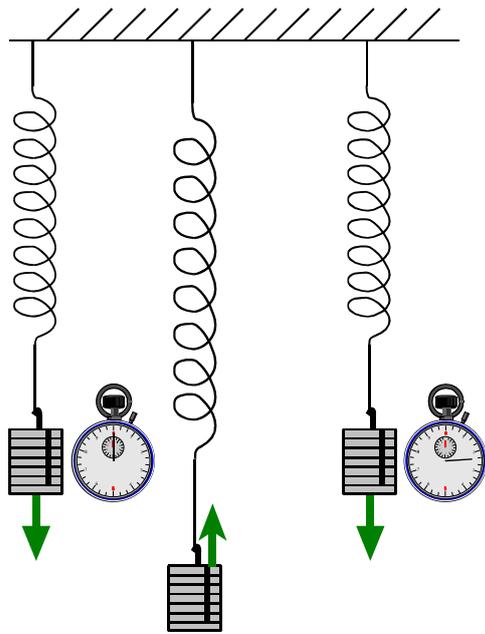
Here you are asked to make careful measurements to check the effect of changing the mass and spring constant on the period of an oscillation.

You will need

- ✓ retort stand, boss and clamp and G-clamp to fix stand to bench
- ✓ steel spring
- ✓ mass hangers with slotted masses, 100 g
- ✓ hand held stopwatch

Linking the period and the mass

1. Set up spring and mass so that vertical oscillations can be measured.



2. Decide how best to measure the time for one oscillation accurately – this is the period T .
3. Choose a range of masses so that the period varies significantly.
4. Make a number of measurements, taking care not to exceed the elastic limit of the spring, until you have about six pairs of mass-period data.

Theory predicts that

$$T = 2\pi\sqrt{\frac{m}{k}}$$

for the loaded spring oscillator.

5. Calculate the square of the period T^2 for each mass m , and draw an appropriate graph to check whether T^2 is proportional to m .
6. Calculate the gradient of your graph and hence find a value of the spring constant k .
7. To check do a simple Hooke's law experiment with your spring to check this value.

You have checked

1. The theoretical predictions relating the period of a loaded spring oscillator to the mass:

$$T = 2\pi\sqrt{\frac{m}{k}}.$$

Practical advice

This is a straightforward activity. It is assumed that the theory of the loaded spring oscillator has been developed and that this activity checks proportionality of T^2 to m . Students should concentrate on, and devise methods for, accurate measurement. Although some extendable springs appear to extend non-linearly for low added masses, this defect does not significantly reduce the possibility of students obtaining good results.

Social and human context

A light-hearted, but realistic, application of the result is considering baby bouncers. A baby's mass increases significantly over a period of 12 months, and students could be asked to calculate approximately (given that the bouncer is not a standard loaded spring oscillator) how this would affect the frequency of the oscillation.

An alternative application is that the relationship can be used to determine the mass of astronauts in free fall provided a 'two spring' system is used.

External reference

This activity is taken from Advancing Physics chapter 10, 260E