

Energy Worksheet
Springs and Hooke's Law/Conservation of Energy

Elastic Potential Energy – Stored energy in an elastic medium such as a spring, rubber band, etc.

Elastic medium – A medium that, when distorted, will return to its original shape when the distorting force is removed.

The force in the medium is governed by how far it is stretched, compressed, or bent.

This is known as Hooke's Law:

$$\mathbf{F = - kx}$$

The negative in the equation above indicates that the force is a *restoring* force.

Energy stored in an elastic medium is given by:

$$\mathbf{EPE = (1/2)kx^2}$$

Where K is the spring constant, and x is the displacement from equilibrium (the natural rest length or shape of the elastic medium)

1. If a spring has a spring constant of 2 N/m and it is stretched 5 cm, what is the force of the spring?

2. If a spring has a spring constant of 0.5 N/m and it is stretched 0.5 m, what is the force of the spring?

3. A spring is stretched 6 cm when a mass of 200 g is hung on it. Calculate the spring constant of this spring.

4. If you use the spring from problem #3 and hang a 500 g mass on it, how far will it stretch? Convert your answer to cm.

5. A spring with a spring constant of 400 N/m has a mass hung on it so that it stretches 8 cm. Calculate how much mass the spring is supporting.

1. A spring is stretched 2 cm when a mass of 40 grams is hung from it. What is the spring constant of the spring?

2. A trampoline has a spring constant of 3430 N/m. How far will the trampoline sink when a 70 kg person steps on it?

3. A force of 200 N stretches a spring 30 cm. What is the spring constant of the spring?
How far would this spring stretch with a force of 100 N applied to it?
4. A 20 kg box is attached to a compressed spring that has a spring constant of 300 N/m.
The box is resting on a frictionless surface and the spring is compressed 30 cm.
- What is the EPE of the spring?
 - What will be the KE of the box when the spring expands back to its natural length?
 - How fast will the box be moving after the spring releases the box?
5. A spring has a spring constant of 256 N/m. How far must it be stretched to give it an elastic potential energy of 48 J?

6. A toy rocket-launcher contains a spring with a spring constant of 35 N/m . How much must the spring be compressed to store 1.5 J of energy?

7. Each of the coil springs of a car has a spring constant of $25,000 \text{ N/m}$. How much is each spring compressed if it supports one-fourth of the car's $12,000 \text{ N}$ weight?

8. The force constant of a spring is $150. \text{ N/m}$.
(a) How much force is required to stretch the spring 0.25 m ?
(b) How much work is done on the spring in that case?

9. A 1.00 kg mass is placed at the free end of a compressed spring. The force constant of the spring is 115 N/m. The spring has been compressed 0.200 m from its neutral position. It is now released. Neglecting the mass of the spring and assuming that the mass is sliding on a frictionless surface, how fast will the mass move as it passes the neutral position of the spring?

10. A 5.0 g pellet is placed in the barrel of a toy gun and is propelled by a spring of force constant 50. N/m. The spring is compressed 20. cm and then released. Calculate the maximum velocity of the pellet when shot horizontally.

11. A linear elastic spring can be compressed 10.0 cm by an applied force of 5.0 N. A 4.5 kg crate of apples, moving horizontally at 2.0 m/s collides with the spring. What will be the maximum compression of the spring?

12. A spring with a force constant of 5.20 N/m has a relaxed length of 2.45 m . When a mass is attached to the end of the spring and allowed to come to rest, the vertical length of the spring is 3.57 m . Calculate the elastic potential energy stored in the spring.

13. The staples inside a stapler are kept in place by a spring with a relaxed length of 0.115 m . If the spring constant is 51.0 N/m , how much elastic potential energy is stored in the spring when its length is 0.150 m ?

14. A 0.0340 kg bullet traveling at 120 m/s embeds itself in a 1.24 kg wooden block which is at rest on a smooth surface. The block then slides toward a spring and collides with it. The block compresses the spring ($k = 99.0 \text{ N/m}$). Calculate how far the block-bullet compresses the spring.

15. A 10.0 g pebble is placed in a sling shot with a spring constant of 200.0 N/m and is stretched back 0.500 m . What is the maximum velocity the pebble will acquire?