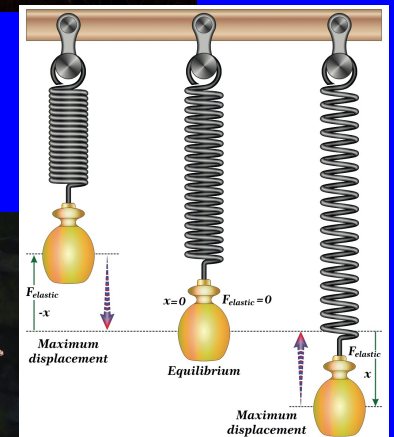
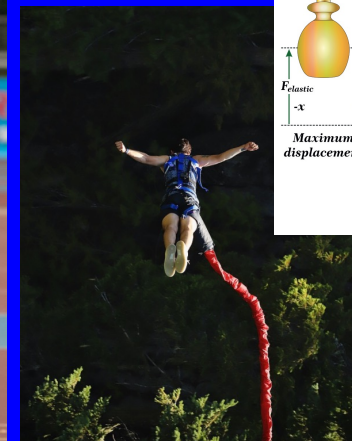
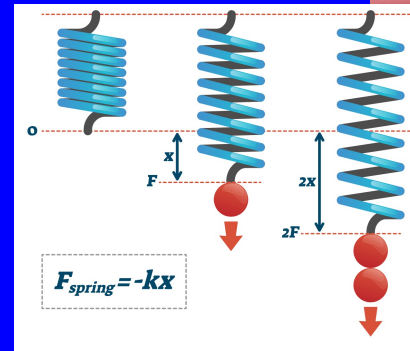


Elastic Potential Energy & Simple Harmonic Motion

- Robert Hooke
- Hooke's Law
- Applications
- Elastic Potential Energy
- Energy Transfer
- Simple Harmonic Motion
- Practice



Preview File

Please enjoy this preview of your Student Version of the presentation. Please note within this sample file:

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- Other slides may have on them, this represents writing that has been removed on this sample

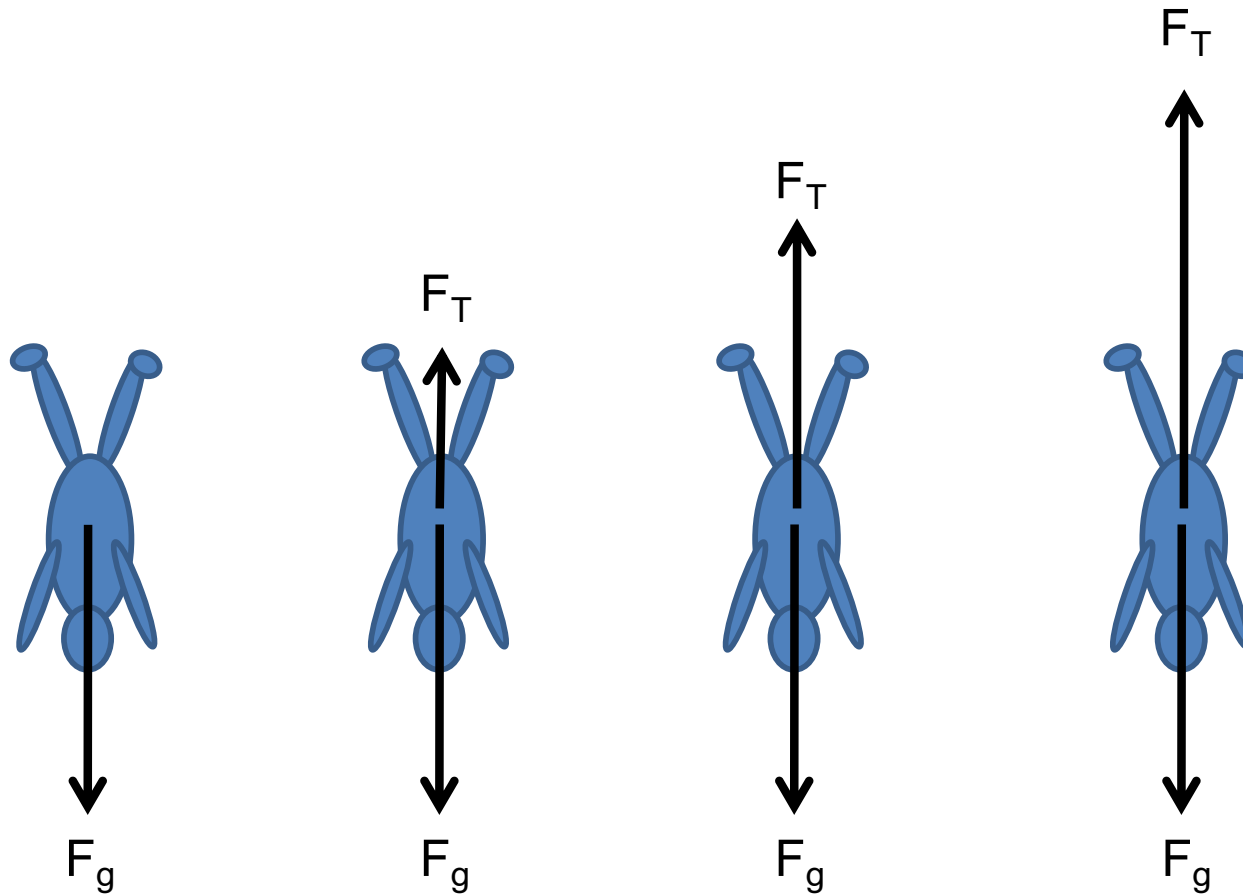
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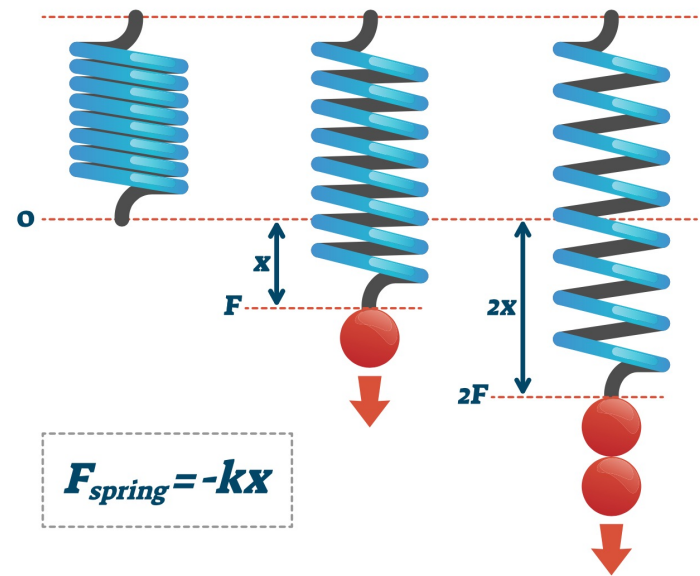


FBD – Bungee Jumping



Sir Robert Hooke

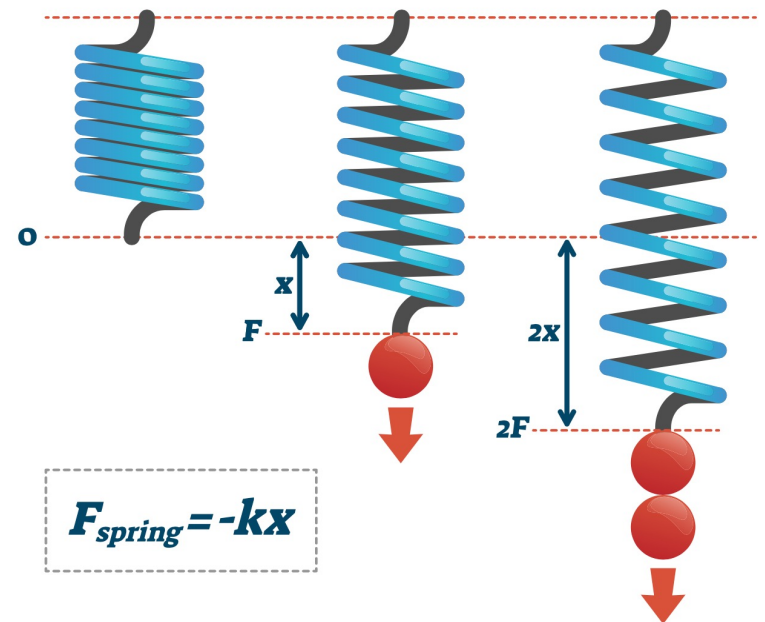
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Hooke's Law

- The constant k is called the spring constant and is the absolute magnitude (positive)
- _____
- The negative is because the displacement is in the opposite direction of the restoring force
- *SI unit of $k = \text{N/m}$*



Check Your Understanding

A student stretches a spring horizontally a distance of 15 mm by applying a force of 0.18 N [E].

- a) Determine the force constant of the spring.
- b) What is the force exerted by the spring on the student?

$$F = -kx$$

Check Your Understanding

A ball of mass 0.075 kg is hung from a vertical spring that is allowed to stretch slowly from its unstretched equilibrium position until it comes to a new equilibrium position 0.15 m below the initial one.

- a) Determine the force constant of the spring.
- b) If the ball is returned to the spring's unstretched equilibrium position and then allowed to fall, what is the net force on the ball when it has dropped 0.071 m ?
- c) Determine the acceleration of the ball at the position specified in (b).

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Elastic Potential Energy



Elastic Potential Energy

The energy stored can be calculated with the following expression:

$$E_e = \frac{1}{2} kx^2$$

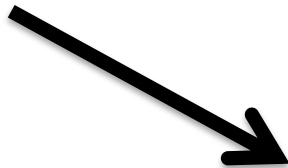
Energy Transfer



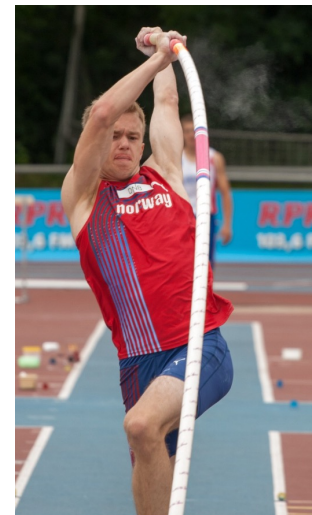
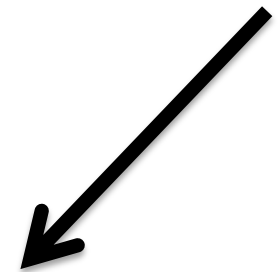
Elastic potential energy can be transformed into other forms of energy, such as:

- the kinetic energy of an arrow shot by a bow
- the gravitational potential energy of a pole-vaulter at the top of the jump

Minimum Elastic Energy,
Maximum Potential Energy

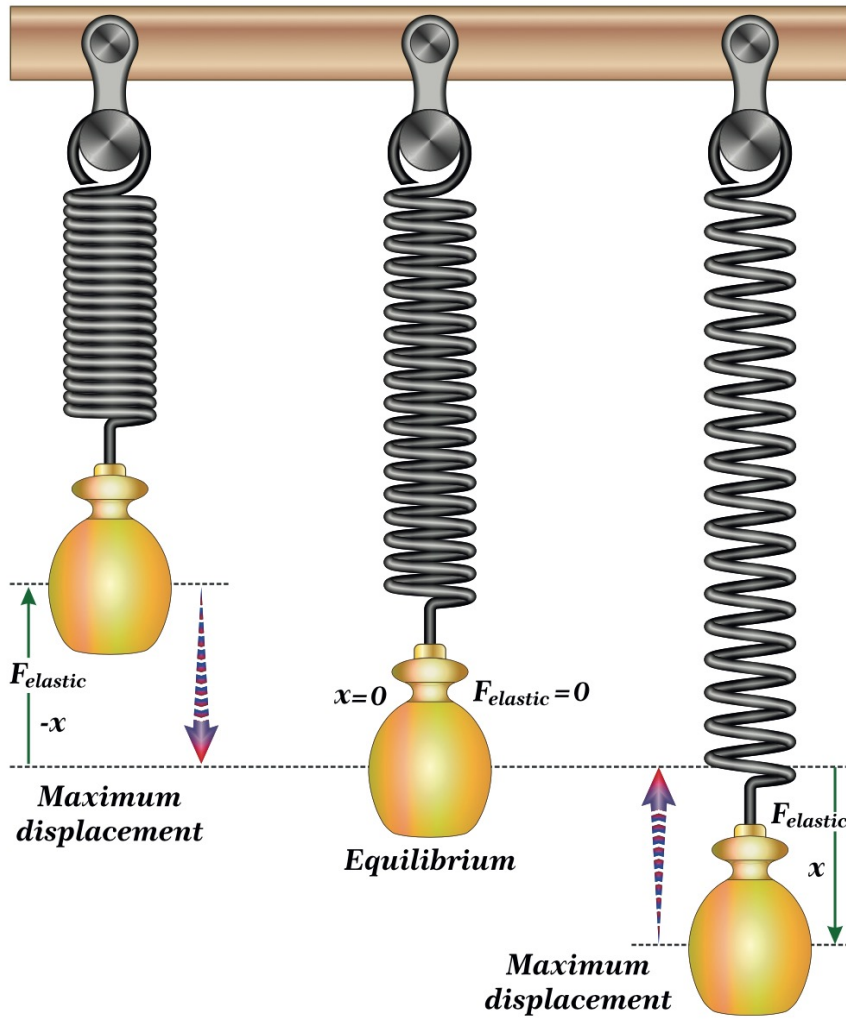


Maximum Elastic Energy,
Minimum Potential Energy



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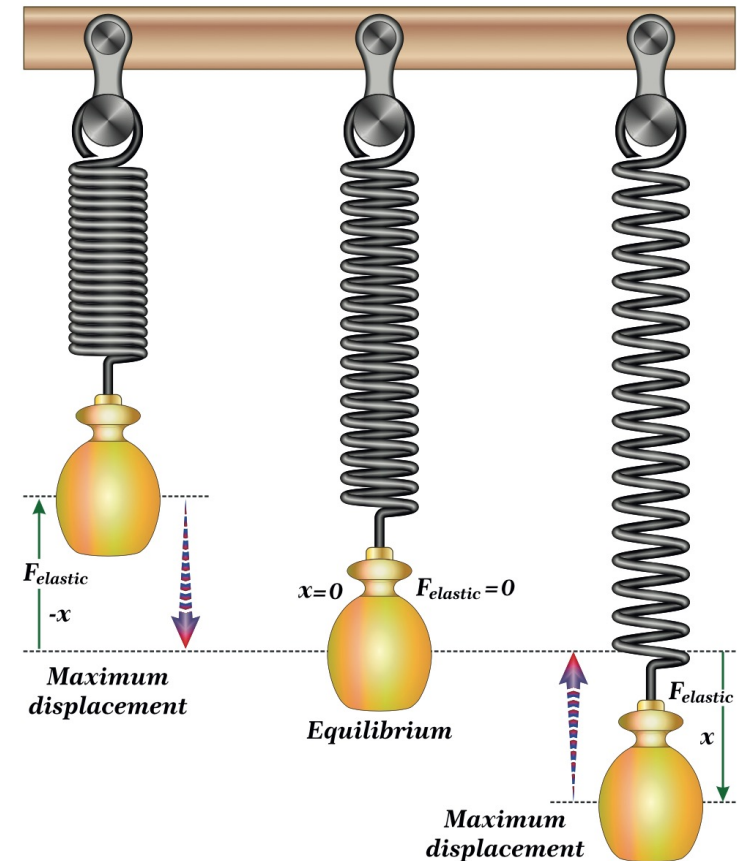
Simple Harmonic Motion



- The repetitive movement back and forth through an equilibrium, or central position, so that the maximum displacement on one side of this position is equal to the maximum displacement on the other side
- The force

Simple Harmonic Motion

- _____
- The velocity is at a maximum at the equilibrium point
- The spring compression/stretching (causes acceleration in the opposite direction) hasn't started yet



Equations

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

Since the frequency is the reciprocal of the period,

$$f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$$

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Check Your Understanding

A 0.25-kg mass is attached to the end of a spring that is attached horizontally to a wall. When the mass is displaced 8.5 cm and then released, it undergoes SHM. The force constant of the spring is 1.4×10^2 N/m. The amplitude remains constant.

- a) How far does the mass move in the first five cycles?
- b) What is the period of vibration of the mass-spring system?

$$F = -kx$$

$$E_e = \frac{1}{2}kx^2$$

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

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

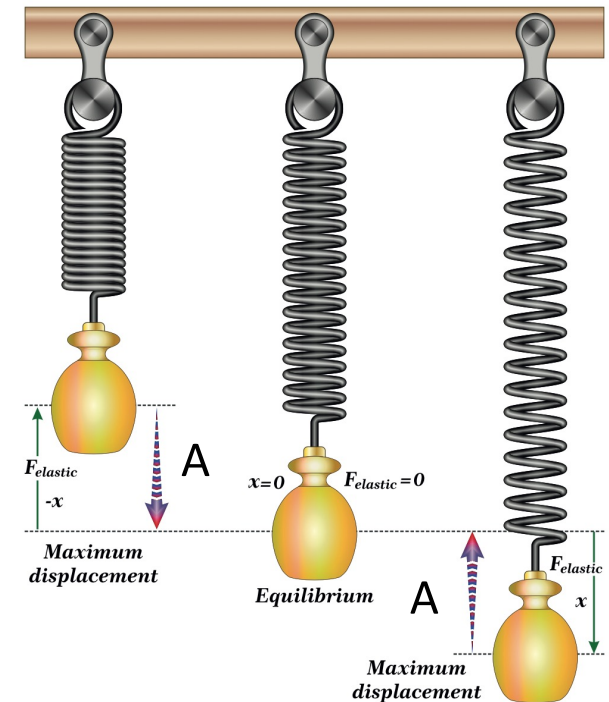
Energy in Simple Harmonic Motion

- _____

$$E_e = \frac{1}{2} kx^2$$

- According to the law of conservation of energy, when the mass is released, the total energy (E_T) of the system is the sum of the elastic potential energy in the spring and the kinetic energy of the mass

$$E_T = \frac{1}{2} kx^2 + \frac{1}{2} mv^2$$



Check Your Understanding

A 55-g box is attached to a horizontal spring of force constant 24 N/m. The spring is

- a) What is the speed of the box when it is at position $x = 5.1$ cm from the equilibrium position?
- b) What is the maximum speed of the box?

$$E_T = \frac{1}{2}kx^2 + \frac{1}{2}mv^2$$