Hooke's Law, Spring

By

Nada Saab, Ph.D

Hooke's Law, Spring

In 1978, the British scientist Robert Hooke was one of the first to study the elasticity of matter and published his law: "The amount of deformation of an elastic object is proportional to the force applied to deform it".

"Stress is proportional to strain".

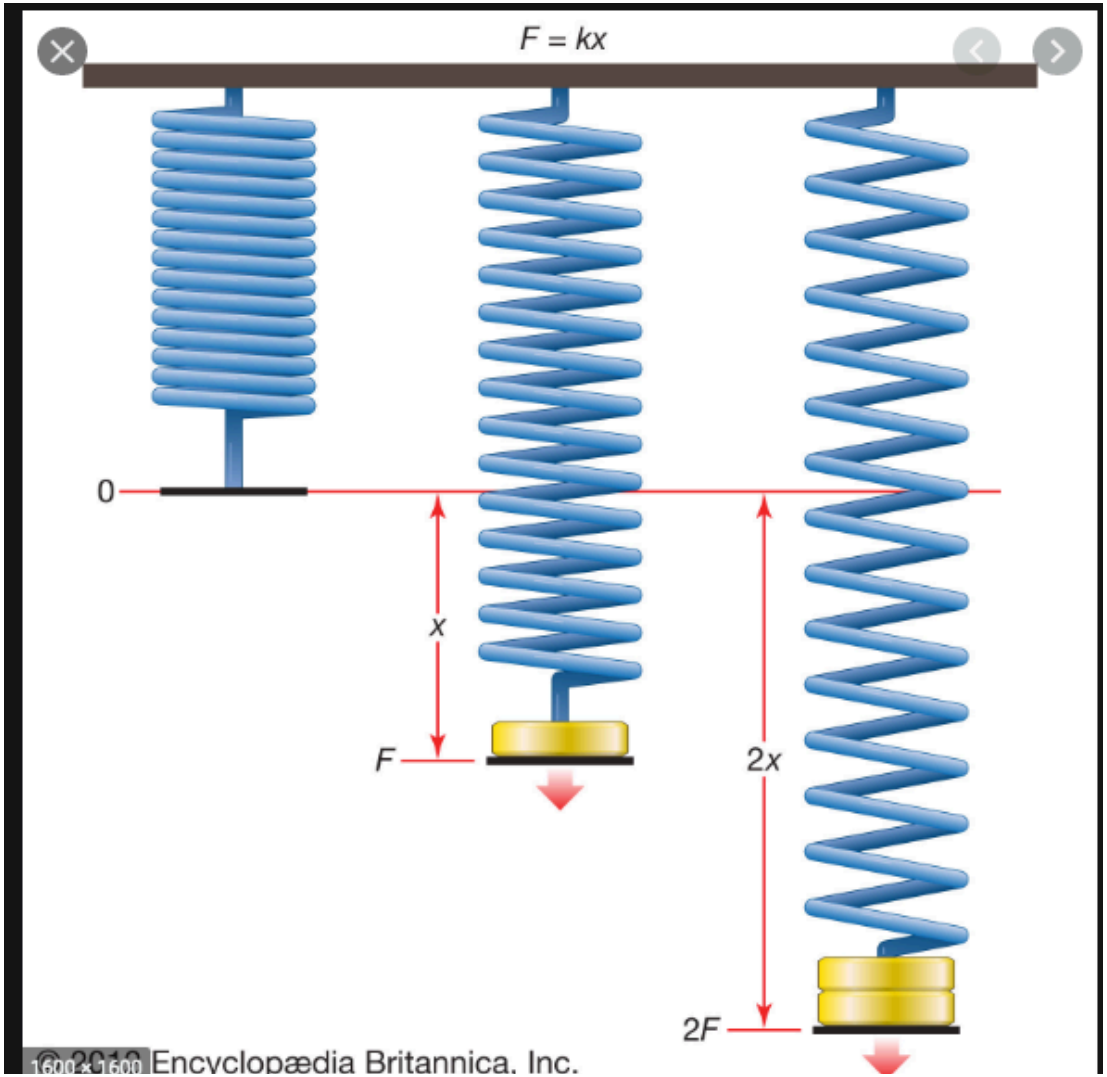
Hooke's Law
$F_s = Kx$

F_s is the force exerted on the deformed spring, in newtons

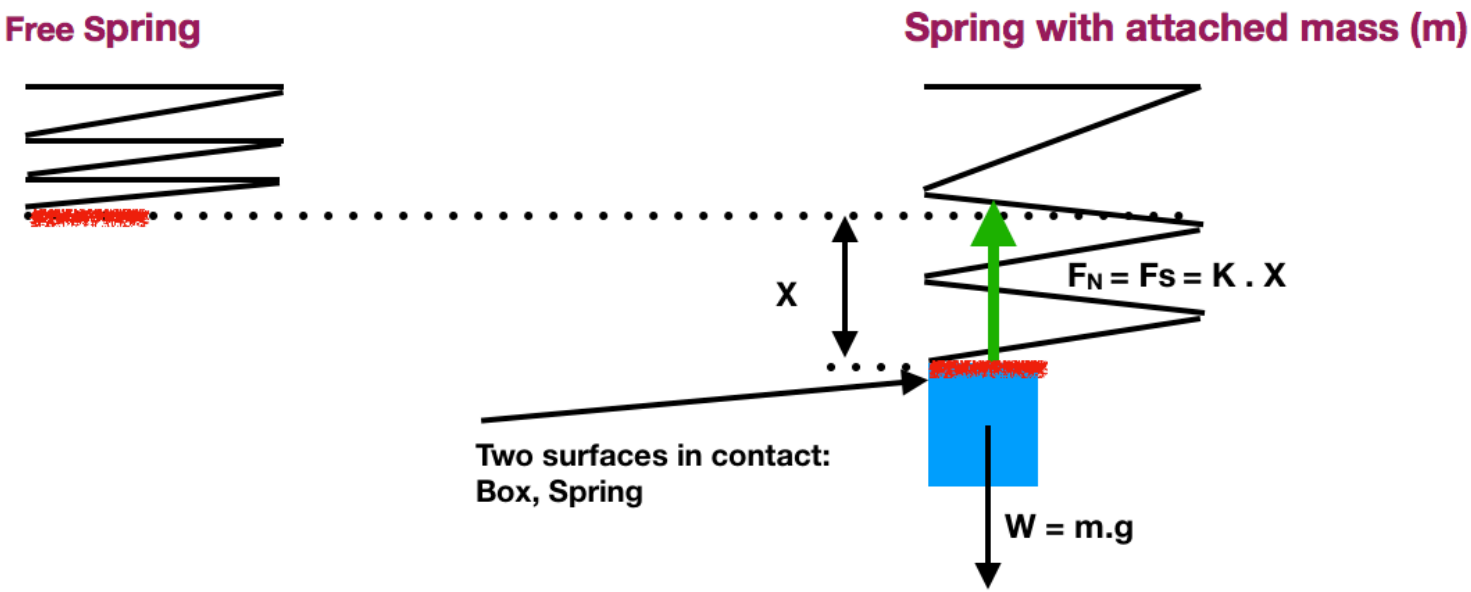
x is the amount of deformation of the spring, in meters.

k is the force constant of the spring, in newtons per meter.

An ideal spring is a spring that behaves according to Hooke's law.


F = kx
0
x
F
2x
2F
1600 × 1600
Encyclopædia Britannica, Inc.

Equilibrium between a mass and a spring;



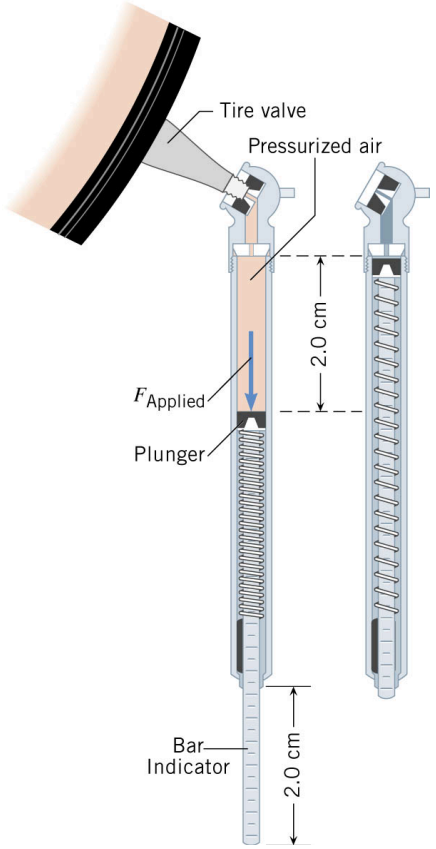
$$F_N = Fs = W$$

$$Fs = W$$

$$K \times X = m \times g$$

Example 1: A Tire Pressure Gauge;

In a tire pressure gauge, the pressurized air from the tire exerts a force F that compresses a spring. The spring constant of the spring is 320 N/m and the bar indicator extends 2.0 cm. What force does the air in the tire apply to the spring?



Data Table		
k	x	F_s
320 N/m	0.02 m	?

$$F_s = K . X$$

$$= 320 \times 0.02$$

$$= 6.4 \text{ N}$$

Example 2: A spring whose force constant is 48 N/m has a 0.25 kg mass suspended from it. What is the extension of the spring?

m = 0.25 kg

K = 48 N/m

X = ?

Hooke's Law: $F_s = K.\ X$ $W = m.\ g$

Equilibrium: $F_s = F_N = W$

$$K\ .\ X = m\ .\ g$$

$$48\ N/m\ .\ X = 0.25\ kg\ .\ 9.8\ N/kg$$

$$48\ N/m\ .\ X = 2.4\ N$$

$$X = 2.4 / 48 = 0.050\ m \text{ or } 5\ cm$$

Practice:

1. What force is necessary to stretch a spring whose force constant is 120 N/m by an amount of 30 cm? Answer: 36 N
2. A spring with a force constant of 600 N/m is used on a scale for weighing fish. What is the mass of a fish that stretches the spring 7.5 cm from is normal length? Answer: 4.6 kg
3. A spring in a pogo stick is compressed 12 cm when a 40 kg boy stand on the stick. What is the force constant for the pogo stick spring?

   Answer: 3.3×10^3 N/m