Springs

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[2024-10-18 Fri 13:44]

1 Spring Equation - Hooke's Law

$$F_s = -k\Delta x$$

Variable	Meaning
F_s	Force of spring
k	spring constant
Δx	change in position

The more you pull spring, the more it wants to go back together.

2 Diagrams

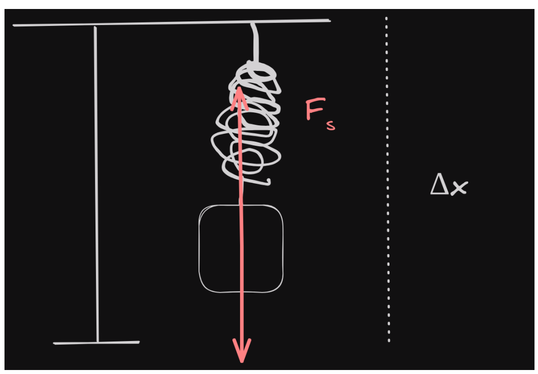

Figure 1: One spring

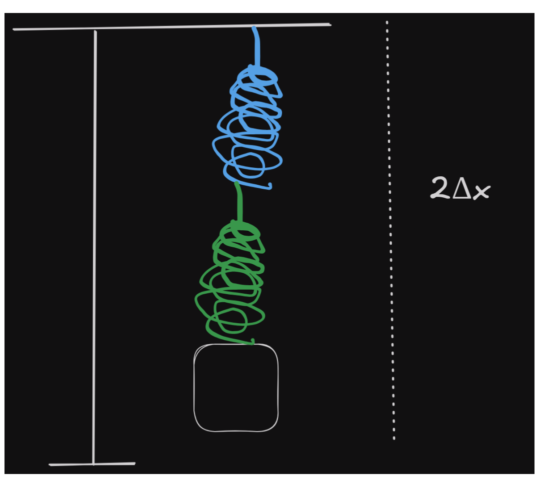

Figure 2: Springs in a series

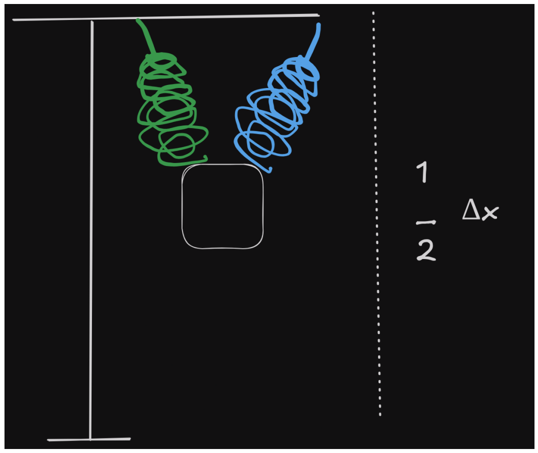

Figure 3: Springs in parallel

3 Adding spring constants in Series

$$\frac{1}{k_{\text{series}}} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3} \dots + \frac{1}{k_n} \tag{1}$$

Example

A spring with a constant of 50 is in a series with another spring with a constant of 100. Find the stretch distance when a 2 kg mass is added.

First, find the spring constant of the system.

$$\frac{1}{k_{\text{ser}}} = \frac{1}{50} + \frac{1}{100} = \frac{3}{100} \tag{2}$$

Next, find the distance using Hooke's law.

$$\Delta x = \frac{F_s}{k} = \frac{20}{0.03} = 0.6m \tag{3}$$

4 Elastic Potential Energy

Formula

$$U = \frac{1}{2}k\Delta x^2 \tag{4}$$

Doesn't this remind you of kinetic energy formula (KE $= \frac{1}{2}mv^2$)?

Example

A horizontal spring with a spring constant of 15 is attached to a frictionless surfae. A 2kg block is attached to the end of the spring. A man spends 20 Joules of energy to compress the sprin. How far from equilibrium is the block?

Using $V = \frac{1}{2}k\Delta x^2$:

$\Delta x = \sqrt{\frac{2V}{k}}$

$\Delta x = \sqrt{\frac{2\times 20}{k}} = 1.63$m