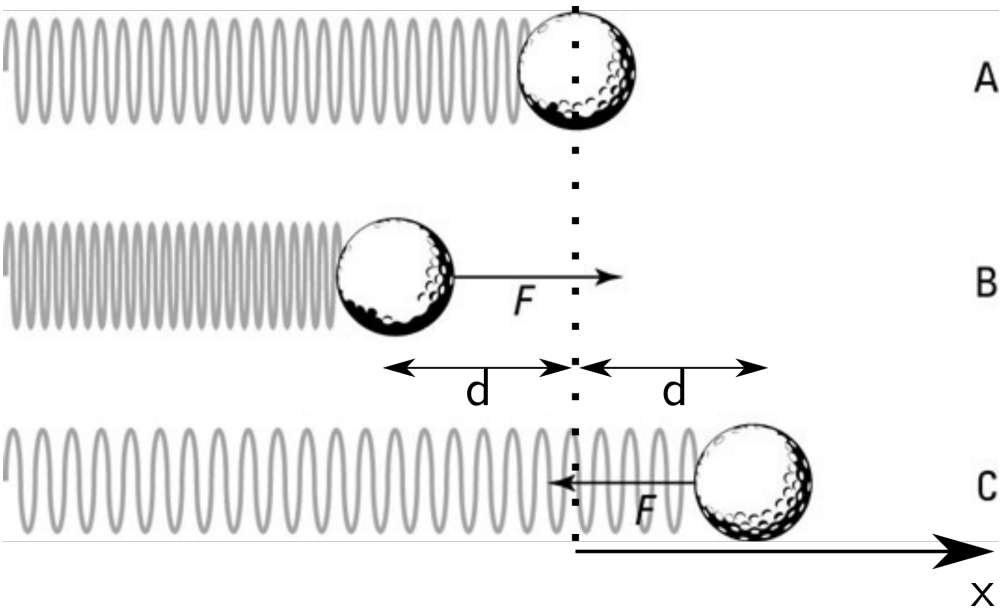

Hooke's law:

$$F_s = -kx \tag{1}$$

where

k - spring constant,

x - extension of the spring (position of the ball).

Gravitational force:

$$F_g = mg \tag{2}$$

$$x = x_0 cos(\omega t), \tag{3}$$

$$x' = -\omega x_0 sin(\omega t), \tag{4}$$

$$x'' = -\omega^2 x_0 cos(\omega t). \tag{5}$$

where

x_0 - amplitude of oscillation,

ω - period of oscillation,

t - time.

combinding (3) and (5):

$$a = -\omega^2 x \tag{6}$$

Newton's second law then gives us:

$$F = ma, \tag{7}$$

$$-kx = -m\omega^2 x, \tag{8}$$

$$\omega = \sqrt{\frac{k}{m}}. \tag{9}$$

Helpful formulas:

$$T = \frac{1}{f}, \tag{10}$$

$$\omega = \frac{2\pi}{T}. \tag{11}$$

Energies:

$$E_p = \frac{1}{2}kx^2, \tag{12}$$

$$E_k = \frac{1}{2}mV^2. \tag{13}$$

Damped oscillation equation:

$$x = x_0 e^{-\gamma t} cos(\omega t) \tag{14}$$