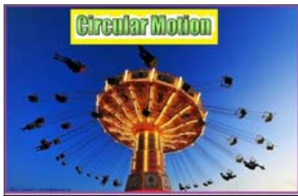


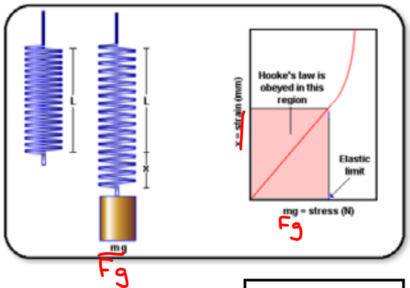
Unit 3: Circular Motion, Work and Energy

3.7 Hooke's Law and Elastic Energy

In 1676, Robert Hooke devised a relationship between the amount of stretch in a spring and the weight suspended by that spring.

Random Scientist Facts

This is not Robert Hooke... No one really liked him because as the years went on he became grumpy. So no one bothered to keep paintings of him in tact and we have no real likeness of him to this day.



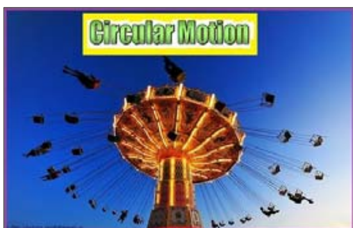
$$F_s = kx$$

F = force applied to the spring (N)

x = displacement from equilibrium (stretch or compress) of spring (m)

k = spring constant (slope) (N/m)

rise / run



Note: You will notice there are two very similar formulas on your formula sheet for Kooke's Law. One with a negative and one without. This is because as you stretch a spring, you can decided which direction you want to be positive or negative and adapt the formula accordingly.

If you find the area under a weight vs. stretch graph, you are finding work (and therefore energy).

A = 1/2 bh

or

→ E = 1/2 Fx

E = 1/2(kx)x

which yields:

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

E_s = elastic potential energy (J)

k = spring constant (N/m)

x = displacement of spring (m)

Ex.) The following graph shows how a force causes change in position as it stretches a spring.

a) Calculate the energy stored in the spring (E_s) when the force is 36.0 N.

b) Compare the energy when the force is 46.0 N to the energy stored in the spring when the position is 7.00 cm. → 0.07m

a) $E_s = \frac{1}{2}kx^2$

$k = \frac{rise}{run} = \frac{46.0}{0.140} = \frac{2300}{7}$

$F_s = kx$

$36.0 = \left(\frac{2300}{7}\right)x$

$x = 0.109\ldots m$

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

$= \left(\frac{1}{2}\right)\left(\frac{2300}{7}\right)(0.109\ldots)^2$

$= \boxed{1.97\ J}$

b) $E_s = \frac{1}{2}kx^2$

$E_s = \left(\frac{1}{2}\right)\left(\frac{2300}{7}\right)(0.140)^2$

$\boxed{E_s = 3.22\ J}$

OR

$E_s = \frac{1}{2}Fx$

$= \left(\frac{1}{2}\right)(46.0)(0.14) = 3.22J$

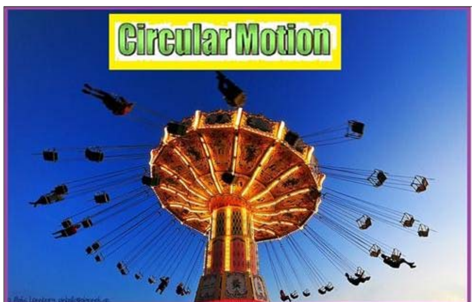
$E_s = \frac{1}{2}kx^2$

$= \left(\frac{1}{2}\right)\left(\frac{2300}{7}\right)(0.07)^2$

$= \boxed{0.805\ J}$

$E_s = \frac{1}{2}k(2x)^2$

$4E_s = 4\left(\frac{1}{2}kx^2\right)$



Questions: Pg. 305 ~~# 2-4, 6-9, 11~~.

#4, 8, 11.