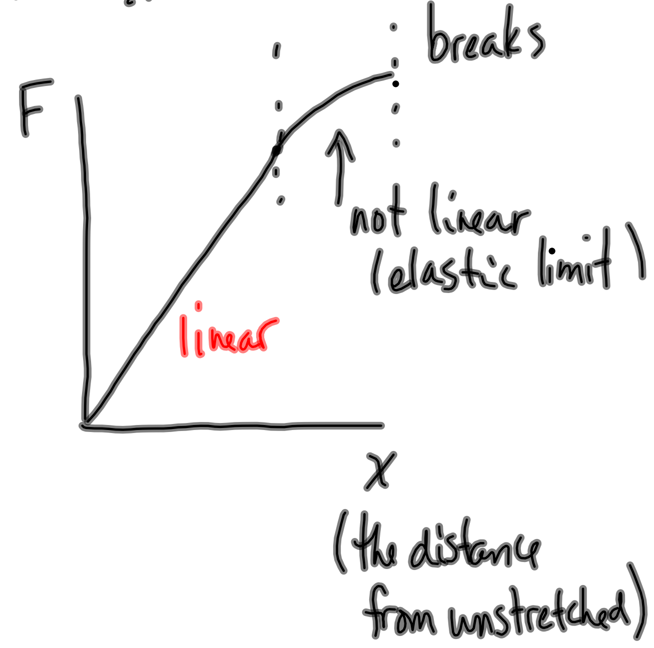
Hooke's Law

More force is required to stretch an elastic or spring a greater distance. Work is done.... but the force is not constant.



$$\boxed{F_a = kx}$$

where F is the applied Force (N)

k is the spring constant (N/m)

x is the amount stretched (m)

Hooke's Law was originally written in terms of the restoring force.

$$\boxed{F = -kx}$$

we will use $F_a = kx$ instead.

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$F_a = 133\,N$

$x = 71\,cm$

$k = ?$

$F_a = kx$

$k = \frac{F_a}{x}$

$k = \frac{133\,N}{0.71\,m}$

$k \doteq 1.9 \times 10^2 \frac{N}{m}$

Elastic Potential Energy

Work is done by stretching the elastic and the elastic is given elastic potential energy.

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

where E_e is the elastic potential energy (J)
k is the spring constant $\left(\frac{N}{m}\right)$
x is the amount stretched (m)

The work-energy theorem also applies to elastic potential energy:

$$\boxed{W = \Delta E_e}$$

DO NOT USE $F_{\parallel}\Delta d$ to find work since the force is not constant during the stretch.

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$k = 75\,N/m$

$x = -28\,cm$

compressed

a) $\Delta E_e = ??$

b) $F_a = ?$ (to hold at 28 cm)

a) $\Delta E_e = E_{e_2} - \cancel{E_{e_1}}^{0}$ (not stretched/compressed)

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

$\Delta E_e = \frac{1}{2}\left(75\frac{N}{m}\right)(-0.28\,m)^2$

$\Delta E_e \doteq 2.9\,J$

There was an increase in elastic potential energy of 2.9 J

b) Use Hooke's Law:

$F_a = kx$

$F_a = \left(75\frac{N}{m}\right)(-0.28\,m)$

$F_a = -21\,N$

pushing to compress

$+x \Rightarrow$ stretches

$-x \Rightarrow$ compressions.

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$W = F_{\parallel}\Delta d$