Springs

Hooke's "Law" → $F_s = -kx$

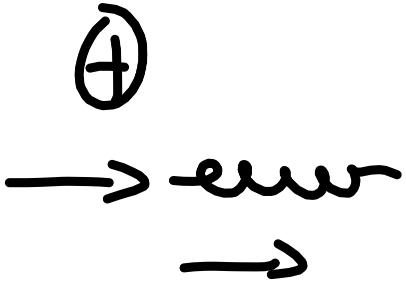
Units: F_s: N; k: $\frac{N}{m}$; x: m

- F_s → Force on a Spring
- k → Spring constant
- x → Spring displacement

ex: $k = 30.\frac{N}{m}$

$F_A = 10.\ N$

How far does the Spring Compress?

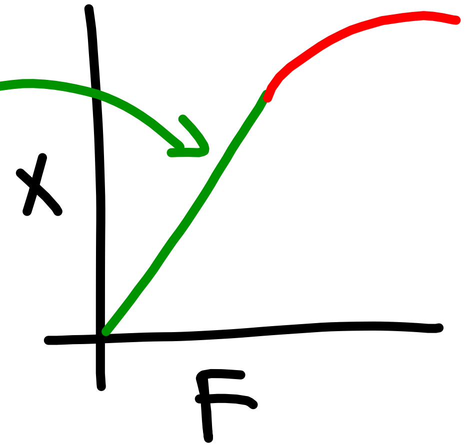


$F_s = -kx$

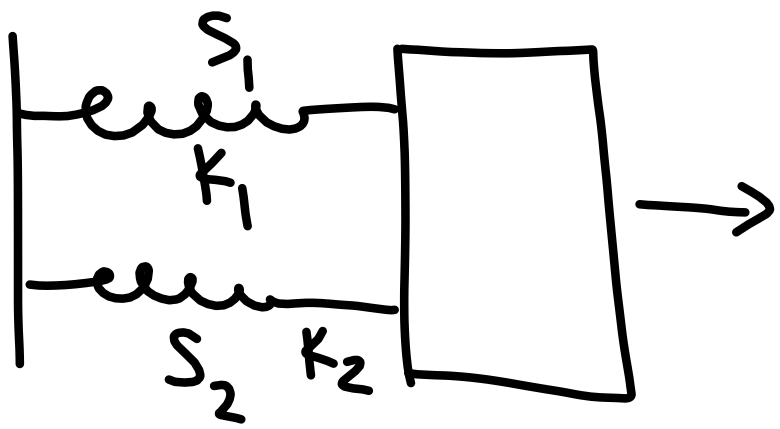
$\frac{F_s}{-k} = x \rightarrow \frac{10}{-30} = x$

$+0.33\ m = x$

N.B. – Hooke's Law only applies in the elastic region.



Parallel



$$k_{eq} = k_1 + k_2 + k_3 \ldots\ldots$$

$$F_b = F_{s_1} + F_{s_2}$$

But: $F_s = -kx$

$$F_b = -k_1 x_1 + -k_2 x_2$$

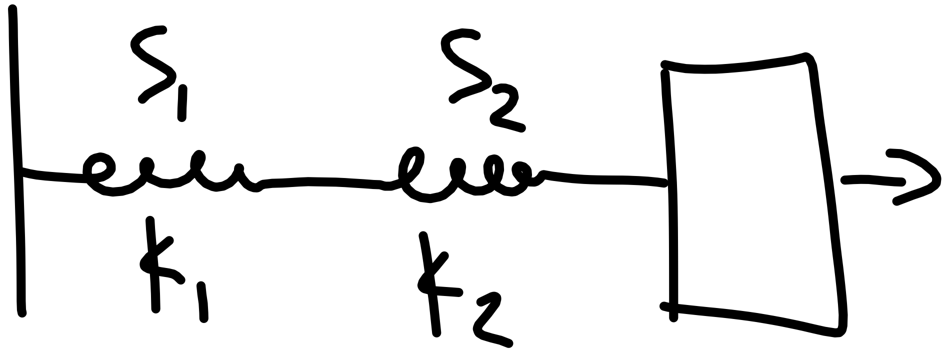
x_1, x_2 → Same!

$$F_b = -k_1 x + -k_2 x$$

$$F_b = (-k_1 + -k_2) x$$

$(-k_1 + -k_2)$ = k_{eq}

Series



$F_1 = -k_1 x_1$ $F_2 = -k_2 x_2$

$x_1 = \frac{F_1}{-k_1}$ $x_2 = \frac{F_2}{-k_2}$

We want → $F_s = -k_{eq}(x_1 + x_2)$

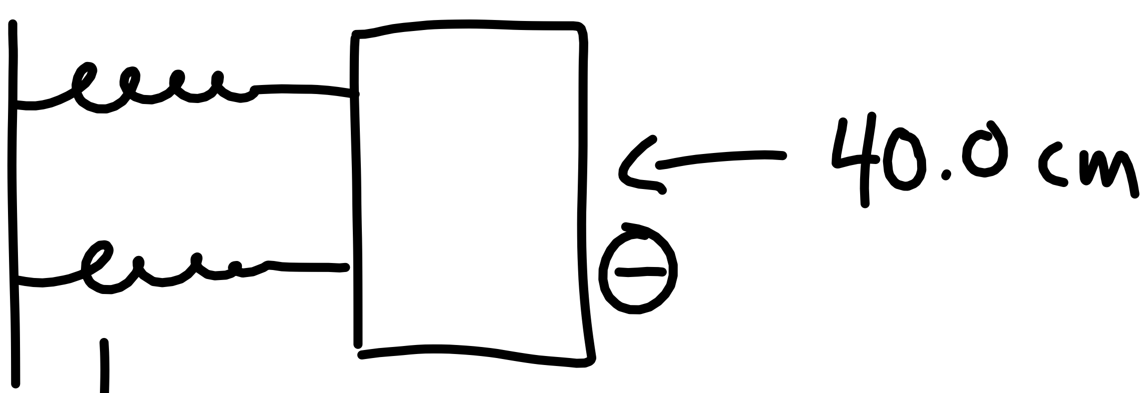
$$\frac{F_s}{-k_{eq}} = x_1 + x_2$$

equal!

$$\frac{F_s}{-k_{eq}} = \frac{F_1}{-k_1} + \frac{F_2}{-k_2}$$

$$\frac{1}{-k_{eq}} = \frac{1}{-k_1} + \frac{1}{-k_2}$$

(3)



$k_1 = k_2 = 9.05\ \frac{MN}{m}$

$F_s = -kx$

$F_s = (-~~9.05~~)(0.4)$

$F_s = (-18.1)(0.4)$ → $k_{eq} = k_1 + k_2$

$F_s = -7.24\ MN$ $\quad 7.24 \times 10^6\ N$