Springs

Hooke's "Law"

↳ Defines Spring Behavior in elastic region

$$F_s = -kx$$

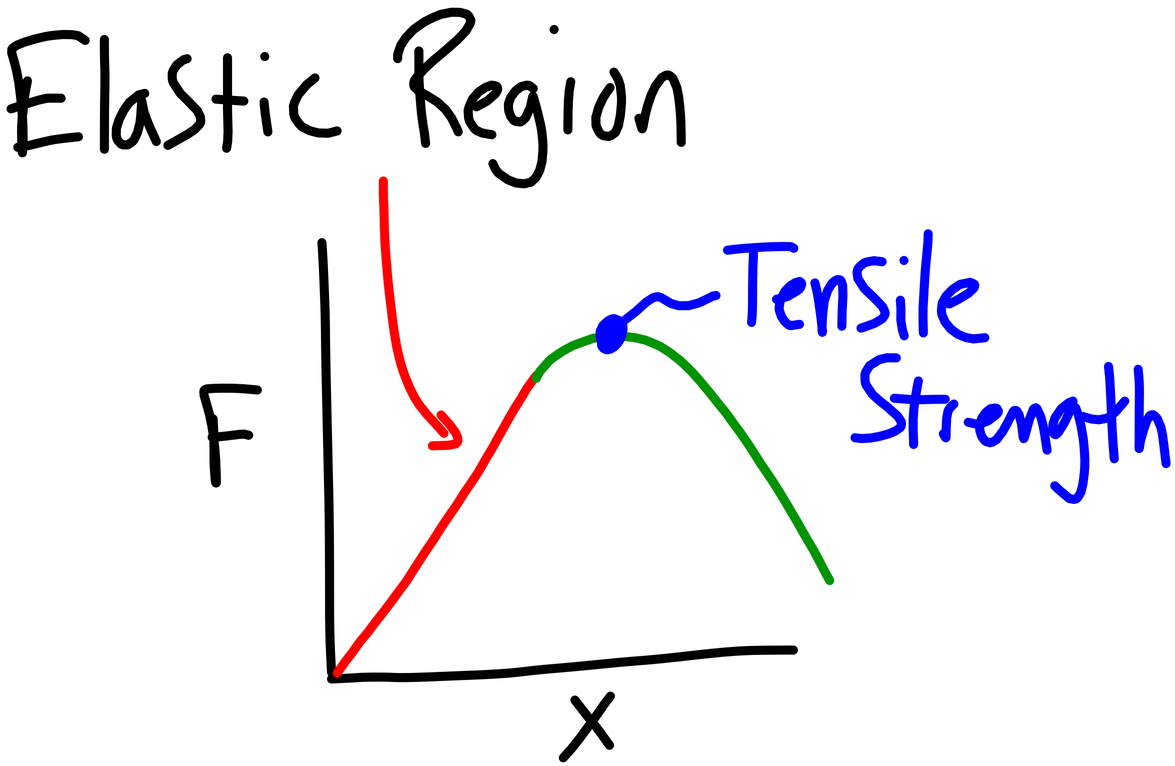
→ Displacement

Force on/of a spring ↙

↳ Spring Constant

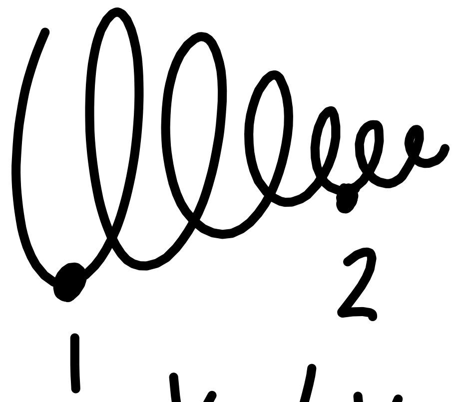
Unit? $F_s = -kx$

$\frac{N}{m}$ $\frac{F_s}{x} = -k$


Elastic Region
Tensile Strength
F
X

What if:

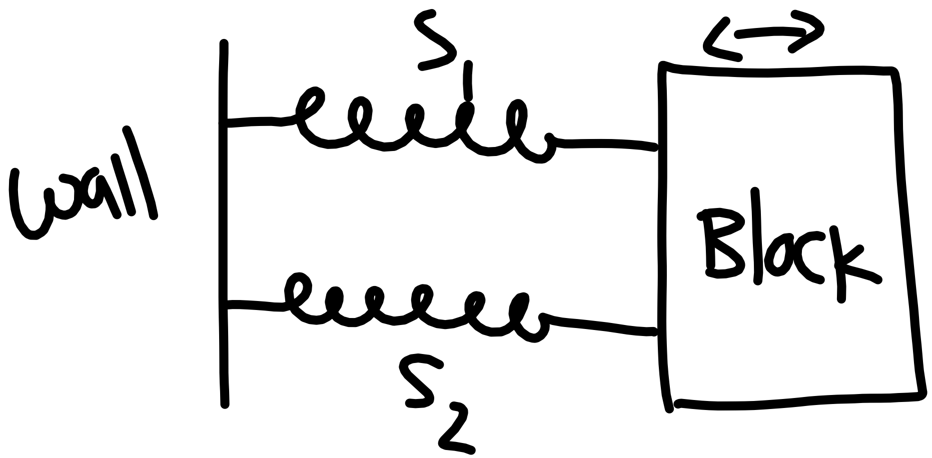
variable k →



$K_1 \neq K_2$

ex: $F_s = -\underbrace{k(x)}_{\text{Function}}\, x$

Springs in Parallel



$X_1 \equiv X_2$

↑ Must equal

Goal: Find K_{eq}

total Spring constant

$$F_B = F_{S_1} + F_{S_2}$$

we know: $F_S = -kx$

then: $F_B = -k_1 x_1 + -k_2 x_2$

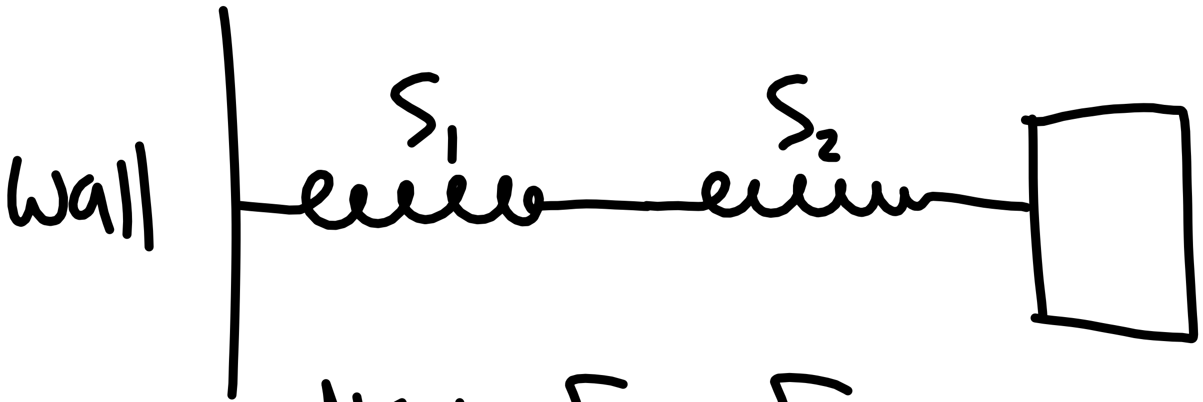
$$F_B = -k_1 x + -k_2 x$$

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

$$K_{eq} = K_1 + K_2 + K_n \ldots\ldots$$

For Parallel Springs

Springs in Series



Now: $F_{s_1} \equiv F_{s_2}$

SO: $F_{s_1} = F_{s_2}$ $\quad F = -k_1 x_1 \quad F = -k_2 x_2$

$-k_1 x_1 = -k_2 x_2 \quad \frac{F}{-k_1} = x_1 \quad \frac{F}{-k_2} = x_2$

We want: $F = k_{eq}(x_1 + x_2)$

<u>or</u>: $\frac{F}{k_{eq}} = x_1 + x_2$

<u>NOW</u>: $\frac{F}{k_{eq}} = \frac{F}{-k_1} + \frac{F}{-k_2}$

$$\frac{1}{K_{eq}} = \frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_n} \cdots\cdots$$

For Series Springs

$A = 40.97$ = initial temp difference

$B = 31.03$ = room temp

$C = 0.0007344$ = cooling constant

$X = t$

$Y = T(t)$

$$T(t) = T_0 e^{-kt} + T_A$$

$T(t)$: temp. at time t

T_0: Initial temp. Diff

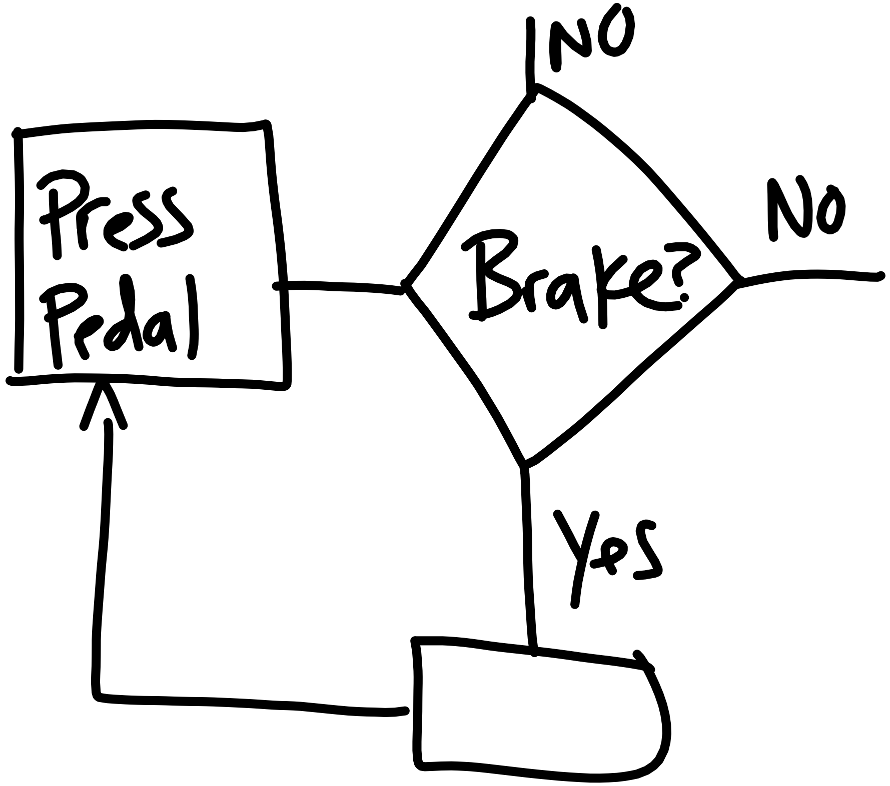
k: constant

T_A: room temp.

$$°C = °C e^{-k(s)} + °C$$

unit of k → $\frac{1}{s}$ ⇝ s^{-1}

$$\frac{dT}{dt} = -K\left(T_L - T_A\right)$$


NO
Press
Pedal
Brake?
No
Yes