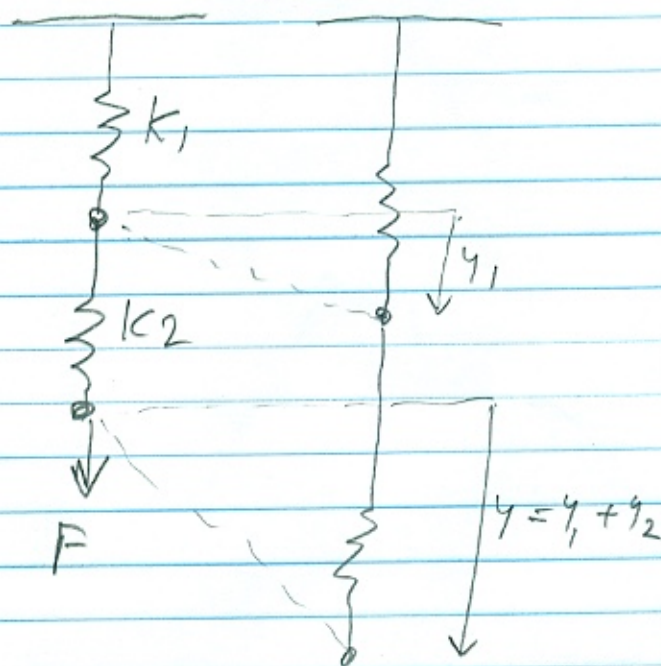


Two springs in series

3-9-21



The force in each spring is $k_1 y_1, k_2 y_2 = F$

Total displacement $y = y_1 + y_2$

$$\text{or } y = \frac{F}{k_1} + \frac{F}{k_2} = F \left[\frac{1}{k_1} + \frac{1}{k_2} \right] = F \left[\frac{k_1 + k_2}{k_1 k_2} \right]$$

$$\text{or } F = \left(\frac{k_1 k_2}{k_1 + k_2} \right) y = k_{eq} y \Rightarrow k_{eq} = \frac{k_1 k_2}{k_1 + k_2}$$

likewise for the Work, $W = \frac{1}{2} k_{eq} y^2$

$$= \frac{1}{2} \frac{k_1 k_2}{k_1 + k_2} y^2$$

• More generally for N springs in series

$$\frac{1}{k_{eq}} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3} + \dots = \left[\sum_{i=1}^N \frac{1}{k_i} \right] = \frac{1}{k_{eq}}$$