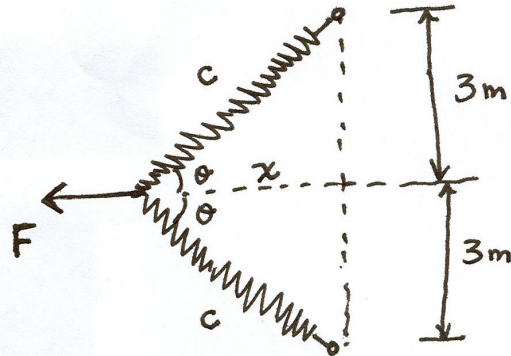
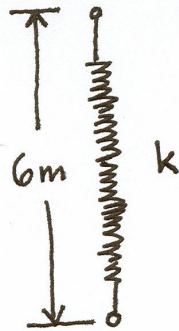


Problem 1: Plot x versus F for five different k values.

Unstretched spring:



$$c = \sqrt{3^2 + x^2}$$

$$\cos \theta = \frac{x}{\sqrt{9 + x^2}}$$

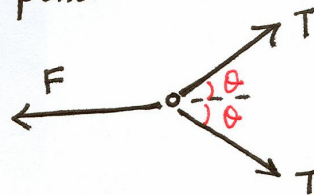
Static equilibrium is considered.

Free body diagram of the mid-point:

$$\sum F_x = 0:$$

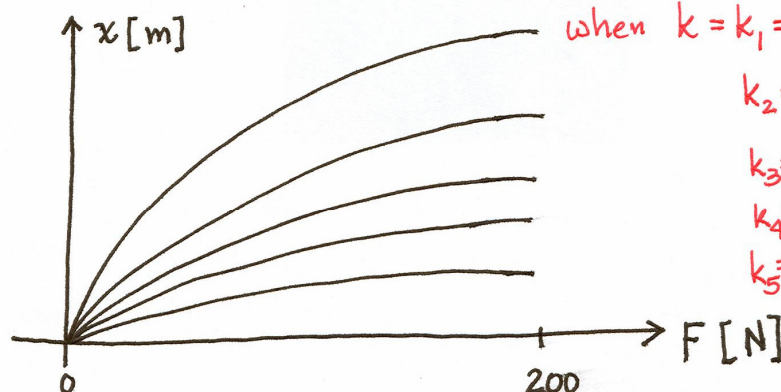
$$-F + 2T \cos \theta = 0$$

$$-F + 2 \left[2k(c - 3) \right] \left[\frac{x}{\sqrt{9 + x^2}} \right] = 0$$



$$4kx(\sqrt{9 + x^2} - 3) - F\sqrt{9 + x^2} = 0$$

Plot the following curves:



when $k = k_1 = 100 \text{ N/m}$

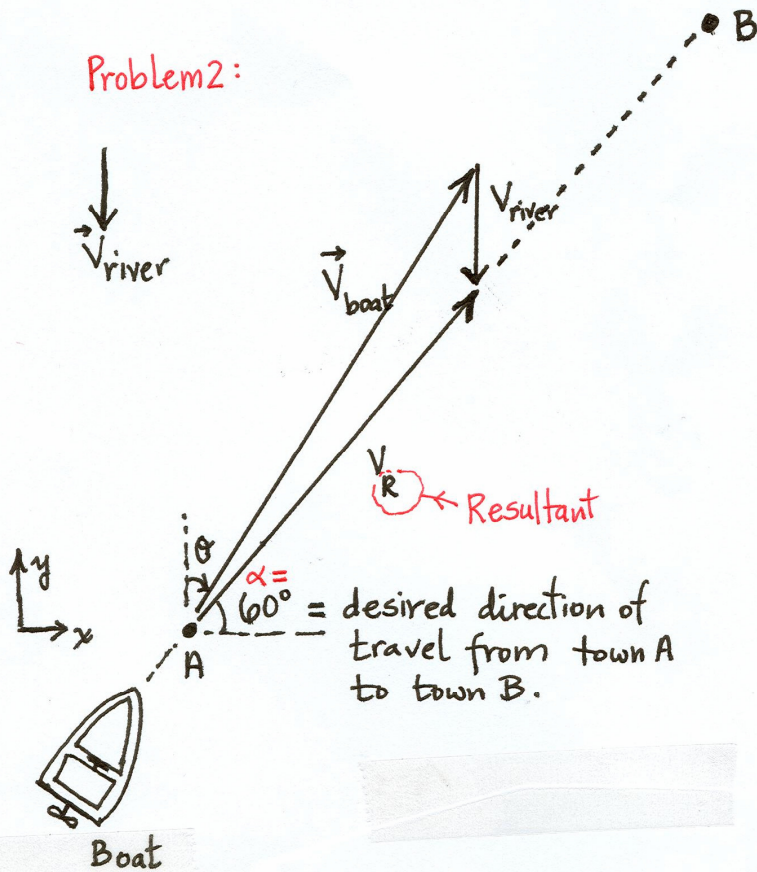
$k_2 = 200 \text{ N/m}$

$k_3 = 300 \text{ N/m}$

$k_4 = 400 \text{ N/m}$

$k_5 = 500 \text{ N/m}$

Problem 2:



$$V_{R,x} = V_{boat,x} \Rightarrow V_R \cos \alpha = V_{boat} \sin \theta \quad (1)$$

$$V_{R,y} = V_{boat,y} - V_{river} \Rightarrow V_R \sin \alpha = V_{boat} \cos \theta - V_{river} \quad (2)$$

From (1): $V_R = V_{boat} \frac{\sin \theta}{\cos \alpha}$; substitute into (2):

$$\left(V_{boat} \frac{\sin \theta}{\cos \alpha} \right) \sin \alpha = V_{boat} \cos \theta - V_{river}$$

Re-organize:

$$\left(\frac{V_{boat}}{\cos \alpha} \right) \sin \theta - \left(\frac{V_{boat}}{\sin \alpha} \right) \cos \theta + \left(\frac{V_{river}}{\sin \alpha} \right) = 0$$

