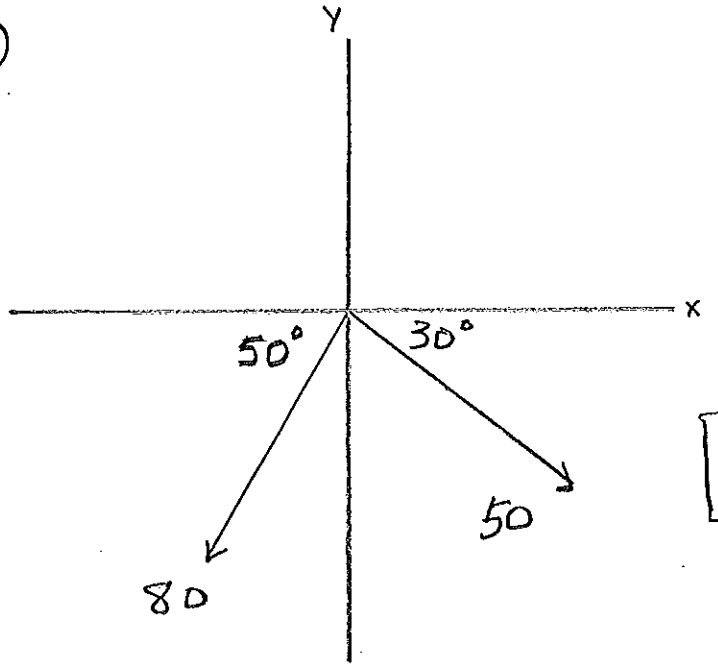
Solutions to Problem Set 1
PHY131

(1)



(a) $\vec{A} = 50\angle 30\,\hat{\imath} - 50\sin 30\,\hat{\jmath}$

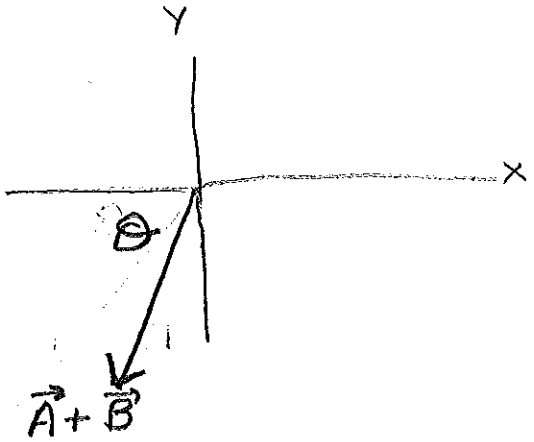
$\boxed{\vec{A} = 43.3\,\hat{\imath} - 25\,\hat{\jmath}}$

(b) $\vec{B} = -80\angle 50\,\hat{\imath} - 80\sin 50\,\hat{\jmath}$

$\boxed{\vec{B} = -51.4\,\hat{\imath} - 61.3\,\hat{\jmath}}$

(b) $\boxed{\vec{A}+\vec{B} = -8.1\,\hat{\imath} - 86.3\,\hat{\jmath}}$

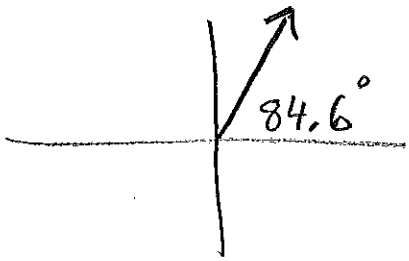
$|\vec{A}+\vec{B}| = \sqrt{86.3^2 + 8.1^2} = \boxed{86.7}$



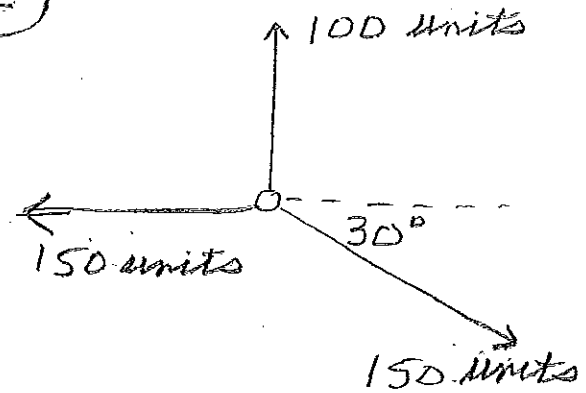
$\tan\theta = \dfrac{86.3}{8.1} \Rightarrow \boxed{\theta = 84.6^\circ}$

Direction is $\boxed{84.6^\circ \text{ S of W}}$

(c) To balance these forces, a force of $\boxed{86.7 \text{ units}}$ is needed at an angle of $\boxed{84.6^\circ \text{ N of E}}$



(2)



$\vec{F}_1 = 100\hat{j}$

$\vec{F}_2 = -150\hat{i}$

$\vec{F}_3 = 150\cos 30\hat{i} - 150\sin 30\hat{j}$

$\vec{F}_3 = 129.9\hat{i} - 75\hat{j}$

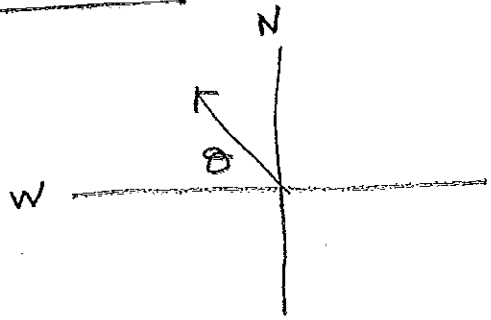
$\vec{F}_{NET} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 = (-150 + 129.9)\hat{i} + (100 - 75)\hat{j}$

$$\boxed{\vec{F}_{NET} = -20.1\hat{i} + 25\hat{j}}$$

$$|\vec{F}_{NET}| = \sqrt{20.1^2 + 25^2} = \boxed{32.1}$$

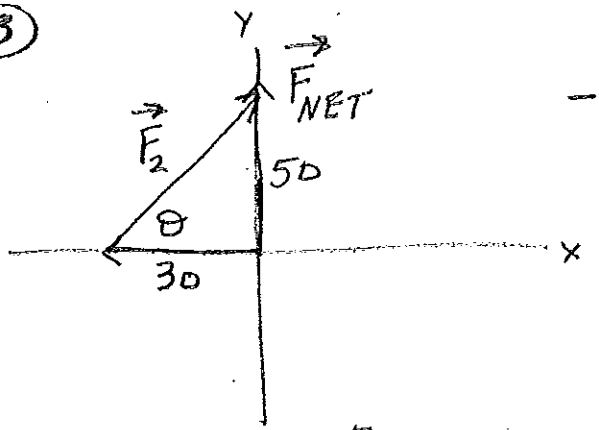
at an angle

$$\tan\theta = \frac{25}{20.1}$$



$$\boxed{\theta = 51.2^\circ \text{ N of W}}$$

(3)



$-30\hat{i} + \vec{F}_2 = 50\hat{j}$

$$\boxed{F_2 = 30\hat{i} + 50\hat{j}}$$

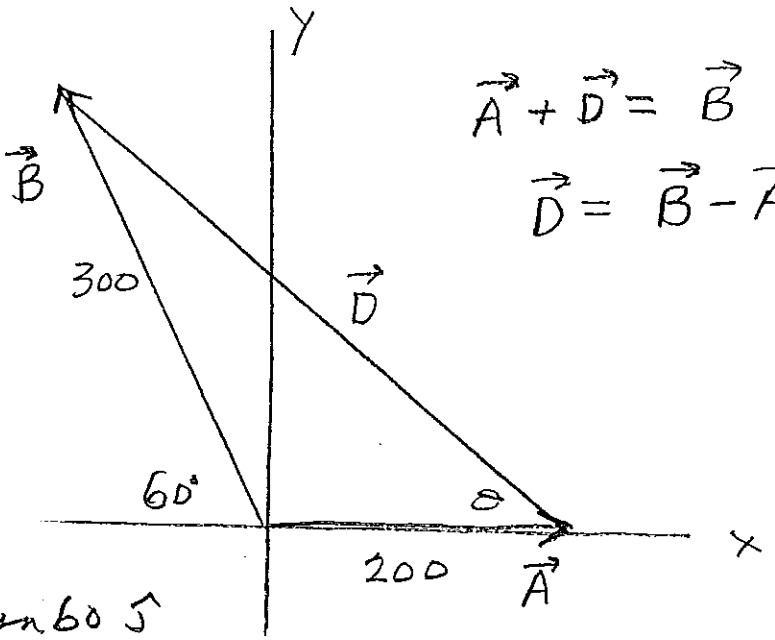
$|F_2| = \sqrt{30^2 + 50^2} = \boxed{58.3 \text{ units}}$

$\tan\theta = \frac{50}{30}$

$\theta \approx 59^\circ$

at an angle of $\boxed{59^\circ \text{ N of E}}$

(4)



$\vec{A} + \vec{D} = \vec{B}$

$\vec{D} = \vec{B} - \vec{A}$

$\vec{A} = 200\,\hat{i}$

$\vec{B} = -300\cos 60\,\hat{i} + 300\sin 60\,\hat{j}$

$\vec{B} = -150\,\hat{i} + 260\,\hat{j}$

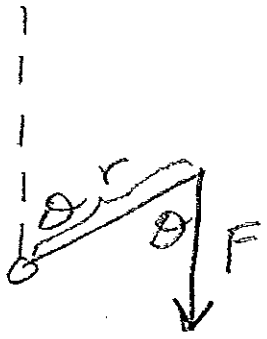
$\vec{D} = \vec{B} - \vec{A} = (-150 - 200)\,\hat{i} + (260 - 0)\,\hat{j}$

$\boxed{\vec{D} = -350\,\hat{i} + 260\,\hat{j} \text{ meters}}$

or $|\vec{D}| = \sqrt{350^2 + 260^2} = \boxed{436 \text{ meters}}$

$\tan\theta = \frac{260}{350} \Rightarrow \boxed{\theta = 36.6^\circ \text{ N of W}}$

(5)



$\tau = rF\sin\theta$

$\tau = (\frac{1}{2}\text{ ft})(100\text{ lbs})\sin\theta$

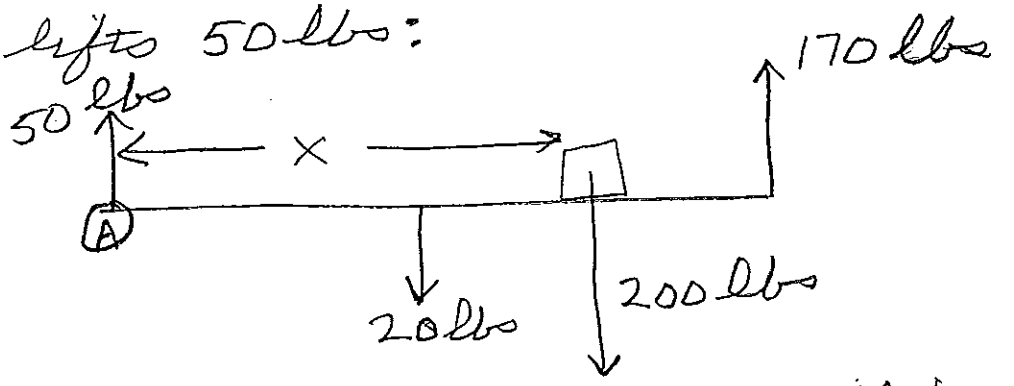
$\tau = 50\sin\theta$ ft-lbs

(a) $\theta = 30 \Rightarrow \tau = 50\sin 30 = \boxed{25 \text{ ft-lbs}}$

(b) $\theta = 90^\circ \Rightarrow \tau = 50\sin 90 = \boxed{50 \text{ ft-lbs}}$

(c) $\theta = 180^\circ \Rightarrow \tau = 50\sin 180 = \boxed{0}$

(6) (a) The closest the rock can be so Willie lifts 50 lbs:

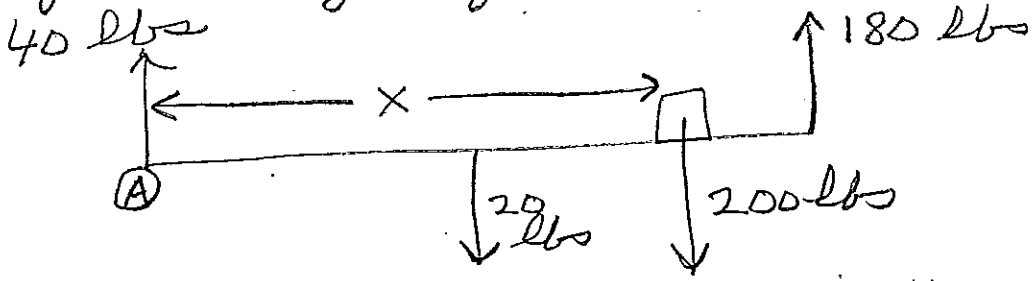


Taking the torque about Willie's end:

$$\tau_A = -20(3) - x(200) + 170(6) = 0$$

$$x = \frac{170(6) - 60}{200} = \boxed{4.8 \text{ ft}}$$

(b) If Sammy lifts 180 lbs:

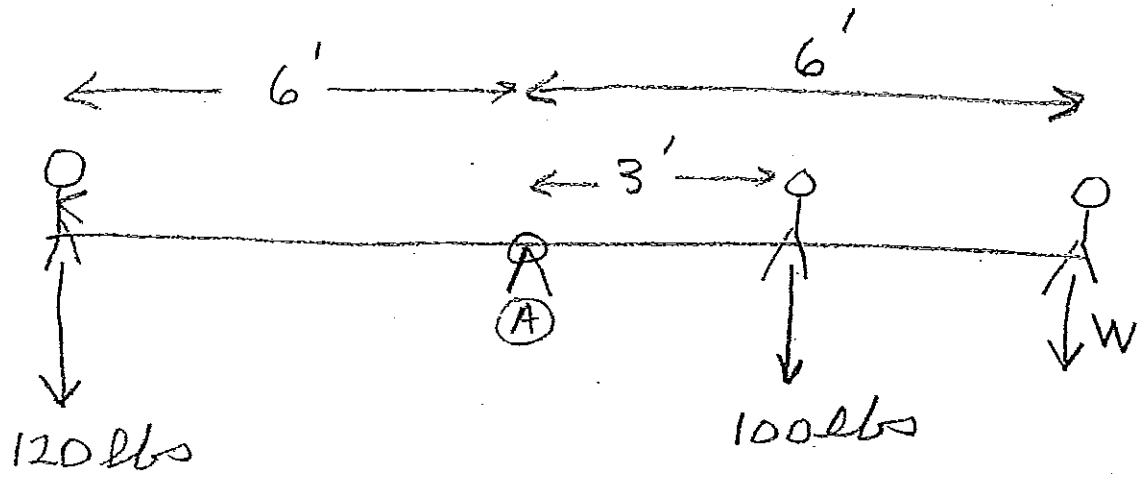


Taking the torque about Willie's end:

$$\tau_A = -20(3) - x(200) + 180(6) = 0$$

$$x = \frac{180(6) - 60}{200} = \boxed{5.1 \text{ ft}}$$

(4)



Adding the torque about the axis (A):

$$\tau_{(A)} = +6(120) - 3(100) - 6W = 0$$

$$W = \frac{6(120) - 3(100)}{6}$$

$$\boxed{W = 70 \text{ lbs}}$$