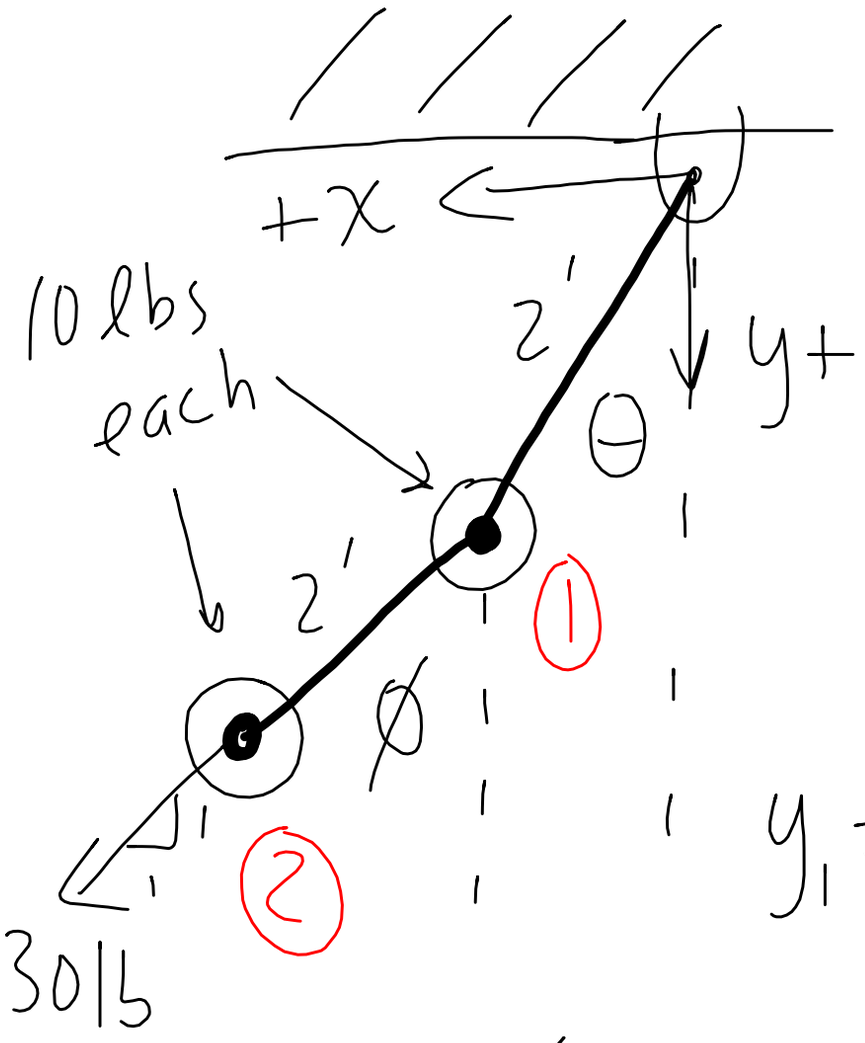

Find θ + φ for equil

$x_1 = 2\sin\theta$

$\delta x_1 = 2\cos\theta\,\delta\theta$

$y_1 = 2\cos\theta \quad \delta y_1 = -2\sin\theta\,\delta\theta$

$x_2 = 2\sin\theta + 2\sin\phi$

$\delta x_2 = 2\cos\theta\,\delta\theta + 2\cos\phi\,\delta\phi$

$y_2 = 2\cos\theta + 2\cos\phi \quad \delta y_2 = -2\sin\theta\,\delta\theta - 2\sin\phi\,\delta\phi$

Part 1: Hold θ const ($\delta\theta \to 0$) & vary ϕ

$$\delta W_{total} = 10\,\delta y_2 + \frac{30}{\sqrt{2}}\delta x_2 + \frac{30}{\sqrt{2}}\delta y_2 = 0$$

$$10\cancel{\phi}\left[-\cancel{8}\sin\phi\,\cancel{\delta\phi}\right] + \frac{30}{\sqrt{2}}\cancel{\phi}\left[\cancel{8}\cos\phi\,\cancel{\delta\phi} - \cancel{8}\sin\phi\,\cancel{\delta\phi}\right] = 0$$

$$-\sin\phi + \frac{3}{\sqrt{2}}\left[\cos\phi - \sin\phi\right] = 0$$

$$\frac{3}{\sqrt{2}}\left[\cot\phi - 1\right] = 1 \qquad \cot\phi = 1 + \frac{\sqrt{2}}{3} \qquad \phi = 34.2^\circ$$

Part 2: Hold ϕ const ($\delta\phi = 0$) + vary θ

$$\delta W_{total} = 10\delta y_1 + 10\delta y_2 + \frac{30}{\sqrt{2}}\delta x_2 + \frac{30}{\sqrt{2}}\delta y_2 = 0$$

$$10\left[-\cancel{2}\sin\theta\,\cancel{\delta\theta}\right] + 10\left[-\cancel{2}\sin\theta\,\cancel{\delta\theta}\right] + \frac{30}{\sqrt{2}}\left[\cancel{2}\cos\theta\,\cancel{\delta\theta} - \cancel{2}\sin\theta\,\cancel{\delta\theta}\right] = 0$$

$$-\sin\theta - \sin\theta + \frac{3}{\sqrt{2}}\left[\cos\theta - \sin\theta\right] = 0$$

$$\frac{3}{\sqrt{2}}\cos\theta = \left(2 + \frac{3}{\sqrt{2}}\right)\sin\theta \qquad \tan\theta = \frac{3/\sqrt{2}}{2 + 3/\sqrt{2}} \qquad \theta = 27.2^\circ$$