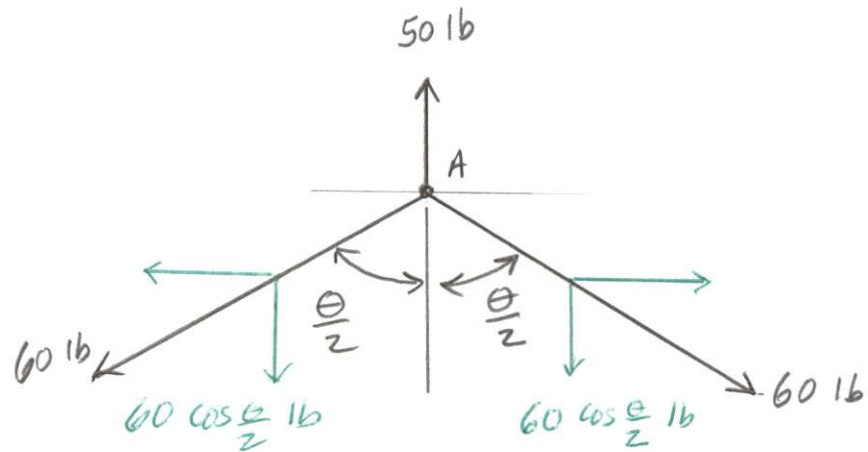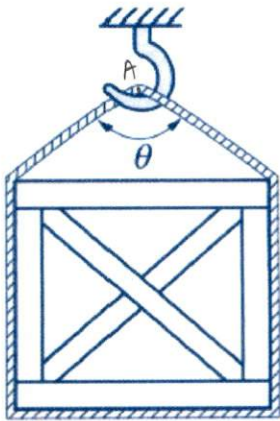11-17

A 50-lb weight is lifted by a cable as shown in Fig. Pl 1-17. If the rope has a tensile breaking strength of 180 lb, determine the maximum value of angle θ using a factor of safety of 3 to guard against breaking.

Solution.

FBD

Tensile strength of the rope

$$T_{allow} = \frac{Tensile\ strength}{F.S.} = \frac{180\ lb}{3} = 60\ lb$$

Equilibrium Equations

$$[\Sigma F_y = 0] \qquad -60\cos\frac{\theta}{2}\ lb - 60\cos\frac{\theta}{2}\ lb + 50\ lb = 0$$

$$2(60)\cos\frac{\theta}{2}\ lb = 50\ lb$$

$$\cos\frac{\theta}{2} = \frac{25\ lb}{60\ lb} = 0.417$$

$$\frac{\theta}{2} = \cos^{-1}(0.417) = 65.4°$$

$$\underline{\underline{\theta = 130.8°}}$$