H.W # 7 (CH 13)

25. (a) We note that the angle θ between the cable and the strut is $45^\circ - 30^\circ = 15^\circ$. The angle ϕ between the strut and any vertical force (like the weights in the problem) is $90^\circ - 45^\circ = 45^\circ$. Denoting $M = 225$ kg and $m = 45.0$ kg, and ℓ as the length of the boom, we compute torques about the hinge and find

$$T = \frac{Mg\ell \sin\phi + mg\left(\frac{\ell}{2}\right)\sin\phi}{\ell \sin\theta} \ .$$

The unknown length ℓ cancels out and we obtain $T = 6.63 \times 10^3$ N.

(b) Since the cable is at 30° from horizontal, then horizontal equilibrium of forces requires that the horizontal hinge force be

$$F_x = T\cos 30^\circ = 5.74 \times 10^3 \text{ N} \ .$$

(c) And vertical equilibrium of forces gives the vertical hinge force component:

$$F_y = Mg + mg + T\sin 30^\circ = 5.96 \times 10^3 \text{ N} \ .$$