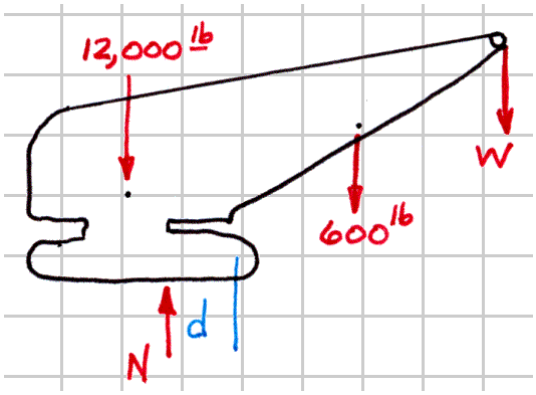
1-39*

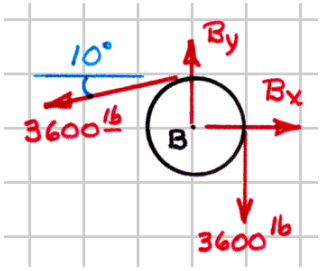
(a) First draw an overall free-body diagram. The force of the ground on the track of the crane is equivalent to a single concentrated force N acting at some location on the treads. As the load increases, the distance d gets smaller and smaller. The maximum load that the crane can lift corresponds to $d = 0$. Then, summing moments about the point where the normal force acts gives



$$9(12{,}000) - (12\cos 30° - 1)(600)$$
$$-(24\cos 30° - 1 + 1)(W) = 0$$

$W = 4930$ lb ..... **Ans.**

(b) Next, from a free-body diagram of the pulley at the end of the boom the equations of equilibrium give

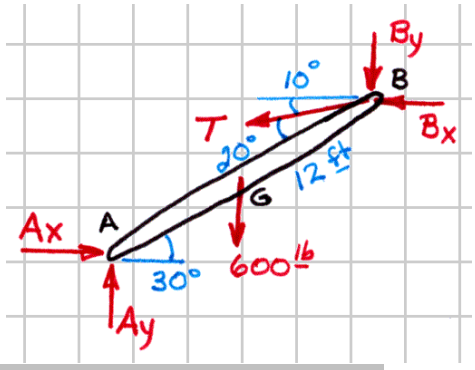


$\rightarrow \Sigma F_x = 0$: $\quad B_x - 3600\cos 10° = 0$

$\uparrow \Sigma F_y = 0$: $\quad B_y - 3600 - 3600\sin 10° = 0$

$$B_x = 3545.3079 \text{ lb}$$
$$B_y = 4225.1334 \text{ lb}$$

Finally, from a free-body diagram of the boom the equations of equilibrium give



$\rightarrow \Sigma F_x = 0$: $\quad A_x - (3545.3079) - T\cos 10° = 0$

$\uparrow \Sigma F_y = 0$: $\quad A_y - 600 - T\sin 10° - (4225.1334) = 0$

$\circlearrowleft \Sigma M_A = 0$:

$$24(T\sin 20°) + (24\sin 30°)(3545.3079)$$
$$-(12\cos 30°)(600) - (24\cos 30°)(4225.1334) = 0$$

$T = 6275.1466$ lb $\cong 6280$ lb ..... **Ans.**

(c) $A_x = 9725.1209$ lb $\qquad A_y = 5914.8012$ lb

A $= 11{,}380$ lb ∡ $31.3°$ ..... **Ans.**