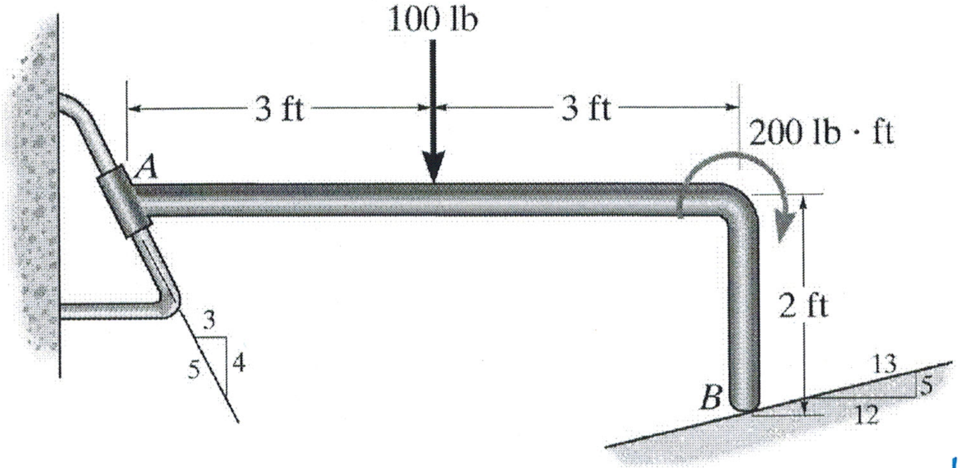
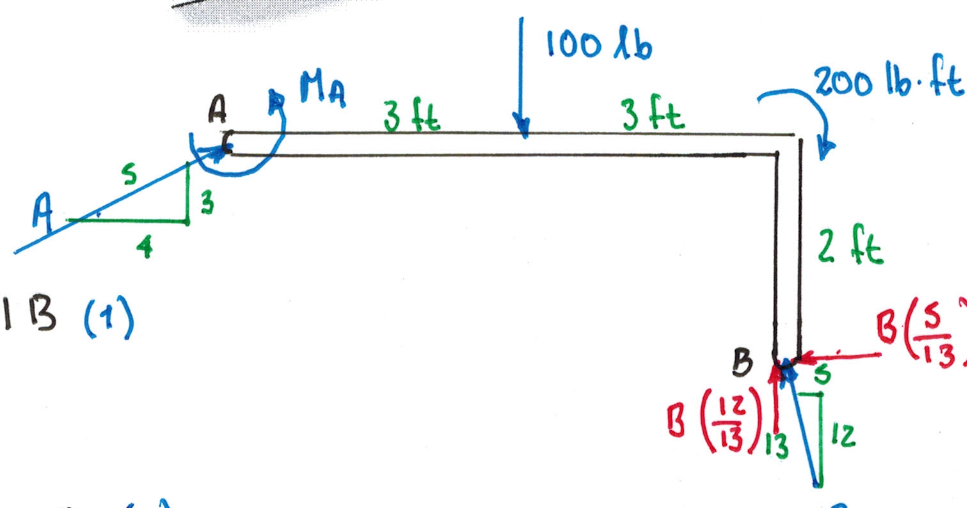
Determine the reactions on the bent rod which is supported by a smooth surface at $B$ and by a collar at $A$, which is fixed to the rod and is free to slide over the fixed inclined rod.




$\Sigma F_x = 0$

$A\left(\frac{4}{5}\right) - B\left(\frac{5}{13}\right) = 0$

$A = \left(\frac{5}{4}\right)\left(\frac{5}{13}\right) B = 0.481 B \quad (1)$

$\Sigma F_y = 0$

$A\left(\frac{3}{5}\right) - 100 + B\left(\frac{12}{13}\right) = 0 \quad (2)$

sub eq (1) in (2)

$0.481 B\left(\frac{3}{5}\right) - 100 + B\left(\frac{12}{13}\right) = 0$ $\qquad B = \frac{100}{1.2115} = \underline{82.5\ lb}$

sub B in eq (1)

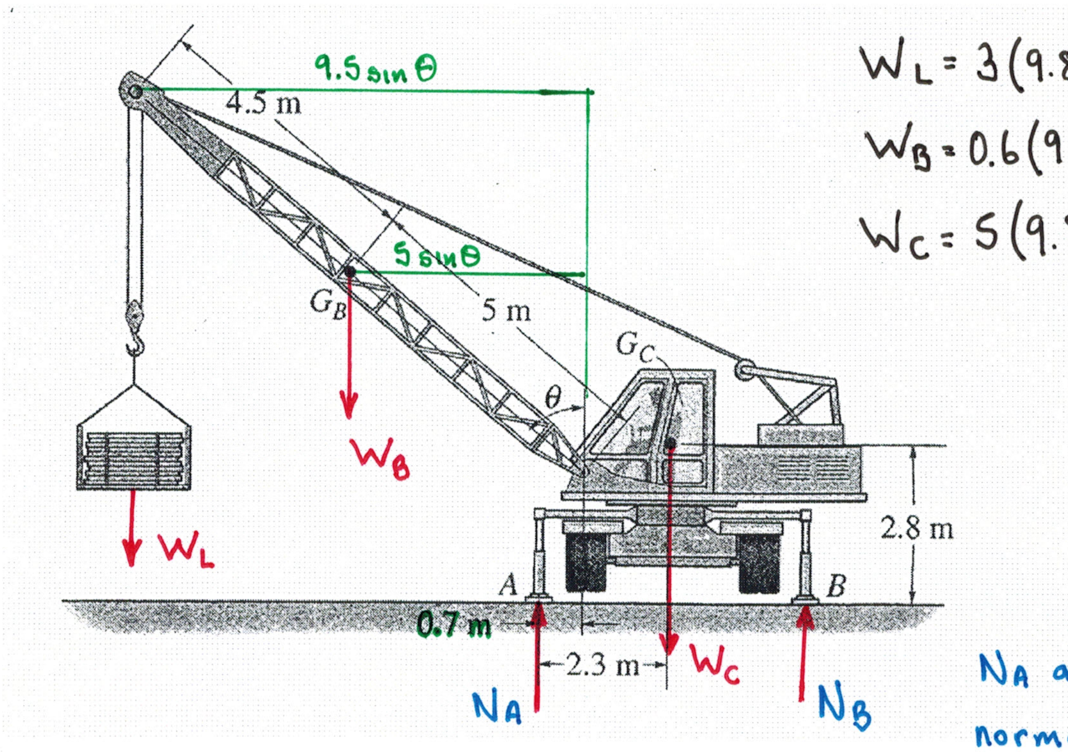
$A = 0.481(82.5) = \underline{39.7\ lb}$

$\Sigma M_A = 0$

$M_A - 100(3) - 200 - B\left(\frac{5}{13}\right)(2) + B\left(\frac{12}{13}\right)(6) = 0$

$M_A = 500 - B\left(\frac{12}{13}(6) - \frac{5}{13}(2)\right) = 500 - 4.769(82.5) = \underline{106.4\ lb \cdot f}$

Outriggers A and B are used to stabilize the crane from overturning when lifting large loads. If the load to be lifted is 3 Mg, determine the maximum boom angle $\theta$ so that the crane does not overturn. The crane has a mass of 5 Mg and center of mass at $G_C$, whereas the boom has a mass of 0.6 Mg and center of mass at $G_B$.




$W_L = 3(9.81) = 29.4$ KN

$W_B = 0.6(9.81) = 5.89$ KN

$W_C = 5(9.81) = 49.1$ KN

$N_A$ and $N_B$ are the normal force reactions

Note, the crane will overturn when the load on the left hand side is so large that the normal force at B becomes zero, i.e., $N_B = 0$. The moment produced by $W_L$ and $W_B$ on the crane is related to the boom angle $\theta$. We can find the onset of overturning by setting $N_B = 0$ and taking moments about point A, any angle greater than the maximum will overturn.

$$\sum M_A = 0 \qquad W_L(9.5\sin\theta - 0.7) + W_B(5\sin\theta - 0.7) - W_C(2.3) = 0$$

$$\sin\theta = \frac{W_C(2.3) + W_L(0.7) + W_B(0.7)}{W_L(9.5) + W_B(5)} = 0.446 \qquad \boxed{\theta = 26.5^\circ}$$