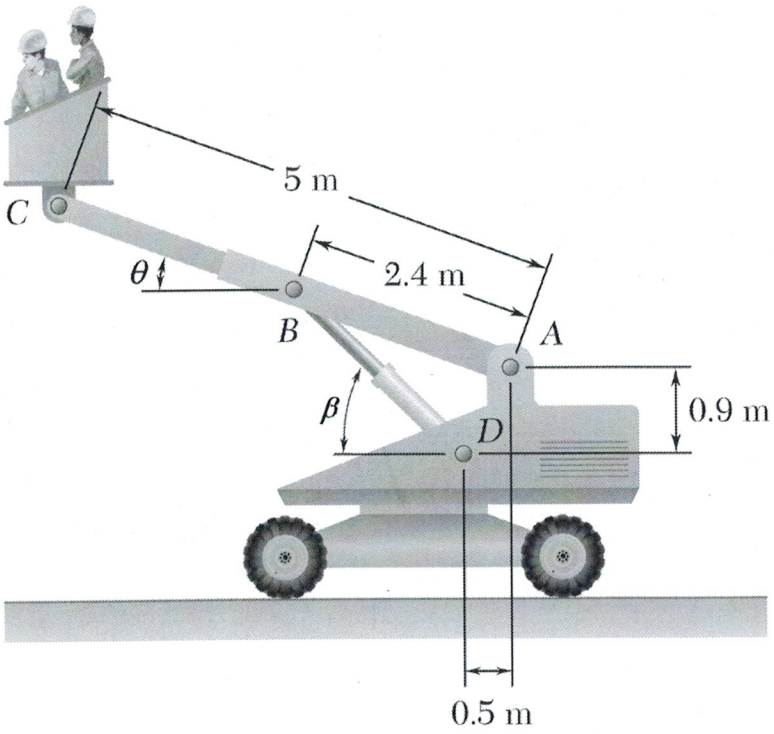
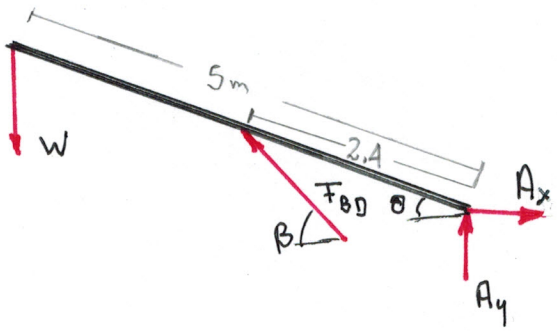
The telescoping arm ABC is used to provide an elevated platform for construction workers. The workers and the platform together have a mass of 200 kg and have a combined center of gravity located directly above C. For the position when $\theta = 20°$ and $\beta = 44.43°$, determine

(a) The force exerted at B by the single hydraulic cylinder BD

(b) The force exerted on the supporting carriage at A.



Draw Free Body Diagram including all forces and dimensions



a)

$W = (200)\,9.81 = 1.962$ kN

$\sum M_A = 1.962\,(5\cos\theta) - F_{BD}\sin\beta\,(2.4\cos\theta) + F_{BD}\cos\beta\,(2.4\sin\theta) = 0$

$9.2185 - F_{BD}(0.9927) = 0$

$F_{BD} = 9.29$ kN $\angle\beta$

b)

$\sum F_x = 0 \qquad A_x - F_{BD}\cos\beta = 0 \qquad A_x = 9.2867\cos\beta$

$A_x = 6.63$ kN

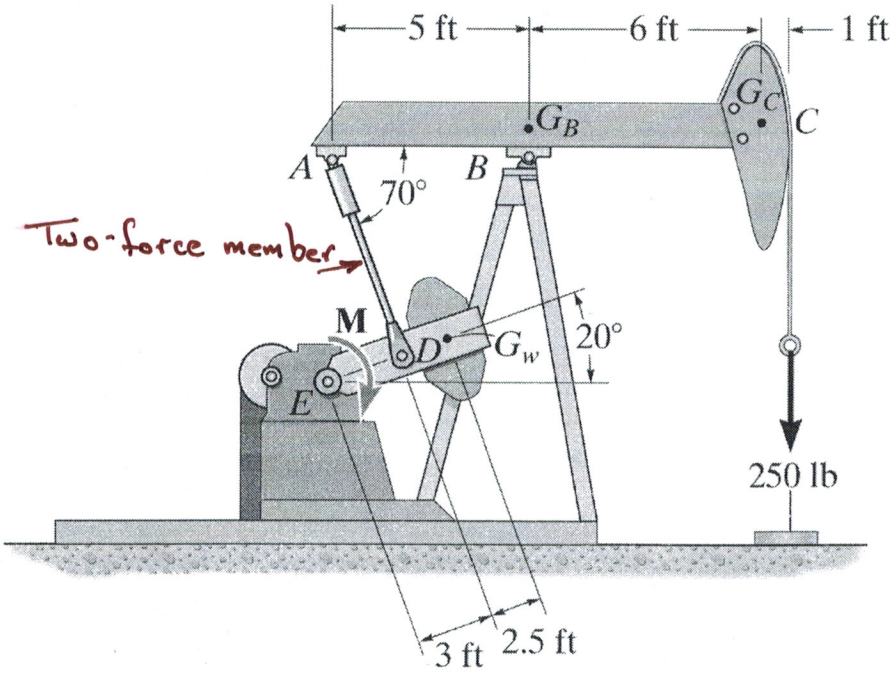
$\sum F_y = 0 \qquad A_y - 1.962 + F_{BD}\sin\beta = 0$

$A_y = 1.962 - 9.2867\sin\beta$

$A_y = -4.539$ kN

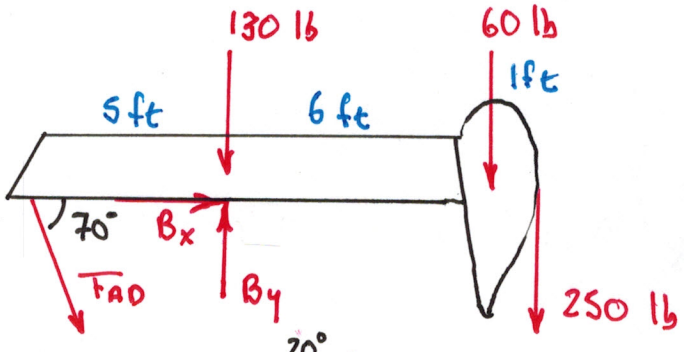
$A = 8.04$ kN $\angle 34.4°$

The pumping unit is used to recover oil. When the walking beam *ABC* is horizontal, the force acting in the wireline at the well head is 250 lb. Determine the torque **M** which must be exerted by the motor in order to overcome this load. The horse-head *C* weighs 60 lb and has a center of gravity at G_C. The walking beam *ABC* has a weight of 130 lb and a center of gravity at G_B, and the counterweight has a weight of 200 lb and a center of gravity at G_W. The pitman, *D*, is pin connected at its ends and has negligible weight.



$\Sigma M_B = 0 \quad F_{AD}\sin 70(5) - 6(6) - 250(7) = 0$

$F_{AD} = 449.1 \text{ lb}$



$\Sigma M_E = 0$

$449.1(3) - 200\cos 20°(5.5) - M = 0$

$M = 314 \text{ lb}\cdot\text{ft}$