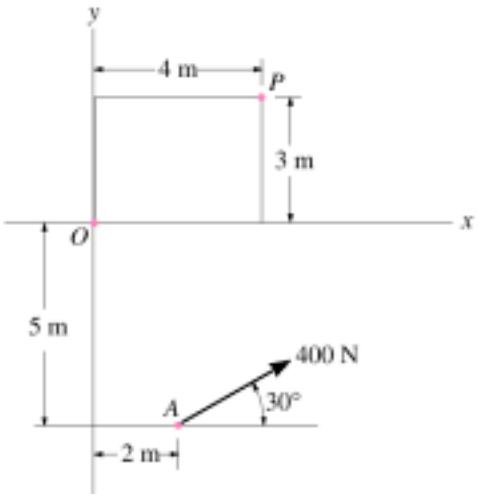
Momemt 1

Problem 1:

Determine the magnitude and directional sense of the moment of the force at A about point P.



Solution:

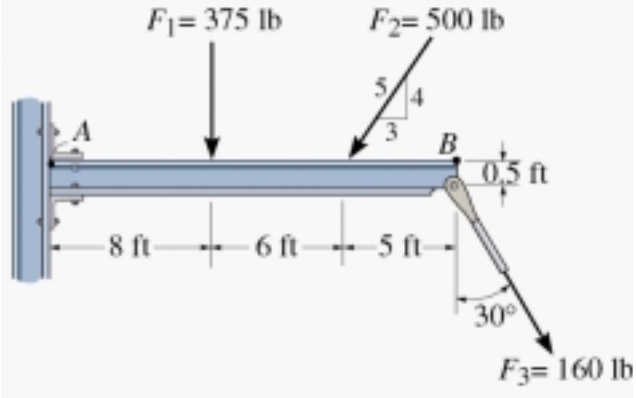
$$\left(+M_p = \sum Fd = F_x y + F_y x\right.$$

$$\Rightarrow M_p = 400\cos 30°(8) - 400\sin 30°(4-2)$$

$$\Rightarrow M_p = 2.37kN.m(\text{counterclockwise})$$

Problem 2:

Determine the moment about point B of each of the three forces acting on the beam.



Solution:

$$\left(+\left(M_{F_1}\right)_B = 375(11) = 4125 \text{ lb.ft}\right.$$

$$\Rightarrow \left(M_{F_1}\right)_B = 4.125 \text{ kip.ft (Counterclockwise)}$$

$$\left(+\left(M_{F_2}\right)_B = 500\left(\frac{4}{5}\right)(5) = 2000 \text{ lb.ft}\right.$$

$$\Rightarrow \left(M_{F_2}\right)_B = 2.00 \text{ kip.ft (Counterclockwise)}$$

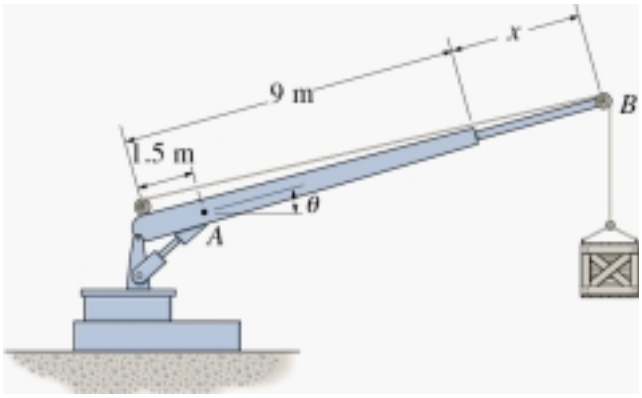
$$\left(+\left(M_{F_3}\right)_B = 160\sin 30°(0.5) - 160\cos 30°(0)\right.$$

$$\Rightarrow \left(M_{F_3}\right)_B = 40.0 \text{ lb.ft (Counterclockwise)}$$

Problem 3:

The crane can be adjusted for any angle $0 \le \theta \le 90$ and any extension $0 \le x \le 5$m. For a suspended mass of 120 kg, determine the moment developed at A as a function of x and θ.

What values of both x and θ develop the maximum possible moment at A? Compute this moment. Neglect the size of the pulley at B.



Solution:

$$\left(+M_A = -120(9.81)(7.5+x)\cos\theta\right.$$

$$\Rightarrow M_A = \{-1177.2\cos\theta(7.5+\mathrm{x})\}\text{N.m}$$

$$\Rightarrow M_A = \{1.18\cos\theta(7.5+\mathrm{x})\}\text{kN.m (clockwise)}$$

The maximum moment at A occurs when $\theta = 0°$ and $x = 5$m

$$\left(+(M_A)_{max} = \{-1177.2\cos 0°(7.5+5)\}\text{N.m}\right.$$

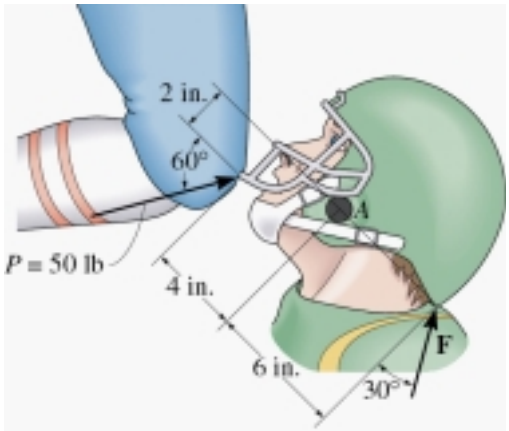
$$\Rightarrow (M_A)_{max} = \text{-14715 N.m}$$

$$\Rightarrow (M_A)_{max} = 14.7\text{ kN.m (clockwise)}$$

Problem 4:

Serious neck injuries can occur when a football player is struck in the face guard of his helmet in the manner shown, giving rise to a guillotine mechanism.

Determine the moment of the knee force P = 50 lb about point A. What would be the magnitude of the neck force F so that it gives the counterbalancing moment about A?



Solution:

$$\left(+M_A = 50\sin 60°(4) - 50\cos 60°(2)\right.$$

$$\Rightarrow M_A = 123.2 = 123\text{ lb.in}\left.\right)$$

$$123.2 = F\cos 30°(6)$$

$$\Rightarrow F = 23.7\text{ lb}$$