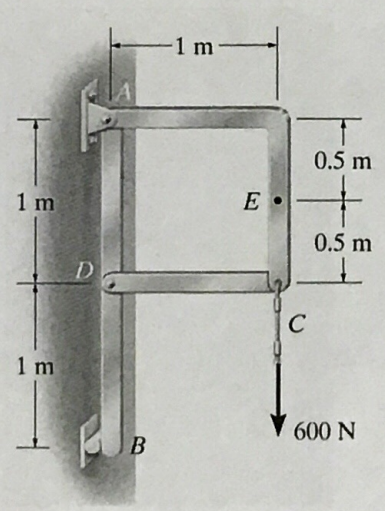
# TAM 210/211 - Worksheet 7

Objectives:

- Investigate 2D and 3D rigid bodies in equilibrium.

1) The frame in equilibrium shown below is loaded with a force of 600 N in the negative y-direction on pin $C$. The frame is also supported by a roller at $B$. Assume the weight of the frame and its components are negligible.




(A) What support reactions (force component(s) and/or couple moment) for the frame are possible at

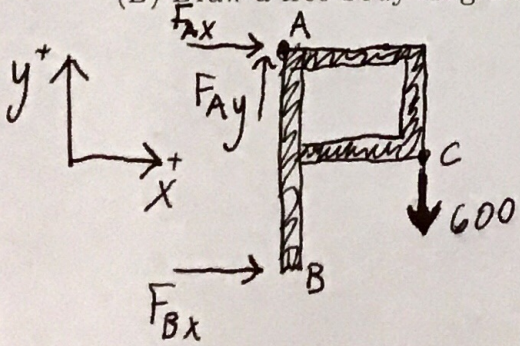
(i) Pin support $A$?

$[F_{Ax}, F_{Ay}]$

(ii) Roller support $B$?

$[F_{Bx}]$

(B) Draw a free-body diagram for the whole frame.



(C) Write the equations of equilibrium for the frame and solve for the support reactions at $A$ and $B$.

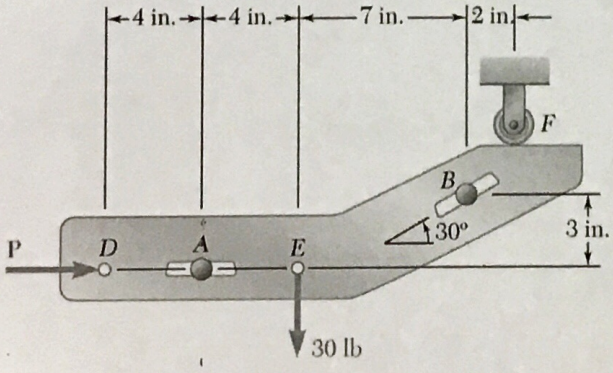
$\Sigma F_x = 0 \Rightarrow F_{Ax} + F_{Bx} = 0 \Rightarrow F_{Ax} = -F_{Bx}$

$\Sigma F_y = 0 \Rightarrow -600 + F_{Ay} = 0 \Rightarrow F_{Ay} = 600N$

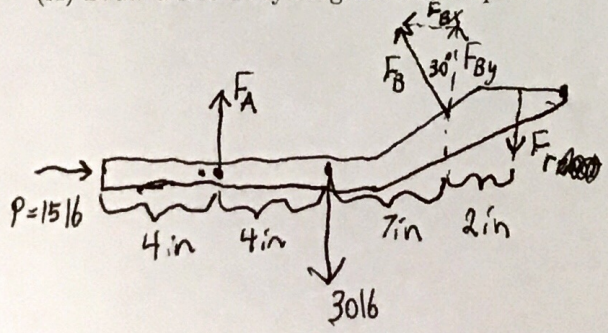
$\Sigma M_A = 0 \Rightarrow F_{Bx}(2) - 600(1) = 0 \Rightarrow F_{Bx} = 300N$

$F_{Ax} = -300N$

2) Two slots have been cut in plate $DEF$, and the plate has been placed so that the slots fit two fixed, frictionless pins $A$ and $B$. Knowing that $P = 15$ lb.




(A) Draw a free-body diagram for the plate.



(B) Write the equations of equilibrium for the plate and determine the support reaction from the roller at $F$.

$$\Sigma F_x = 0 \Rightarrow 15 - F_B \sin(30°) = 0 \quad \Rightarrow F_B = 30\text{lb}$$

$$\Sigma M_A = 0 \Rightarrow -30(4) + F_B \cos(30°)(11) + F_B \sin(30°)(3) - F_r(13) = 0$$

$$\boxed{F_r = 16.21\,N}$$

3) The bent rod $AB$ has 2 force loadings supported at $A$ and $B$ as shown below.

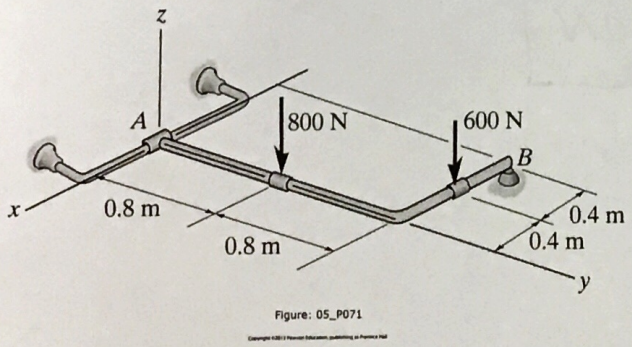



Figure: 05_P071

(A) What support reactions (force component(s) and/or couple moment) for the rod are possible at

(i) Fixed connect collar $A$?

$F_{Ay}, F_{Az}, M_{Az}, M_{Ay}$

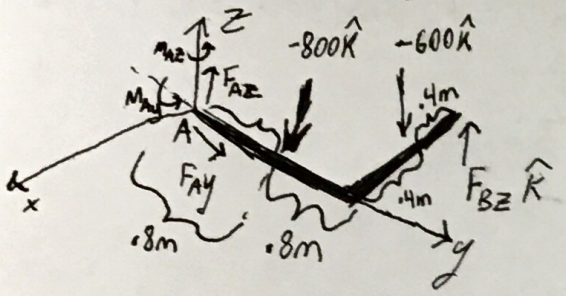
(ii) Roller $B$?

$F_{Bz}$

(B) Does $AB$ have redundant constraints? Why or why not?

NO, redundant constraints are defined as ~~supports~~ unnecessary supports that make the body statically undeterminate. i.e. more unknowns than equations. In this case, we have 5 unknowns and 6 E.o.E. where all the unknowns can be solved for.

(B) Draw a free-body diagram for rod $AB$.




(C) Determine the support reaction at $B$.

$$\Sigma M_{Ax} \Rightarrow -800(.8) - 600(.8+.8) + F_{Bz}(1.6) = 0$$

$$\boxed{F_{Bz} = 1000N}$$