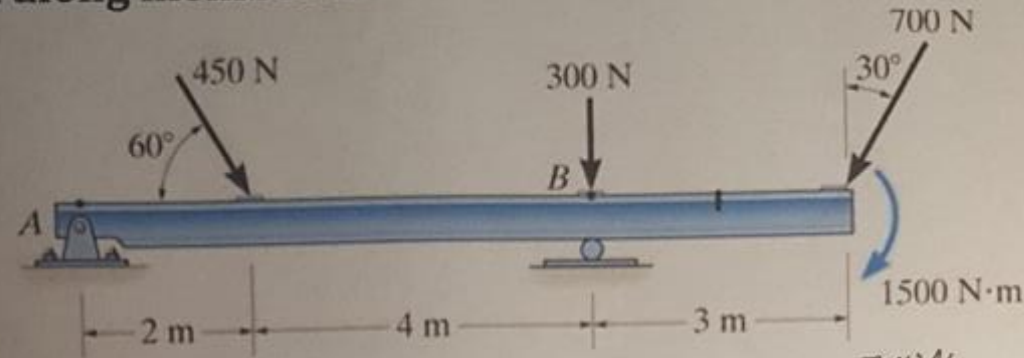
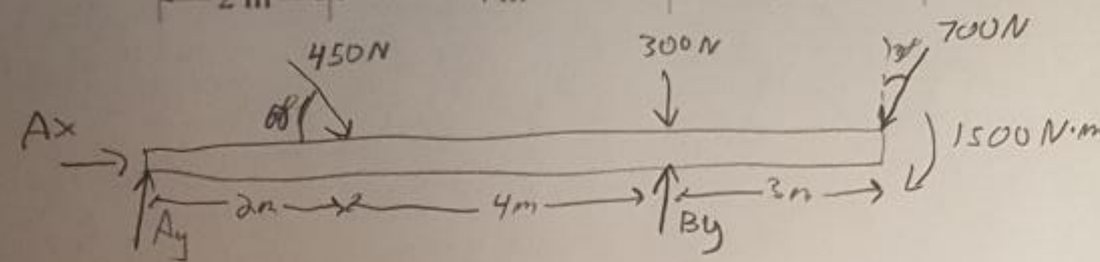
1a. Determine the Reactions at A and B

b. Replace the force moment system with an equivalent force and specify its location along member AB



a)



$\Sigma F_x = 0 = A_x + 450\cos 60^\circ - 700\sin 30^\circ$

$A_x = 125\ N$

$\Sigma F_y = 0 = A_y - 450\sin 60^\circ - 300 - 700\cos 30^\circ + B_y$

$\Sigma M_A = 0: \quad 450\sin 60^\circ (2) + 300(6) + 700\cos 30^\circ (9) + 1500 = 6 B_y$

$B_y = 1589.23\ N$

$A_y = -293.3\ N$

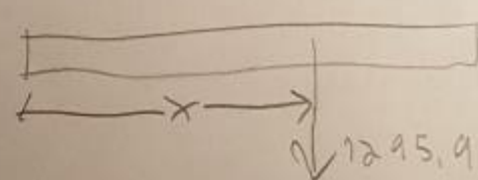
negative about A

b)

$M_{RA} = -9535.4\ N\cdot m$

$F_y = -1295.93\ N$

$F_x = 450\cos 60^\circ - 700\sin 30^\circ = -125 N$



$M_{RA} = x F_y$

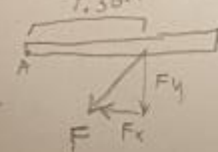
$-9535.4 = x(-1295.93)$

$\boxed{x = 7.36\ m}$

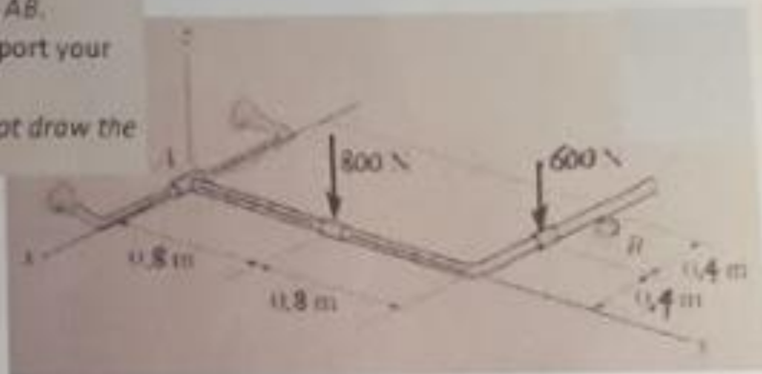
$F = \sqrt{F_x^2 + F_y^2}$

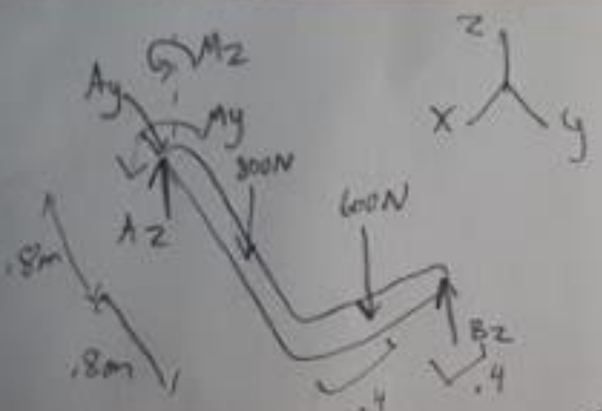
$= \sqrt{(-125)^2 + (-1295.9)^2}$

$= \boxed{1302\ N}$



2. The weightless pipe assembly is supported in the horizontal plane by a smooth collar at *A* and rests on a smooth surface support at *B*. Two vertical forces are applied as shown.
   (a) Draw a free-body diagram of the pipe assembly *AB*.
   (b) Determine the support reactions at *A* and *B*. Report your answers in Cartesian vector form.
   You will receive no credit for part (b) if you do not draw the free-body diagram.





$\Sigma M_x = 0 = -800(.8) - 600(1.6) + 1.6 B_z$

$\boxed{B_z = 1000\ N}$

$\Sigma F_x = 0$

$\Sigma F_y = \boxed{0 = A_y}$

$\Sigma F_z = 0 = -800 - 600 = A_z + B_z$

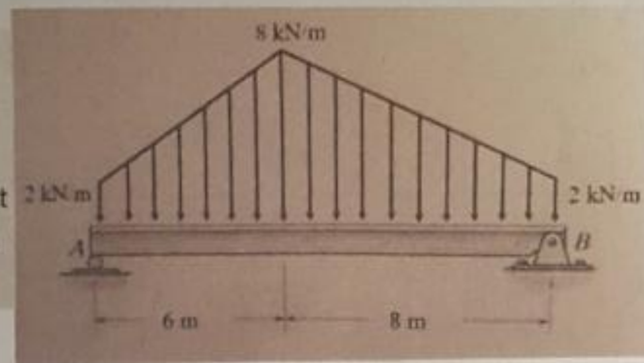
$\boxed{A_z = 400\ N}$

$\Sigma M_y = M_y + .8 B_z - 600(.4) = 0$

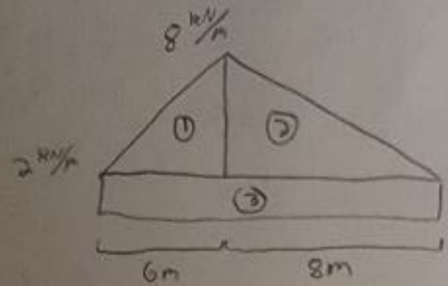
$\boxed{M_y = -560\ N \cdot m}$

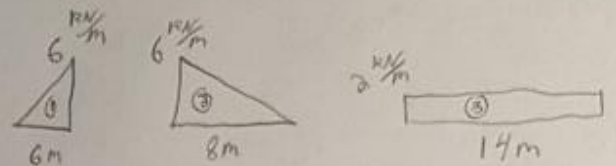
$\Sigma M_z = \boxed{0 = M_z}$

3. The distributed load acts on the beam *AB* as shown.
   (a) Determine the force-couple system at point *A* that is equivalent to the original distributed load.
   (b) Replace the original distributed load with an equivalent resultant force, and specify its location measured from point *A*.



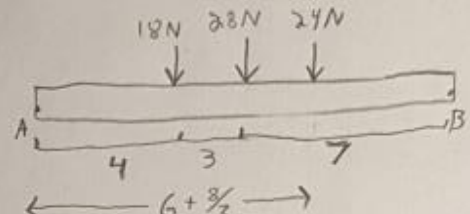
a)





$$F_R = F_1 + F_2 + F_3$$
$$= \tfrac{1}{2}(6)(6) + \tfrac{1}{2}(8)(6) + 2(14)$$
$$= 18 + 24 + 28$$
$$= 70 \text{ kN}$$

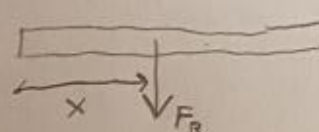
$$\boxed{\vec{F}_R = -70 \text{ kN } \hat{k}}$$



$$\circlearrowleft^{+} \; M_{RA} = -F_1 d_1 - F_2 d_2 - F_3 d_3$$
$$= -18(4) - 28(7) - 24(6 + \tfrac{8}{3})$$
$$= \boxed{-476 \text{ kN}\cdot\text{m}}$$

b) $M_{RA} = x \, F_R$

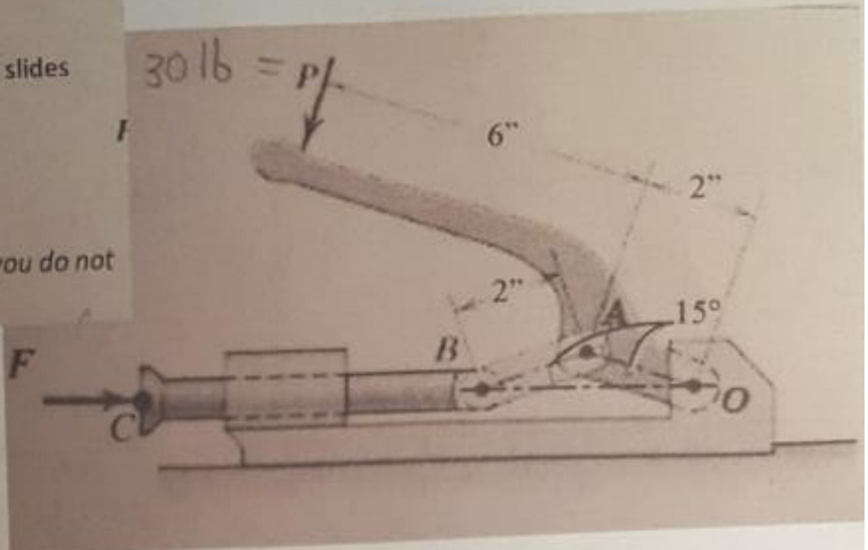
$$x = \frac{M_{RA}}{F_R}$$
$$= \frac{-476 \text{ kN}\cdot\text{m}}{-70 \text{ kN}}$$
$$= \boxed{6.8 \text{ m}}$$



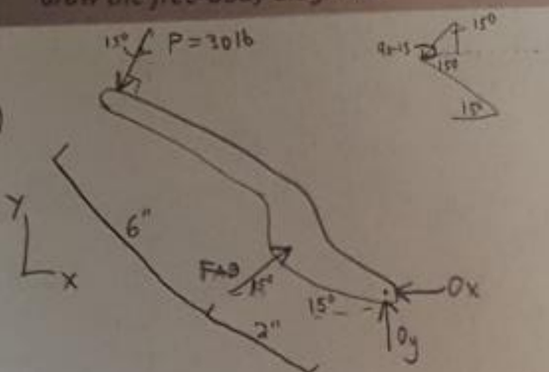
A force P is applied to the handle of the toggle clamp, resulting in a clamping force F at point C. The system is in equilibrium for the orientation shown. Neglect weight.

(a) Draw a free-body diagram of the handle.
(b) Draw a free-body diagram of the shaft CB, which slides freely in its smooth guide.
(c) Draw a free-body diagram of link AB.
(d) Determine the magnitudes of forces P and F.
(e) Determine the magnitude of the pin force at O.

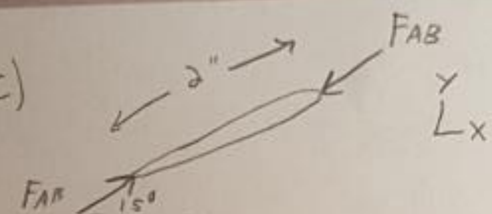
You will receive no credit for parts (d) and (e) if you do not draw the free-body diagrams.



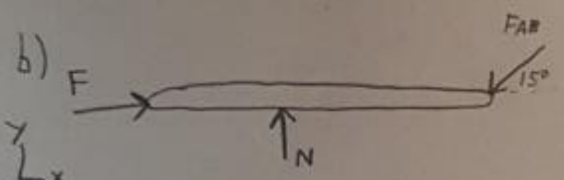
a)



c)



b)



w/ $F_{AB} = 240$

d) <u>Handle</u>: $\Sigma F_x = 0 = -30\sin 15^\circ - O_x + F_{AB}\cos 15^\circ \Rightarrow O_x = 224.1$ lb

$\Sigma F_y = 0 = -30\sin 15^\circ + O_y + F_{AB}\sin 15^\circ \Rightarrow O_y = 33.12$ lb

$$\Sigma M_O = 0 = (-F_{AB}\cos 15^\circ)(2\sin 15^\circ) - (F_{AB}\sin 15^\circ)(2\cos 15^\circ) + 30(8)$$

$$F_{AB} = \frac{240}{4\sin 15^\circ \cos 15^\circ} = 240 \text{ lb}$$

<u>Shaft CB</u>: $\Sigma F_x = 0 = F - F_{AB}\cos 15^\circ$

$$F = 240\cos 15^\circ = \boxed{231.8 \text{ lb}}$$

e) From Handle equations: ΣF_x and ΣF_y w/ $F_{AB} = 240$ lb

$O_x = 224.1$

$O_y = 33.12$

$$O = \sqrt{O_x^2 + O_y^2} = \sqrt{224.1^2 + 33.12^2} = \boxed{226.5 \text{ lb}}$$