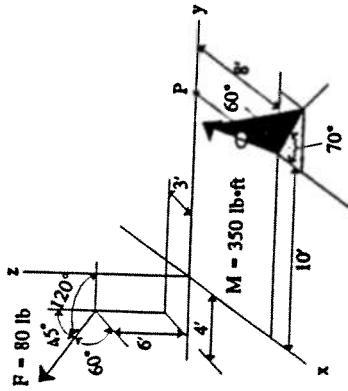


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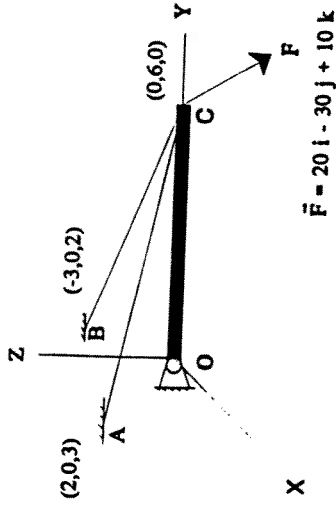
1. Replace the force and couple system by an equivalent force and couple moment at point P. Express the results in Cartesian vector form.



Answers: $\mathbf{F}_R = 40\mathbf{i} - 40\mathbf{j} + 56.6\mathbf{k}$, lb.

$\mathbf{M}_P = -492.5\mathbf{i} + 574.2\mathbf{j} + 983.1\mathbf{k}$, lb-ft.

3. A beam is supported with a ball-and-socket joint at point O and by the two cables AC and BC. If a force \mathbf{F} is applied at point C as shown, determine the tension in the cables. Lengths are in feet and force is in pounds.

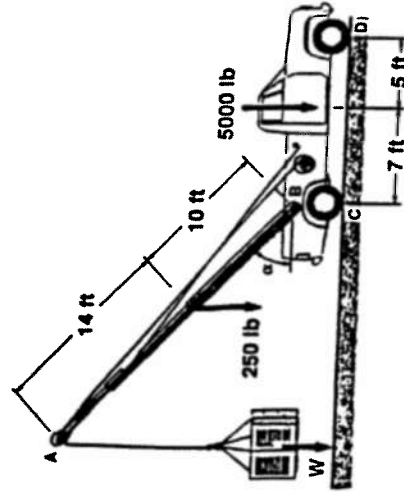


Answers: $T_{AC} = 37.7$ lb.

$T_{BC} = 48.46$ lb.

$\mathbf{F} = 20\mathbf{i} - 30\mathbf{j} + 10\mathbf{k}$

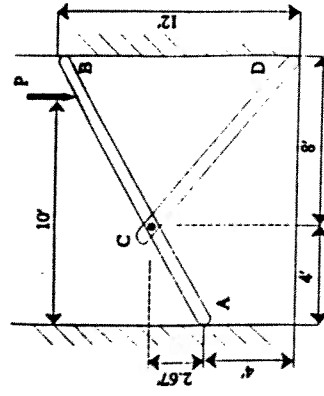
2. A truck-mounted crane is used to lift a 750 lb. compressor. The weights of the boom AB and of the truck are as shown, and the angle the boom forms with the horizontal is $\alpha = 40^\circ$. Determine the reaction at each of the two (a) rear wheels C, (b) front wheels D.



Answers: $R_C = 2,196$ lb.

$R_D = 804$ lb.

4. A load P of 100 lb. magnitude is supported by the two members AB and CD which are pin connected at C and are placed between the two smooth walls and floor as shown. Determine the horizontal and vertical components of all forces exerted on member AB.



Answers: $B_x = -34.98$ lb.

$A_x = 154.9$ lb.

$C_x = -119.9$ lb.

$C_y = 100$ lb.

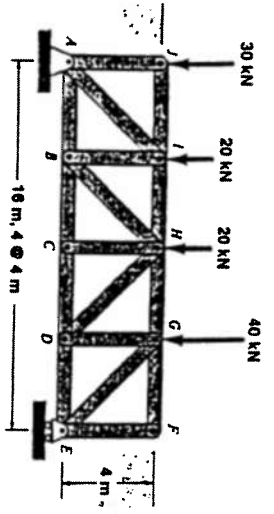
5. The Howe bridge truss is subjected to the loading shown. List all zero-force members and determine the force in members IH, BH and BI. Indicate whether the members are in tension or compression.

Answers: BH = 21.21 kN (C)

HI = 35.0 kN (C)

BI = 15.0 kN (T)

Zero-force Members: IJ, FG, FE, CH.

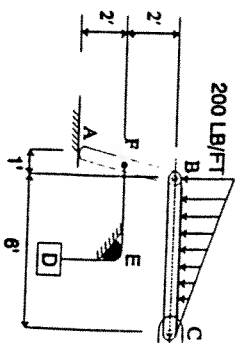


7.

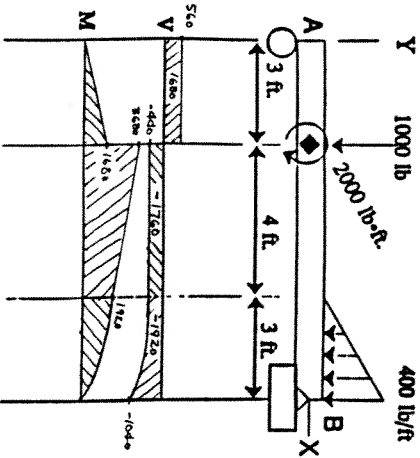
- The rope which supports block D passes over the fixed drum at E ($\mu = 0.2$) and is attached to bar AB at F. Neglect the weights of bars AB and BC, determine the maximum and minimum permissible values of the weight D if the system is to remain in equilibrium. The coefficient of friction between AB and the horizontal plane is 0.1.

Answers: $W_{D,MIN} = 87.7 \text{ lb.}$

$W_{D,MAX} = 383.4 \text{ lb.}$



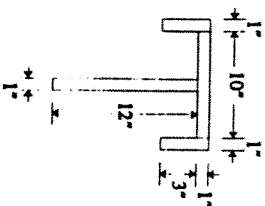
8. Part a: Draw the shear force and bending moment diagrams for the beam loaded as shown. Label all significant points. The beam is supported by a roller at A and a pin at B.



8. Determine the moment of inertia of the area shown with respect to a horizontal axis passing through the centroid of the area.

Answers: $\bar{y} = 3.5 \text{ inches from top}$

$I_x = 410.5 \text{ in}^4.$



Part b: Write the equation for the bending moment in the region $7' < x < 10'$.

$$M_x = 12,622 - 3,707x + 466.7x^2 - 22.22x^3$$