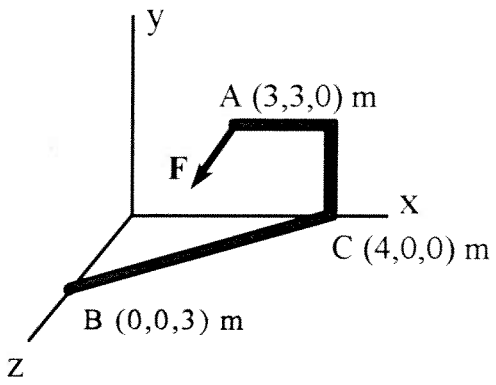
BE 50 Fall 96 Final Exam

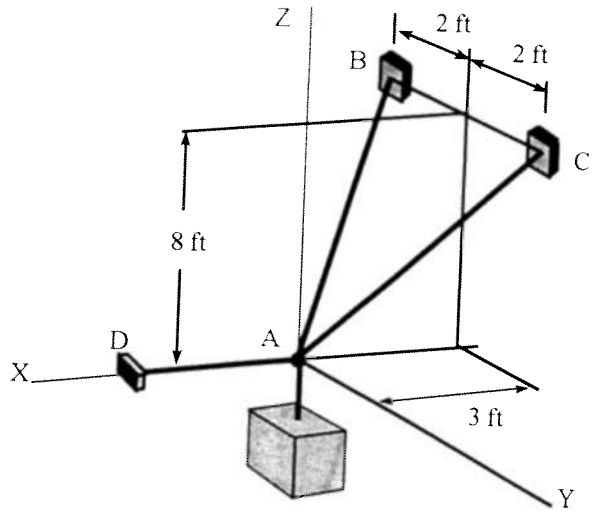
Dept. Avg 73.4%

1. The force, **F**= 500 **k** kN, acts on the shaft handle AC at the point A (3,3,0) m. Determine the moment of the force about the shaft BC. Express your answer in Cartesian vector form.



AUS: $\bar{M}_{BC} = 960\,\hat{i} - 720\,\hat{k}$ kN·m

2. Determine the force developed in cables AB, AC and AD used to support the 40 lb crate.

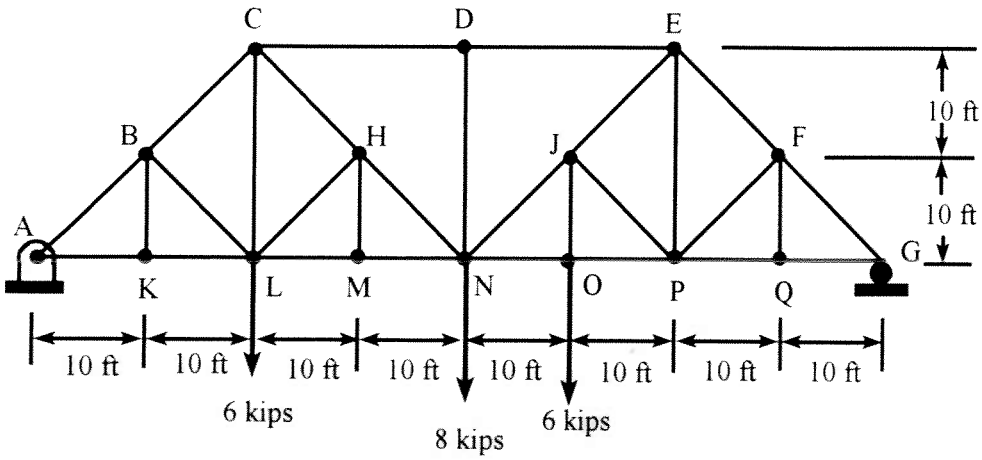


ANS:

$T_{AB} = T_{AC} = 21.94$ Lb

$T_{AD} = 15$ Lb.

3. Determine the forces in members CD, DN, and JN of the Baltimore truss. The given figure may be used to draw an overall FBD. Be sure to specify tension or compression.



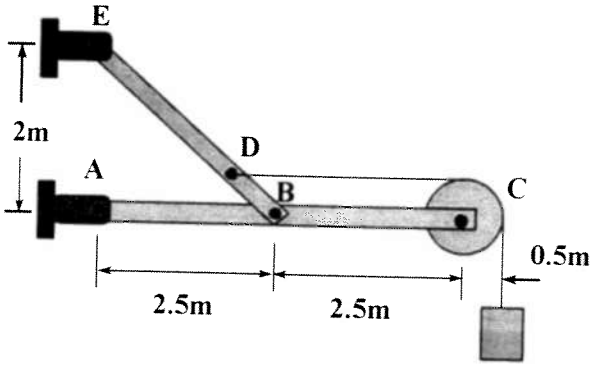
AUS:

DN = 0

CD = 15.5 kips (C)

JN = 4.6 kips (T)

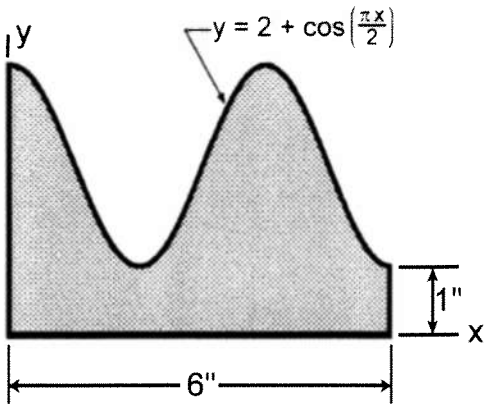
4. Determine all forces acting on bar BDE. The cord supporting the 100 kg box passes around the frictionless pulley C and is attached to member BDE at point D. Show your answers on a sketch of the member.



ANS: $E_x = 2697.8\ N \leftarrow$
$E_y = 1962\ N \uparrow$
$B_x = 1716.8\ N \rightarrow$ on BE
$B_y = 1962\ N \downarrow$ on BE

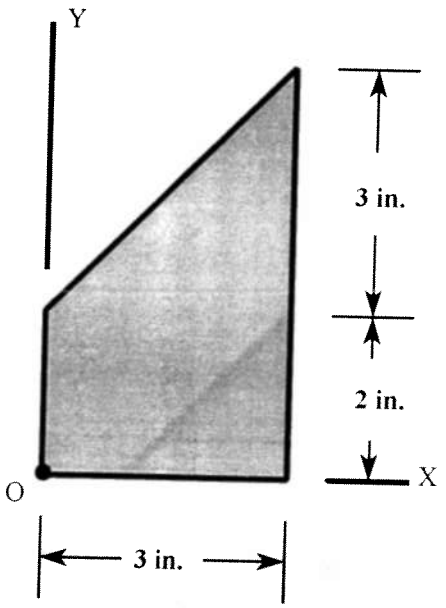
5. The figure shows the cross section of a new bottle proposed for distributing soap. The curve shown is rotated about the x-axis to form the bottle. Determine the volume of soap the bottle will hold.
NOTE:
$\int \cos(a\,x)\,dx = (1/a)\sin(a\,x)$

$\int \cos^2(a\,x)\,dx = x/2 + \{\sin(2\,a\,x)\}/(4\,a)$



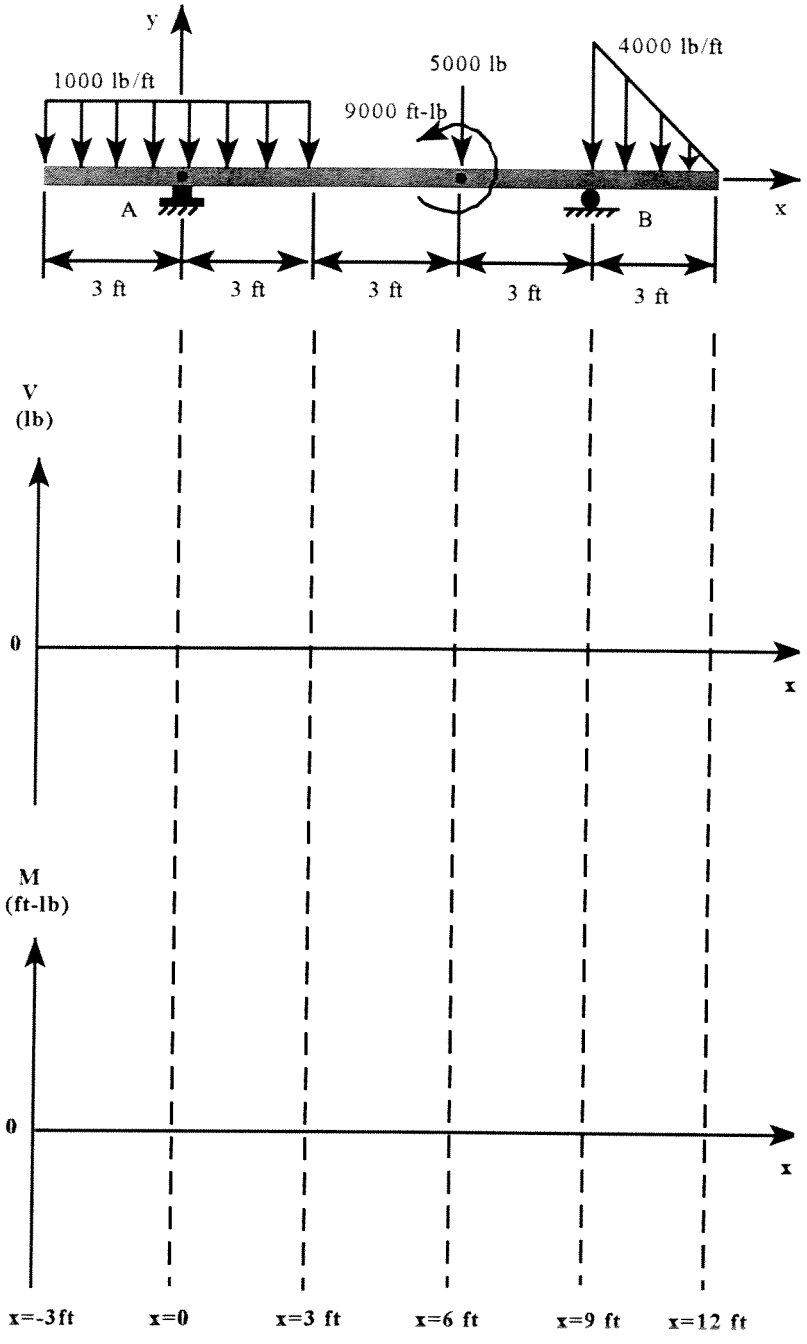
ANS: $V = 84.82\ in^3$

6. For the shaded area shown, determine:
a) I_X, I_Y, I_{XY}
b) the principal axes and the corresponding principal area moments of inertia. Show the axes properly oriented and label them.



ANS: $I_x = 50.75\ in^4$
$I_y = 38.25\ in^4$
$I_{xy} = 37.125\ in^4$
$\theta_p = -40.2°$
$I_{max} = 82.15\ in^4 @ \theta_p$
$I_{min} = 6.85\ in^4$

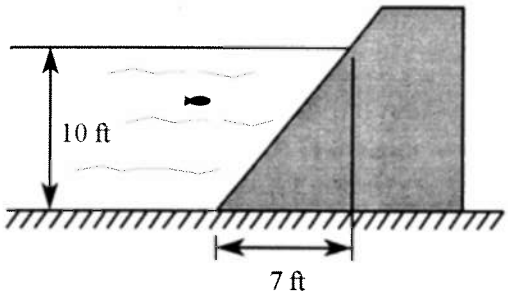
7. Draw and carefully label all significant points on the shear force and bending moment diagrams of the beam. Hint: The support reaction at A is 8000 lb upwards, and the support reaction at B is 9000 lb upwards.



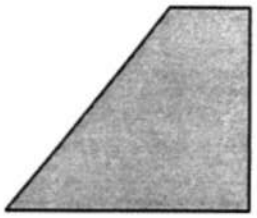
$V_{max} = 6000$ lb

$M_{max} = 12000$ lb·ft

8. The concrete dam weighs 150,000 pounds and rests on a solid foundation (assume no fluid is under the dam). The depth of the dam into the page is 15 feet, and the weight density of the water is 62.4 lb/ft^3.



FBD of dam:



(a). Neglecting atmospheric pressure, complete the FBD of the dam (above) and then determine the force(s) on the dam caused by the water. Show these forces on the sketch.

ANS: F = 571276

(b). Using equilibrium equations for the FBD and your knowledge of impending slip, determine the minimum coefficient of friction between the dam and the foundation required to keep the dam from sliding.

ANS:
Friction = 46,787 Lb
Normal = 182751 Lb
$\mu = 0.256$