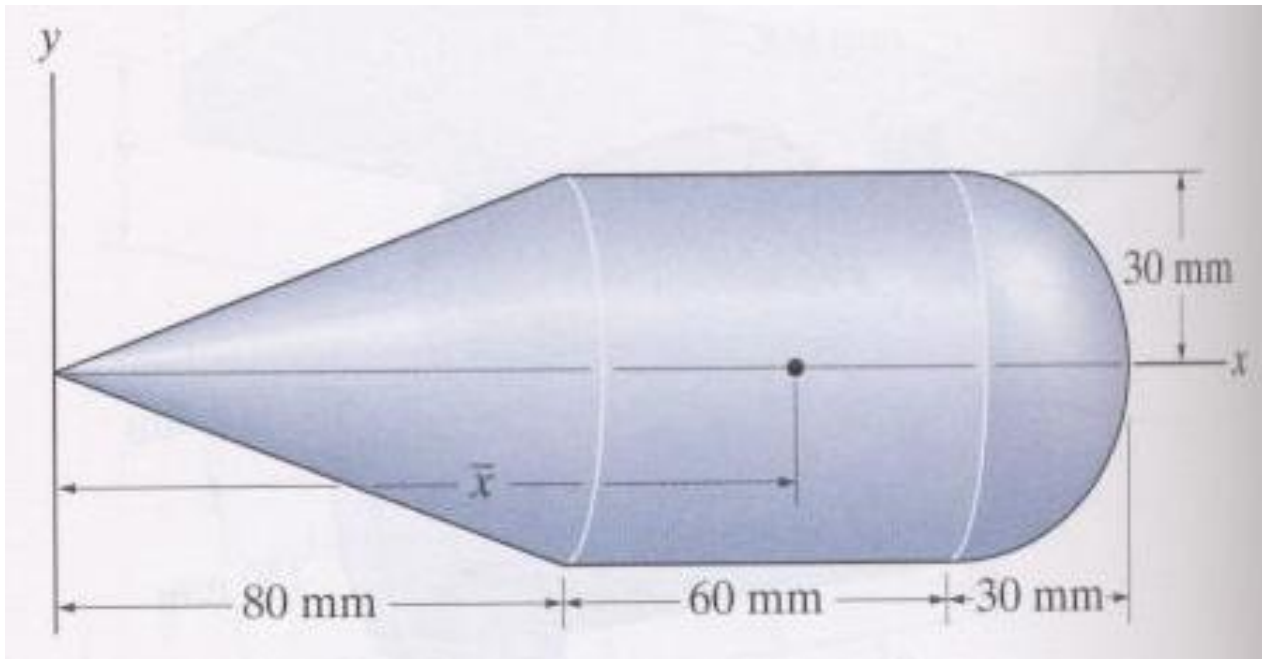


FINAL EXAM

Open Book, Closed Notes, Do not write on this sheet, Show all work

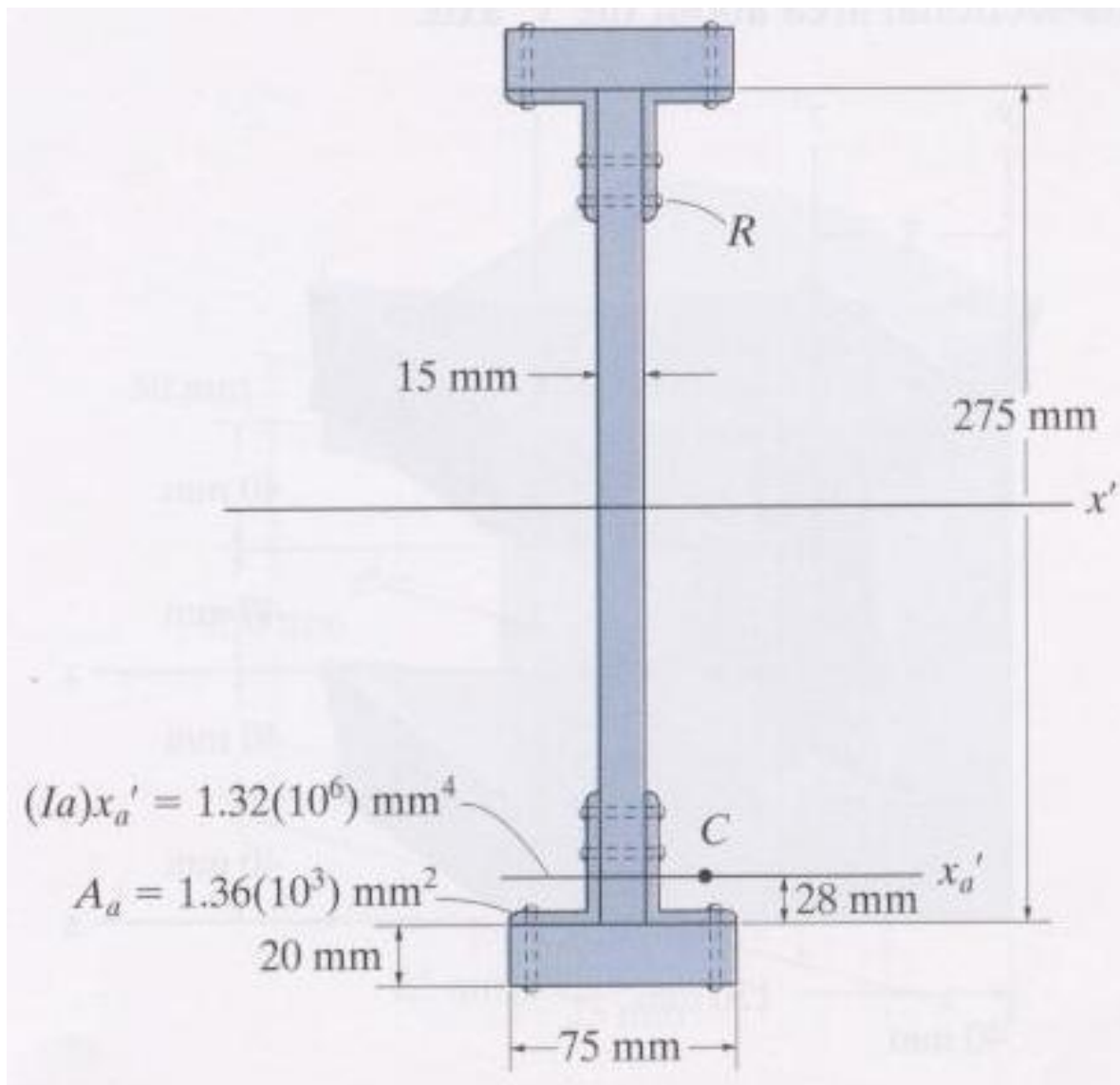
1. (25 points) Determine the location \bar{x} of the center of gravity of the solid made from a hemisphere, cylinder, and cone.



FINAL EXAM

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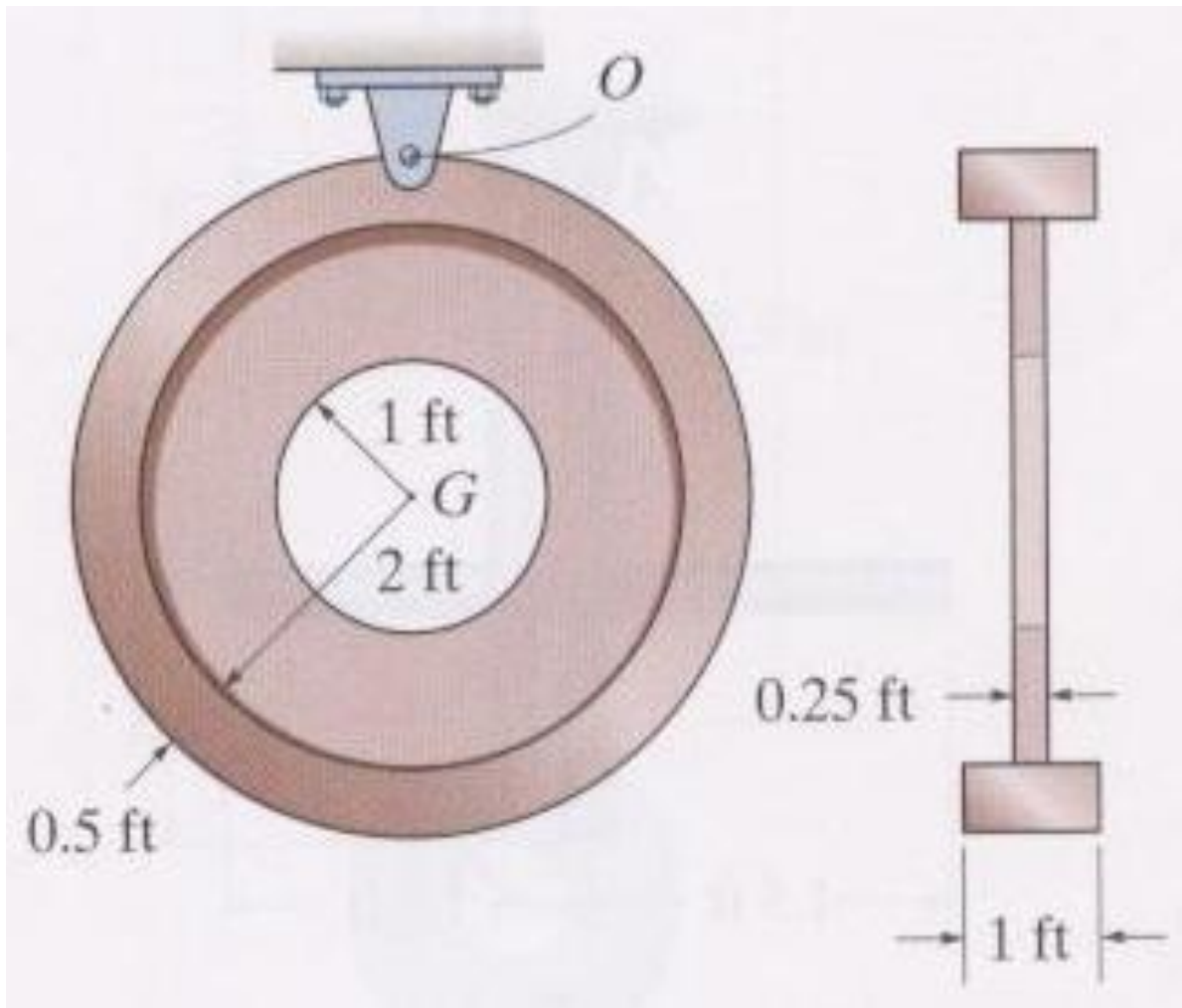
2. (25 points) Determine the moment of inertia for the beam's cross-sectional area with respect to the x' centroidal axis. Neglect the size of all the rivet heads, R , for the calculation. Handbook values for the area, moment of inertia, and location of the centroid C of one of the angles are listed in the figure.



FINAL EXAM

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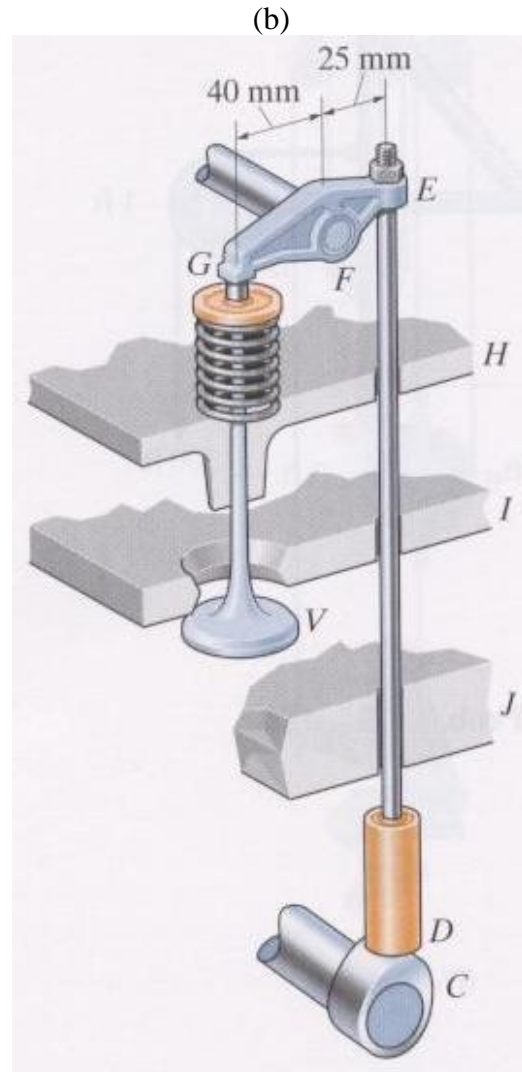
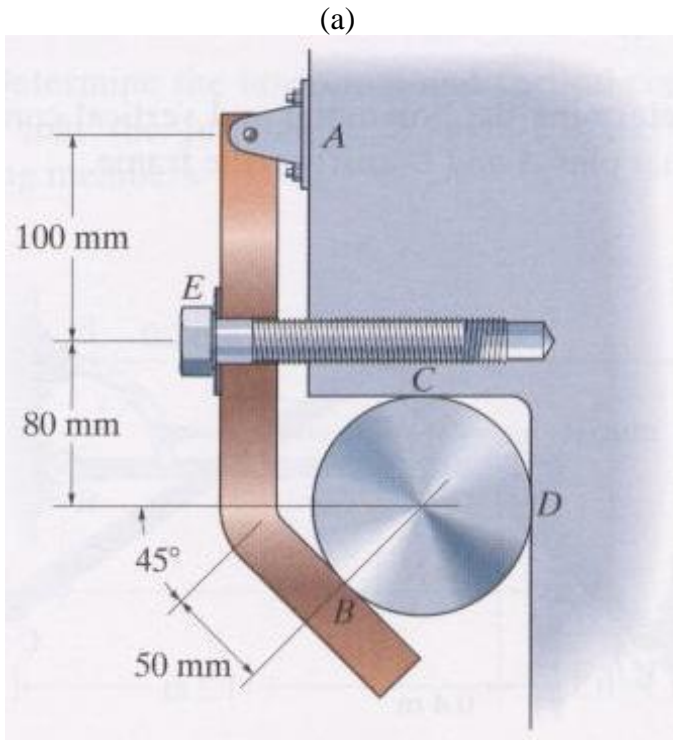
3. (30 points) Determine the mass moment of inertia of the assembly about an axis which is perpendicular to the page and passes through point O . The material has a specific weight of $\gamma = 90 \text{ lb/ft}^3$.



FINAL EXAM

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4. (20 points) Draw the free-body diagrams for the four following situations.



The link is used to hold the rod in place. Determine the required axial force on the screw at *E* if the largest force to be exerted on the rod at *B*, *C*, or *D* is to be 100 N. Also, find the magnitude of the reaction force at pin *A*. Assume all surfaces of contact are smooth.

Operation of exhaust and intake valves in an automobile engine consists of the cam *C*, push rod *DE*, rocker arm *EFG* which rides on a smooth bearing at *F*, and a spring and valve, *V*. If the compression in the spring is 20 mm when the valve is open as shown, determine the normal force acting on the cam lobe at *C*. Assume the contact between the cam and the push rod at *D* is normal and smooth. The spring has a stiffness of 300 N/m.

FINAL EXAM

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5. Bonus Question: (20 points, **No partial credit will be awarded**) Determine the internal shear force and moment acting at point *D* of the beam.

