ME 101 – Engineering Mechanics
Assignment

Problems 1 and 2 will be solved by the tutor at the beginning. Students may go through the remaining problem in the class and discuss with the tutor if they have any doubt. **There will be no assessment for this assignment.**

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(1) Considering the Fig. 1, show that the moment of inertia of the rectangular area about the x-axis through one end may be used for its polar moment of inertia about point O where b is considered small as compared with a. What is the percentage error where $b/a = 1/10$.

(2) Determine the moment of inertia of the shaded area (shown in Fig. 2) about the x- and y-axes. Use the differential element for both the calculations.

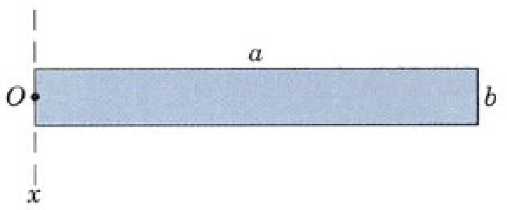


Fig. 1

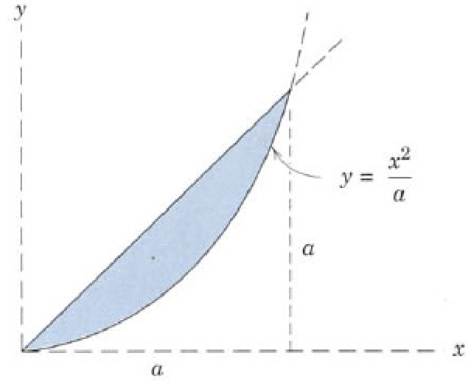


Fig. 2

(3) Determine the rectangular moments of inertia of the shaded area in Fig. 3 about the x- and y-axes and the polar radius of gyration about point O.

(4) Determine the product of inertia about x-y axes of the circular area (as given in Fig. 4) with equal three square holes.

(5) The maximum and minimum moments of inertia of the shaded area are 12×10^6 mm^4 and 2×10^6 mm^4, respectively, about axes passing through the centroid C, and the product of inertia with respect to the x-y axes has a magnitude of 4×10^6 mm^4. Use the proper sign for the product of inertia and calculate I_x and the angle α measured counterclockwise from the x-axis to the axis of maximum moment of inertia. (Refer Fig. 5)

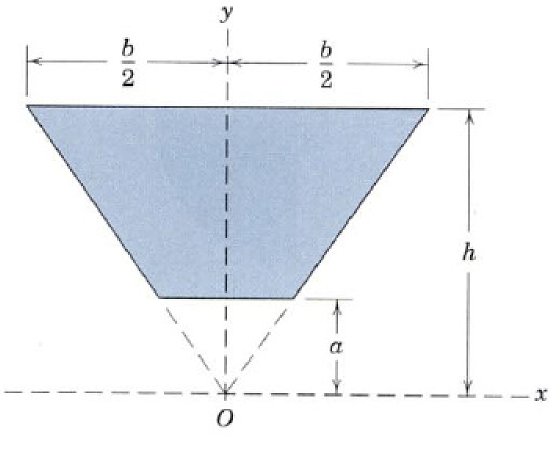


Fig. 3

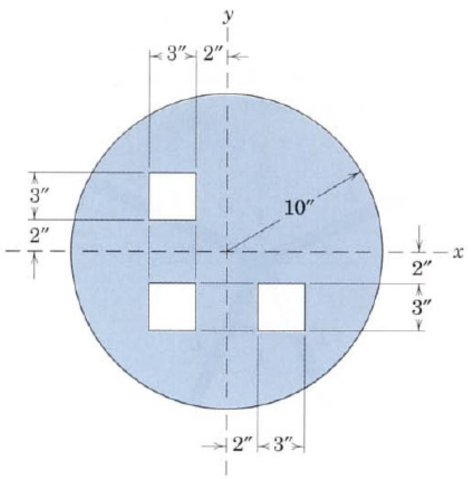


Fig. 4

(6) Derive the expression for the moment of inertia of the trapezoidal area as shown in Fig. 6 about the x-axis through its base.

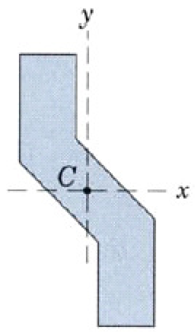
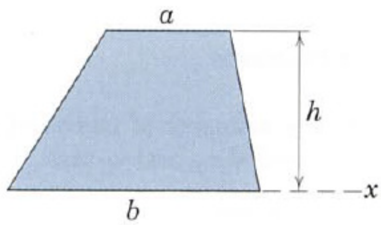


Fig. 5



Prob. 6

(7) Calculate the polar radius of gyration about point O of the area shown in Fig. 7. Note that the widths of the elements are small compared with their lengths.

(8) A thin plate of mass m has the trapezoidal shape shown in the Fig. 8. Determine the mass moment of inertia of the plate with respect to (a) the x-axis and (b) the y-axis.

(9) Determine by direct integration of the mass moment of inertia with respect to y-axis of the pyramid shown in Fig. 9, assuming that it has a uniform density and a mass m.

(10) Shown in Fig. 10 is the cross section of ideal roller. Determine its mass moment of inertia and its radius of gyration with respect to the axis AA'. (The density of bronze is 8580 kg/m^3; of aluminum, 2770 kg/m^3; and of neoprene, 1250 kg/m^3.)

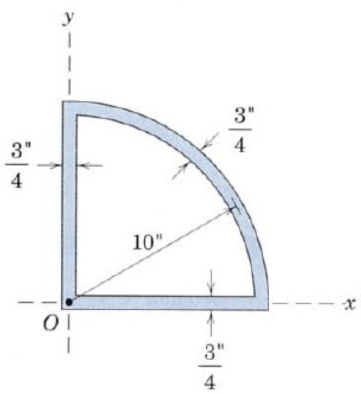


Fig. 7

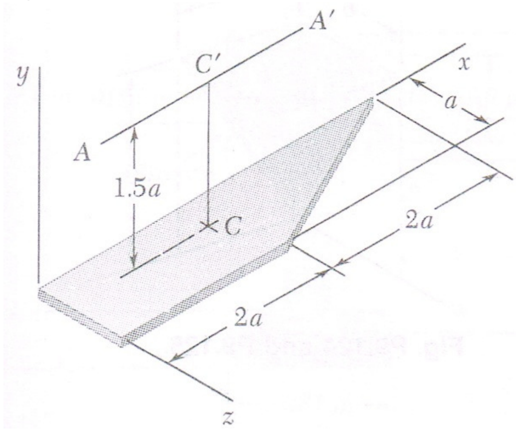


Fig. 8

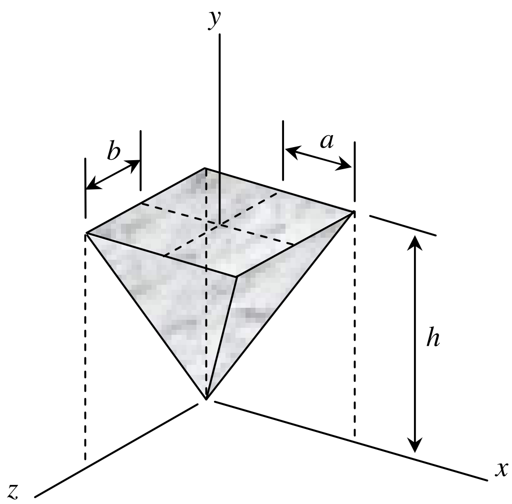


Fig. 9

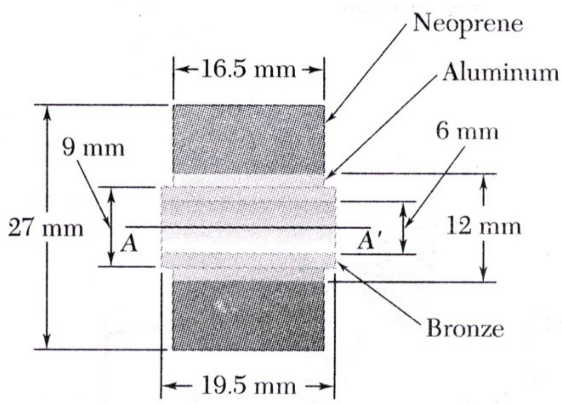


Fig. 10