**APL 100 Practice Sheet 0**

***Theory to be covered in the tutorial:***

*Recapitulation of the concept of the centre of mass.*

$$\vec{r}_C \equiv \iiint \vec{r}_p \, dm \Big/ \iiint dm; \qquad \text{For a system of masses: } \vec{r}_C = \frac{\sum_{i=1}^{n} \vec{r}_{Ci} m_i}{\sum_{i=1}^{n} m_i};$$

1) Find the centres of mass of the solid object (a), the plate (b) and the wire (c) shown. The density may be assumed uniform in each case. Choose a convenient origin and axes in each case.

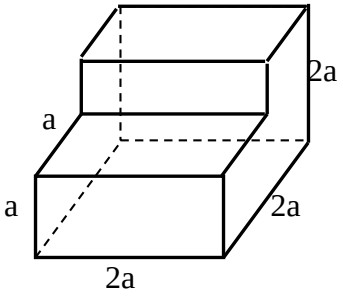


**Fig. 1a**

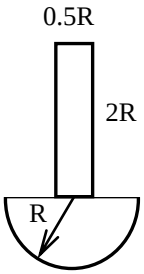


Fig. 1b

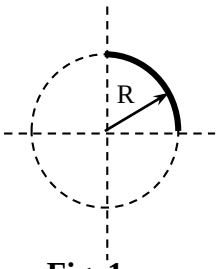


**Fig. 1c**

2) Locate the centres of mass of the solid objects shown. In (a) and (b) the density is uniform while, in (c) the density varies as: $\rho = \rho_0 \left[1 + (x/a)(1 + y^2/b^2)\right]$. Choose a convenient origin and axes (if not specified) in each case.

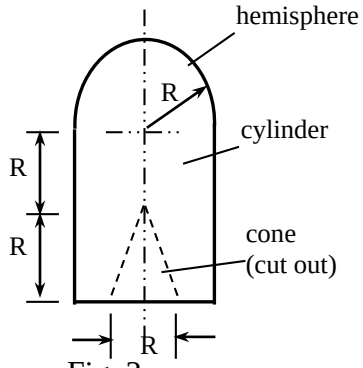


Fig. 2a

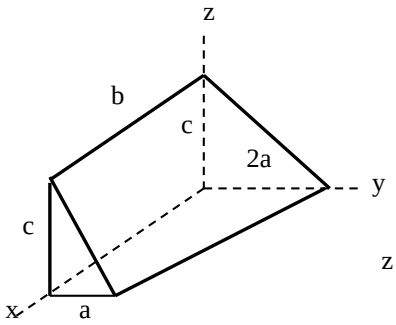


**Fig. 2b**

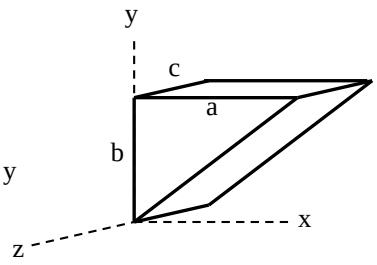


Fig. 2c

*Note: A cut-out can be handled by considering an equivalent body without the cut-out and then subtracting the cut-out.*

Note: i) For a semi-circular (radius R) plate the centre of mass lies on the axis of symmetry at a distance of $4R/3\pi$ from the flat side.
ii) The centre of mass for a uniform cone (radius R and height H) lies on the axis of symmetry at a height H/4 from the base.
iii) The centre of mass for a solid hemi-sphere of radius R lies on the axis of symmetry at a height 3R/8 from the base.