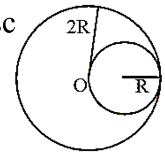
41. (1)

From the principle of moments $m_1r_1 = m_2r_2$

$$\frac{r_1}{r_2}=\frac{m_2}{m_1}=\frac{6}{3}=\frac{2}{1}$$

42. (2)

Let σ be the mass per unit area of the disc.



Then the mass of the complete disc

$= \sigma(\pi(2R)^2)$

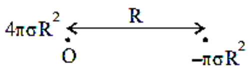
The mass of the removed disc

$= \sigma(\pi R^2) = \pi\sigma R^2$

Let us consider the above situation to be a complete disc of radius 2R on which a disc of radius R of negative mass is superimposed. Let O be the origin. Then the above figure can be redrawn keeping in mind the concept of centre of mass as :

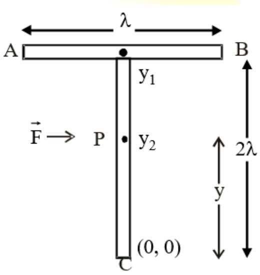
$$\chi_{cm}=\frac{\left(6\pi\left(2R\right)^2\right)\times 0+\left(-6\left(\pi R^2\right)\right)R}{4\pi\sigma R^2-\pi\sigma R^2}$$

$$\therefore\ \chi_{cm}=\frac{-\pi\sigma R^2\times R}{3\pi\sigma R^2}$$



$$\therefore\ \chi_{cm}=-\frac{R}{3}=\alpha R\Rightarrow\alpha=\frac{1}{3}$$

43. (4)



To have translational motion without rotation, the force $\vec{F}$ has to be applied at centre of mass. i.e., the point 'P' has to be at the centre of mass taking point C at the origin position, positions of y, and y_2 are $r_1 = 2l$, $r_2 = l$ and $m_l = m$ and $m_2 = 2m$

$$y=\frac{m_1y_2+m_2y_2}{m_1+m_2}=\frac{m\times 2l+2m\times l}{3m}=\frac{4l}{3}$$

44. (2)

45. (4)

46. (4)

47. (3)

Moment of inertia of uniform circular disc about its diameter = I

According to theorem of perpendicular axes,

Moment of inertia of disc about its axis = 2I

Applying theorem of parallel axes

Moment of inertia of disc about the given axis

$= 2I + mr^2 = 2I + 4I = 6I$

$$\left(\text{as } 2I=\frac{1}{2}mr^2\ \ \therefore mr^2=4I\right)$$

48. (4)

$$I=\frac{mr^2}{2}+\frac{3mr^2}{2}+\frac{3mr^2}{2}=\frac{7}{2}mr^2$$

49. (3)

$$I=\frac{2}{5}MR^2$$

50. (4)

$$I_1=\frac{MR^2}{4}+MR^2=I_2$$

$$\therefore I_1+I_2=\frac{5}{2}MR^2$$