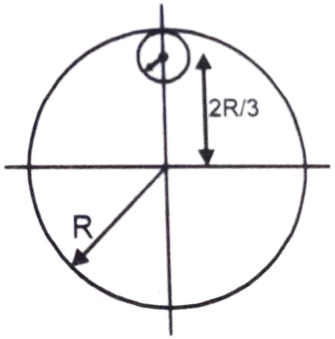
From a uniform circular disc of radius R and mass 9 M, a small disc of radius $\frac{R}{3}$ is removed as shown in the figure. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through centre of disc is : **[JEE MAIN 2018]**



(A) $4\,MR^2$ (B) $\frac{40}{9}MR^2$ (C) $10\,MR^2$ (D) $\frac{37}{9}MR^2$

Solution:

Mass of disc = Volume x Density

9M = $A \times T \times \rho$ (Area x thickness x density)

$9M = \pi R^2 \times t \times \rho \ldots\ldots (i)$

For the disc which is cut off.

$$M' = \pi\left(\frac{R}{3}\right)^2 \times t \times \rho \ldots\ldots (ii)$$

(i)Divided by (ii)

$$\frac{9M}{M} = 9 \Rightarrow M' = M$$

Moment of inertia of complete disc about an axis passes through O.

$$I_1 = \frac{1}{2}(9M) \times R^2$$

Moment of inertia of cut off disc about an axis passes through O

$$I_2 = \frac{1}{2}M \times \left(\frac{R}{3}\right)^2 + M \times \left(\frac{2R}{3}\right)^2$$

$$= \frac{1}{2}\frac{MR^2}{9} + \frac{4MR^2}{9}$$

So, moment of inertia of remaining disc = $I_1 - I_2$

$$= \frac{9MR^2}{2} - \frac{MR^2}{18} - \frac{4MR^2}{9}$$

$$= \left(\frac{81-1-8}{18}\right)MR^2$$

$$= 4MR^2$$

Hence the Solution is Option (1)