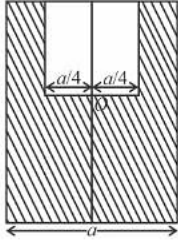


Ques.

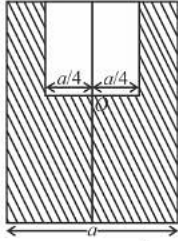
A square plate of edge $a/2$ is cut out from a uniform square plate of edge a as shown in figure. The mass of the remaining portion is M . The moment of inertia of the shaded portion about an axis passing through O (centre of the square of side a and perpendicular to plane of the plate) is given by nma^2 . Find the value of n ?



Let m_1 = mass of the square plate of side a
 and m_2 = mass of the square of side ' $a/2$ '

Then $m_1 = \sigma \left(\frac{a}{2}\right)^2$; $m_2 = \sigma (a)^2$; (σ being the areal density)

and $m_2 - m_1 = M$.



$$\Rightarrow I = \frac{m_2 a^2}{6} - \left\{ \frac{m_1 (a/2)^2}{6} + m_1 \left(\frac{a}{4}\right)^2 \right\}$$

$$= \frac{\sigma a^4}{6} - \left\{ \frac{\sigma (a/2)^4}{6} + \sigma \left(\frac{a}{2}\right)^2 \left(\frac{a}{4}\right)^2 \right\}$$

$$= \sigma a^4 \left\{ \frac{1}{6} - \frac{1}{16 \times 6} - \frac{1}{4 \times 16} \right\}$$

$$= \sigma a^4 \left\{ \frac{(2 \times 16) - 2 - 3}{16 \times 12} \right\}$$

$$I = \sigma a^4 \left\{ \frac{27}{16 \times 12} \right\}$$

$$\text{Also; } M = \sigma \left(1 - \frac{1}{4}\right) a^2$$

$$\sigma = \frac{4M}{3a^2}$$

$$\Rightarrow I = \left(\frac{4M}{3a^2}\right) \cdot a^4 \left\{ \frac{27}{12 \times 6} \right\}$$

$$\Rightarrow I = \frac{3Ma^2}{16} = 0.1875 Ma^2$$

The correct answer is: 0.1875