

A body is rolling without slipping on horizontal plane. The rotational energy of the body is 40 % of the total kinetic energy. Identify the body?

Option: ring, disc, hollow cylinder or hollow sphere.

Solution

A body is rolling without slipping, so $v = r\omega$, where v – velocity, ω – angular velocity, r – radius.

Total kinetic energy:

$$K_{\text{total}} = K_{\text{rotational}} + \frac{mv^2}{2}.$$

We know that $\frac{K_{\text{rotational}}}{K_{\text{total}}} = 0.4$, then $K_{\text{rotational}} = \frac{0.4}{0.6} * \frac{mv^2}{2} = \frac{2}{3} \frac{mr^2\omega^2}{2}$.

But on the other hand

$$K_{\text{rotational}} = \frac{I\omega^2}{2},$$

where I – moment of inertia of body.

So

$$I = \frac{2}{3}mr^2 = I_{\text{hollow sphere}}.$$

Answer: hollow sphere.