



A uniform rod of length L and mass m is free to rotate about O . The rod is released from rest in the horizontal position (state A). Define state B to be when the rod passes the vertical position.

Determine kinetic energy released, from A to B. Denote the angular velocity of the rod at B be ω .

- A) $K_B = \frac{m L^2 \omega^2}{6}$ and $U_A - U_B = \frac{m g L}{2}$.
- B) $K_B = \frac{m L^2 \omega^2}{24}$ and $U_A - U_B = \frac{m g L}{2}$.
- C) $K_B = \frac{m L^2 \omega^2}{6}$ and $U_A - U_B = m g L$.
- D) $K_B = \frac{m L^2 \omega^2}{24}$ and $U_A - U_B = m g L$.

$$U_A - U_B = K_B - K_A = K_B.$$

The amount of the potential energy which the rod has released in going from A to B is given by

$$U_A - U_B = \int g y d m = \int g y \frac{d m}{d y} d y = \frac{g m}{L} \int y d y.$$

Integrating y from 0 to L gives

$$U_A - U_B = \frac{m g L}{2}.$$

The kinetic energy of the rod at the state B is

$$K_B = \frac{I \omega^2}{2} = \frac{m L^2}{3} \frac{\omega^2}{2} = \frac{m L^2 \omega^2}{6}.$$

Answer **A**.