a disc of mass 400g is rolling on horizontal surface with uniform velocity of 2m/s. calculate its total kinetic energy.

Solution

Total kinetic energy of the rolling disk is the sum of its rotational energy and kinetic energy of the translation motion.

The kinetic energy of the translation motion:

$$E_{tr} = \frac{mv^2}{2}.$$

The rotational energy:

$$E_{rot} = \frac{I_{disk}\omega^2}{2},$$

where $I_{disk} = \frac{1}{2}mr^2$ is moment of inertia of the disk, ω is angular velocity of the disk, r is radius of the disk.

We consider that disk roll without slipping:

$$v = \omega * r.$$

So

$$E_{rot} = \frac{I_{disk}\omega^2}{2} = \frac{1}{2}mr^2\frac{\omega^2}{2} = \frac{1}{4}m(\omega * r)^2 = \frac{1}{4}mv^2.$$

Total kinetic energy of the rolling disk:

$$E_{total} = E_{tr} + E_{rot} = \frac{mv^2}{2} + \frac{mv^2}{4} = \frac{3}{4}mv^2 = \frac{3}{4} * 0.4 * 2^2 = 1.2\,J.$$

Answer: 1. 2 *J*.