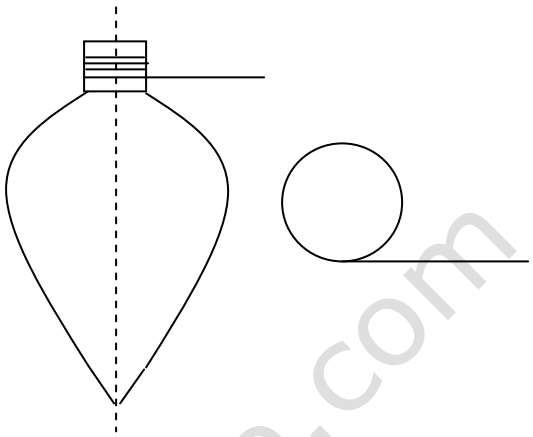
Q- A top has a moment of inertia equal to 4.00 x 10^{-4} kg.m^2 0f and is initially at rest. It is free to rotate about the stationary vertical axis AA'. A string wrapped around a peg along the axis of the top, is pulled in such a manner as to maintain a constant tension of 5.57N. If the string does not slip while it is unwound from the peg, what is the angular speed of the top after 80.0 cm of string has been pulled off the peg?



Here as there is no resistive forces (non-conservative) acting on the system, the work energy rule can be applied.

According to the work energy rule the work done on a system will be equal to increase in its kinetic energy.

Or W = Δ KE

The work done on the top is equal to the product of the force applied on the string and the displacement of the point of application of the force.

The force applied on the string is same as that of the tension in the string and hence the work done on the top is given by

W = F*s = 5.57*80.0*10^{-2} = 4.456 J

The initial KE is zero

The final kinetic energy of the top is purely rotational kinetic energy (as it rotates about a fixed axis) given by

$$KE = \frac{1}{2} I * \omega^2$$

Therefore the work energy rule gives

$$W = \Delta KE = \frac{1}{2} I * \omega^2$$

Gives $\omega = \sqrt{\frac{2W}{I}} = \sqrt{\frac{2 * 4.465}{4.00 * 10^{-4}}} = 149.42$ rad/s

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