

FATIMA AKBAR

Class : 11

Section : A

Physics

Q no 1

Consider a sphere is rolling down the inclined plane without slipping so that it has both translational and rotational motion.

$$K.E_{\text{tran}} = \frac{1}{2} mv^2$$

$$K.E_{\text{rot}} = \frac{1}{2} I\omega^2$$

$$I = \frac{2}{5} mr^2$$

$$K.E_{\text{rot}} = \frac{1}{2} \left(\frac{2}{5} mr^2 \right) \omega^2$$

$$= \frac{1}{5} mr^2 \omega^2$$

$$= \frac{1}{5} m(r\omega)^2$$

$$= \frac{1}{5} mv^2$$

$$\text{Total } K.E = K.E_{\text{tran}} + K.E_{\text{rot}} \Rightarrow \frac{1}{2} mv^2 + \frac{1}{5} mv^2$$

$$\text{Total kinetic energy} = \frac{7}{10} mv^2$$

Calculation for Speed:- P.E at top = K.E at bottom

$$mgh = \frac{7}{10} mv^2$$

$$10gh = 7v^2$$

$$\frac{10}{7}gh = v^2$$

$$v = \sqrt{\frac{10}{7}gh}$$

Hence Proved.

Q no 2

$$v = \sqrt{gR}$$

$$v = \sqrt{9.8 \times 6.4 \times 10^6}$$

$$v = \sqrt{62.72 \times 10^6}$$

$$v = 7.9 \times 10^3 \text{ m/s}$$

$$v = 7.9 \text{ km/s}$$

Hence Proved.

Q no 6

A tiny laser - - - - earth.

Given: $s = 2.50 \text{ m}$, $\theta = 6.6 \times 10^{-9}$

Find:- $r = ?$

Solution: $s = r\theta$

$$r = \frac{s}{\theta}$$

$$r = \frac{2.50}{6.6 \times 10^{-9}}$$

$$r = 0.37 \times 10^{-9}$$

$$r = 3.8 \times 10^{-9}$$

Q no 7

Given:

$$r_o = 3.85 \times 10^8 \text{ m}$$

$$r_s = 1.74 \times 10^6 \text{ m}$$

Find:

$$\begin{array}{l} \text{spin angular mom} \\ \text{Orbital angular mom} \end{array} = \begin{array}{l} L_s \\ L_o \end{array} \Rightarrow$$

Solution:

$$L_s = I_s \omega_s$$

$$L_o = I_o \omega_o$$

$$\frac{L_s}{L_o} = \frac{I_s \omega_s}{I_o \omega_o}$$

$$\omega_s = \omega_o = \omega$$

$$I_s = \frac{2}{5} m r_s^2$$

$$I_o = m r_o^2$$

$$\frac{L_s}{L_o} = \frac{I_s \omega_s}{I_o \omega_o} = \frac{\frac{2}{5} m r_s^2 \omega}{m r_o^2 \omega}$$

$$\frac{L_s}{L_o} = \frac{r_s^2}{r_o^2} = \frac{2 (1.74 \times 10^6)^2}{5 (3.85 \times 10^8)^2}$$

$$= \frac{2 \times 1.74 \times 1.74}{5 \times 3.85 \times 3.85} \times \frac{10^{12}}{10^{16}}$$

$$= 0.0817 \times 10^{12-16} = 0.0817 \times 10^{-4}$$

$$= 8.17 \times 10^{-6}$$

$$L_1 = 8.2 \times 10^{-6}$$

L_0

Q no 5

$$r = \left[\frac{GMT^2}{4\pi^2} \right]^{1/3}$$

$$G = 6.673 \times 10^{-11} \text{ Nm}^2/\text{kg}^{-2}$$

$$M = 6 \times 10^{24} \text{ kg}$$

$$\pi = 3.14$$

$$T = 24 \text{ hr} = 86400 \text{ sec}$$

$$r = 42.3 \times 10^6 \text{ m}$$

$$r = R + h$$

$$h = r - R$$

$$h = 42.3 \times 10^6 - 6.4 \times 10^6$$

$$h = 35.9 \times 10^6 \text{ m}$$

$$h = 3.59 \times 10^7 \text{ m}$$