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11-(A)

Physics Assignment.

Numericals :-

1) A tiny laser beam ..... .

Given:

diameter = S = 2.50m

distance = r = 3.8×10^8 m

Find:

Angle = θ = ?

Formula:

$S = r\theta$

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

$\theta = \frac{2.50}{3.8 \times 10^8} = \frac{2.5}{3.8} \times 10^{8}$

$\theta = .657 \times 10^{-8}$

$\theta = 6.57 \times 10^{-9}$ radian

2) The moon orbits ..... .

Given:

(Distance between moon & Earth) = $r_0 = 3.85 \times 10^8$ m

(Riadius of Moon) = $r_s = 1.74 \times 10^6$ m

Find:

spin angular mom L_s = ?

orbital angular mom L_0

Formula:

$$L_S = I_S \omega_S$$
$$L_O = I_O \omega_O$$

$$\frac{L_S}{L_O} = \frac{I_S \omega_S}{I_O \omega_O}$$

$\omega_S = \omega_O = \omega$ (side of moon faces the Earth)

$I_S = \frac{2}{5} m r_S^{-2}$ (spin motion)

$I_O = m r_O^{2}$ (orbital motion)

$$\frac{L_S}{L_O} = \frac{I_S \omega_S}{I_O \omega_O} = \frac{\frac{2}{5} m r_S^2 \omega}{m r_O^2 \omega}$$

$$\frac{L_S}{L_O} = \frac{2 r_S^2}{5 r_O^2} = \frac{2 (1.74 \times 10^6)^2}{5 (3.85 \times 10^8)^2}$$

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

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

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

$$\frac{L_S}{L_O} = 8.2 \times 10^{-6}$$

Short Question:-

1) When a hoop is released.....

The kinetic energy of the rolling object (hoop or sphere) includes translational and rotational component

- For hoop:-

Moment of inertia $= I = mR^2$.

$$mgh = \frac{1}{2}mv^2 + \frac{1}{2}Iw^2$$

$$w = \frac{v}{R}$$

$$mgh = \frac{1}{2}mv^2 + \frac{1}{2}(mR^2)\left(\frac{v}{R}\right)^2$$

$$mgh = \frac{1}{2}mv^2 + \frac{1}{2}mv^2$$

$$mgh = mv^2$$

$$v = \sqrt{gh}$$

- For sphere:

moment of inertia $= I = \frac{2}{5}mR^2$

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

$$mgh = \left(\frac{1}{2} + \frac{1}{5}\right)mv^2$$

$$mgh = \left(\frac{7}{10}\right)mv^2$$

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

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

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

2) Critical velocity 7.9 km/s.

$$v_c = \sqrt{\frac{6.67 \times 10^{-11} \cdot 5.97 \times 10^{24}}{6.37 \times 10^{6}}}$$

$$v_c = \sqrt{7.5 \times 10^{7}} = 7.9 \text{ km/s}$$

3)

weight in elevator accelerating upward with g:

$$W' = 2W$$

weight in an elevator is the normal force N.

when acelerating upward:

$$N = mg + ma = m(g+a)$$

$$a = g$$

$$N = m(g+g) = 2mg = 2W.$$

4) Satellite speed & orbital period:

Given:

$$v = 1.01 \text{ km/s}$$

$$r = 3904000 \text{ m}$$

Time for one revolution

$$T = \frac{\text{circumference}}{\text{speed}} = \frac{2\pi r}{v}$$

$$T = \frac{2\pi (3904000)}{1.01 \times 10^3}$$

$$= \frac{24518740}{1010} \approx 24300 \text{ s}$$

into days:

$$\frac{24300}{86400} \approx 0.28 \text{ days.}$$