Assigment

Short Questions:

(i)

For sphere:

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

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

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

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

$$K.E_{rotational} = \frac{2}{10} mr^2\omega^2$$

$\therefore r^2\omega^2 = v^2$

$$K.E_{rotational} = \frac{1}{5} mv^2$$

$$K.E_{total} = K.E_{linear} + K.E_{rotational}$$

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

$$= \frac{5mv^2 + 2mv^2}{10}$$

$K.E_{total} = \frac{7mv^2}{10}$

According to the law of angular momentum

P.E at the top = K.E total at the bottom

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

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

$$10gh = 7v^2$$

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

Taking square root on both sides

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

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

(ii)

Criticil velocity = $7.9 kms^{-1}$ prove this

$$F_c = W$$

$$\frac{mv^2}{R} = mg$$

$$\frac{v^2}{R} = g$$

$$v^2 = Rg$$

$$v = \sqrt{Rg}$$

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

$$v = 7919.5 ms^{-1}$$

$$v = 7.915 ms^{-1}$$

$\therefore R = 6.4 \times 10^6 m$

$\therefore g = 9.8$

Find the hieght of geostationary

$\therefore r = R + h$

$r - R = h$

$h = r - R$ ——— (i)

$\therefore r = 4.23 \times 10^{7} m$

$\therefore R = 6.4 \times 10^{6}$

Put the values in (i)

$h = 4.23 \times 10^{6} m - 6.4 \times 10^{6}$

$h = 35900 km$

$h = 36000 km$

(vii)

Given data:

$R = 1.74 \times 10^{6} m$

$r = s = 3.85 \times 10^{8} m$

Find:

$\frac{L_s}{L_o} = ?$

Solve:

$I_s = \frac{2}{5} mR^2$

$I_o = mr^2$

$\therefore \frac{L_s}{L_o} = \frac{I_s}{I_o}$

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

$= \frac{2}{5} \frac{R^2}{r^2}$

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

(vi)

Given data:

$r = 2.50m$ $3.8 \times 10^{8} m$

$\theta = ?$

$s = 2.50m$

To find:

$\theta = ?$

$\therefore s = r\theta$

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

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

$\theta = 6.6 \times 10^{-9} rad$

(iv)

Given data:

$v = 1.01 km s^{-1}$

$r_o = 390400 km$

$T = ?$

Solve:

$S = 2\pi r$

$t = T$

$v = \frac{S}{t} = \frac{2\pi r}{T}$

So $v = \frac{2\pi r}{T}$

$T = \frac{2\pi r}{v}$

$T = \frac{2\pi (390400)}{1.01}$

$T = 22299 s.$

$t = \frac{229936}{86400}$

$t = 25.81 days$

(iii)

When lift is moving upward with acceleratio that is g

$T - W =$ net force

$T = W +$ net force

$T = mg + mg$

$T = 2mg$

$\therefore mg = W$

$T = 2W$