SUBJECTIVE TYPE

PART-I

SHORT ANSWERS

Q.NO.1

SPEED OF SPHERE

Speed of sphere is $\sqrt{\frac{10gh}{7}}$

Proof

Linear ~~Rotational~~ kinetic energy $= \frac{1}{2}mv^2$ ——— (i)

Rotational kinetic energy $= \frac{1}{2}I\omega^2$ ——— (ii)

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

putting value of I in eq (ii)

$$\frac{1}{2}\left(\frac{2}{5}mr^2\right)\omega^2$$

$$\frac{1}{5}mr^2\omega^2 \qquad \because v = r\omega$$

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

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

Total kinetic energy $=$ K.E$_{linear}$ + K.E$_{rot}$

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

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

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

According to law of conservation of angular momentum

P.E at top = K.E at bottom

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

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

$\frac{10gh}{7} = v^2$ Taking square root on b.s

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

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

Q.NO.2
CRICTICAL VELOCITY

The minimum velocity which is required to set any satellite in orbit is called critical velocity Critical velocity is $7.9 kms^{-1}$

Proof

$\therefore$ orbital velocity $= \sqrt{\frac{GM}{r}}$

$\therefore$ orbital velocity $= \sqrt{gr}$

$= \sqrt{(9.8)(6.4\times10^6)}$

$= \sqrt{9.8\times6.4\times10^6}$

$= 7.9 \, kms^{-1}$

NUMERICAL

GIVEN:

$v = 1.01 \text{ kms}^{-1}$

$r = 390400 \text{ km}$

TO FIND:

$T = ?$

Solution

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

$$T = \frac{2(3.14)(390400)}{(1.01)}$$

$T = 2427437$ sec

converting sec into days

$$\frac{2427437}{60 \times 60 \times 24}$$

$= 28$ days

Q.NO.3

~~GEOSTATIONARY SATE~~ HEIGHT OF SATELLITE

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

but $r = R - h$

$h = r + R$

$$h = \left[\frac{GMT^2}{4\pi^2}\right]^{1/3} + 6400$$

Putting the value we get

64000

Q.NO.3

WEIGHT IN LIFT

Condition:

Body is moving upward

$a = g$.

$T - w$ = net force

$T - w = ma$

$T - w = mg$ $\quad \because g = a$

$T = w + mg$ $\quad \because mg = w$

$T = w + w$

$T = 2w$

hence, weight is $2w$

Q.NO.6

NUMERICAL

GIVEN:

Diameter = length of arc $= 2.50m$

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

To Find:

- Distance $= r = ?$

Solution:

$$S = r\theta$$

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

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

$$r = 3.787 \times 10^{8} m$$

Q.NO.7

NUMERICAL

GIVEN:

$r = 3.85 \times 10^8 m$

$R = 1.74 \times 10^6 m$

$\frac{L_o}{L_s}$

$\therefore L_s = I\omega$

$\because I = \frac{2}{5}mR^2$

$L_o = Mr^2\omega$

$\frac{L_o}{L_s} = \frac{2Mr^2\omega}{5MR^2\omega}$

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

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

$\frac{L_o}{L_s} = \frac{2(1.48225 \times 10^{17})}{5(3.0276 \times 10^{12})}$

$\frac{L_o}{L_s} = \frac{2.9645 \times 10^{17}}{1.5138 \times 10^{13}}$

$\frac{L_o}{L_s} = 1.9583 \times 10^4$