9 14 19
10 15 20

# SUBJECTIVE TYPE

## PART-I

## SHORT ANSWERS

## Q.NO.1

## SPEED OF SPHERE

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

<u>Proof</u>

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

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

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

putting value of $I$ in eq (2)

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

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

$\because v = r\omega$

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

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

Total kinetic energy $= K.E_{linear} + K.E_{Rot}$

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

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

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

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 an satellite in orbit is called critical velocity
Critical velocity is $7.9 kms^{-1}$

Proof

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

$$\text{orbital velocity} = \sqrt{gR}$$

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

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

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

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 $=\theta = 6.6\times10^{-9}rad$

**To Find:**

- Distance $=r=?$

**Solution:**

$$S=r\theta$$

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

$$\frac{2.50}{6.6\times10^{-9}}=r$$

$$r=3.787\times10^{8}m$$

# NUMERICAL

**GIVEN:**

$v = 1.01 kms^{-1}$

$r = 390400 km$

**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

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

$$\boxed{= 28 \text{ days}}$$

## Q.NO.3

~~GEOSTATIONARY SATE~~

## HEIGHT OF SATELLITE

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

bcz $r = R - h$

$$h = r + R$$

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

Putting the value we get

64000

# Q.NO.7

## NUMERICAL

**GIVEN.**

$r = 3.85 \times 10^8 m$

$R = 1.74 \times 10^6 m$

$\frac{L_o}{L_s}$

$\because L_s = I\omega$

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

$L_o = Mr^2\omega$

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

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

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

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

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

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