Q=21] Derive the exp. for tension (T) and acc. (a) produced in string in connected motion.

Ans- Let us consider two masses m_1 and m_2 connected with a string having ~~mass~~ Tension (T) over a pulley. let $m_2 > m_1$ then acc. of mass m_1 in upward direct. while acc. of m_2 is in downward.

$m_1 a = T - m_1 g$ — (1)

$m_2 a = m_2 g - T$ — (2)

Add (1) and (2)

$m_1 a + m_2 a = T - m_1 g + m_2 g - T$

$(m_1 + m_2) a = m_2 g - m_1 g$

$a = \frac{(m_2 - m_1) g}{m_1 + m_2}$

Divide eq^n (1) by (2)

$\frac{m_1 a}{m_2 a} \times \frac{T - m_1 g}{m_2 g - T}$

$m_1 m_2 a g - m a_1 T = m_2 a T - m_1 m_2 a g$

$2 m_1 m_2 a g = a T (m_1 + m_2)$

$T = \frac{2 m_1 m_2 g}{m_1 + m_2}$

✓ Good

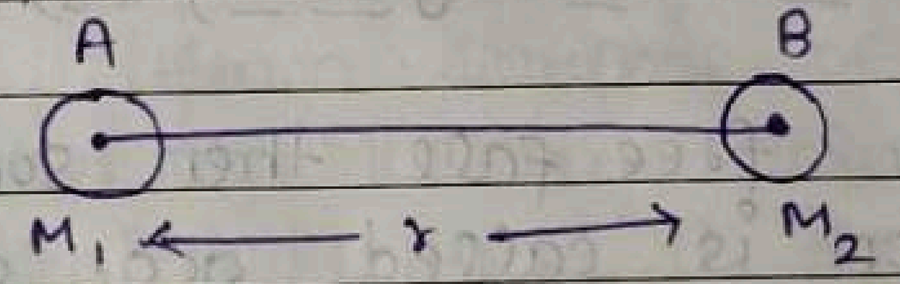
30/9/23

-:[Unit ~ 6 Gravitation]:-

* Gravitational force :
It is the attractive force which come in any two bodies due to their masses is called gravitational force.

* Newton's law of gravitation :
Acc. to this law gravitational force b/w two mass bodies is directly prop. to product of their masses and inversly prop. to square of distance b/w their centres.

Explanation →



Let us consider two bodies A and B having Mass M_1 and M_2 respect. 'r' be the dist. b/w their centres. Then acc. due to gravitational law of force is

i) Directly prop. to product of their masses i.e
$f \propto m_1 m_2$ — (1)

ii) Inversly prop. to square of distance b/w their centres i.e
$f \propto \frac{1}{r^2}$ — (2) -: $G = 6.67 \times 10^{-11} Nm^2/Kg^2$:-

From (1) and (2)

$f = \frac{G m_1 m_2}{r^2}$

Where G is Gravitational constant ↑

$G = \frac{F r^2}{m_1 m_2}$

$= \frac{MLT^{-2} \times L^2}{[M][M]}$

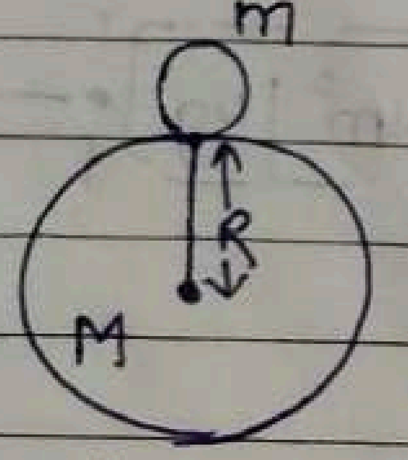
$G = [M^{-1} L^3 T^{-2}]$

* Newton's gravitation law obey Newton 3rd law of motion i.e......

$\vec{F}_{AB} = -\vec{F}_{BA}$

* **Acceleration due to gravity (g):** When an object moves under free fall then some acc. produced in it's motion is called acc. due to gravity. It is denoted (g).
It is vector quantity.
It's value is $9.8\ ms^{-2}$ at the surface of earth
It's value changes as we move from surface of earth.

* **Relation b/w G and g:**



consider a body of mass 'm' placed at surface of earth having mass 'M' and radius 'R'

Then weight of body :-

Gravitational force ⇒ $f = \frac{GMm}{R^2}$ — ii)

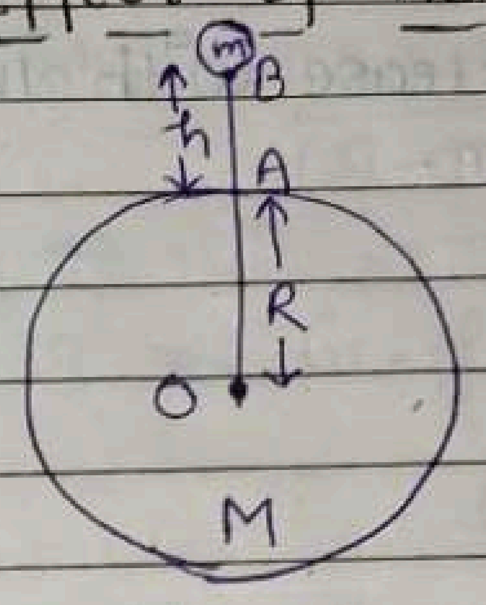
Weight of body :-
$f = mg$ —①

Equating of ① and ⓘⓘ

$\cancel{m}g = \frac{GM\cancel{m}}{R^2}$

$\boxed{g = \frac{GM}{R^2}}$

* **Effect of height on 'g'** –



consider earth as a sphere of radius 'R' and Mass 'M'
Let an object of mass 'm' is placed on point 'B' at height 'h' from surface of earth.

Let 'g' and 'g'' be the value of acc. due to gravity at point A and B respectively.

Then, as we know :-

At point A

$g = \frac{GM}{R^2}$ — i)

At point B

$g' = \frac{GM}{(R+h)^2}$ — 2)

Divide eqⁿ <2> by <1>

$\frac{g'}{g} = \frac{\frac{GM}{(R+h)^2}}{\frac{GM}{R^2}}$

$\frac{g'}{g} = \frac{GM \times R^2}{(R+h)^2 \times GM}$

$\frac{g'}{g} = \frac{R^2}{R^2(1+\frac{h}{R})^2}$

$\frac{g'}{g} = (1+\frac{h}{R})^{-2}$

$g' = g(1+\frac{h}{R})^{-2}$

Using binomial th^m

$$\left[g' = g\left(1 - \frac{2h}{R}\right)\right]$$

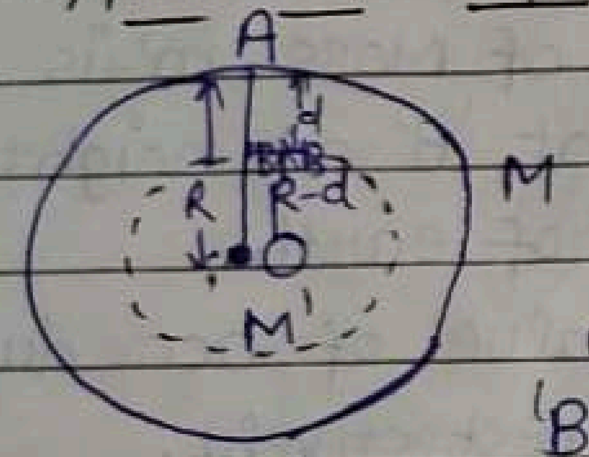
or,

$$g' = g - g\frac{2h}{R}$$

$$\boxed{g' < g}$$

Thus, acc. due to gravity decrease with increase in height from earth's surface.

* Effect of depth on 'g':



Consider earth as a sphere of mass 'M' and Radius 'R' let 'B' be any point at a depth 'd' below surface of earth. g and g' be the value of acc. due to g at point A and B resp.

'ρ' be the density of earth

$$\rho = \frac{M}{V} = \frac{M}{\frac{4}{3}\pi R^3}$$

$$M = \rho \frac{4}{3}\pi R^3 \quad \text{—(i)}$$

At point A

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

from eq^n (i)

$$g = \frac{G \cdot \rho \cdot \frac{4}{3}\pi R^3}{R^2}$$

$$g = \frac{4}{3}\pi G \rho R \quad \text{— ii)}$$

M be the mass of sphere having radius 'R-d'

$$M' = \rho \frac{4}{3}\pi (R-d)^3$$

At point B

$$g' = \frac{GM'}{(R-d)^2}$$

$$g' = \frac{G \cdot \rho \cdot \frac{4}{3}\pi (R-d)^3}{(R-d)^2}$$

$$g' = \frac{4}{3}\pi G \rho (R-d) \quad \text{— iii)}$$

Divide eq^n iii) by ii)

$$\frac{g'}{g} = \frac{\cancel{4/3 \pi G}\, \rho (R-d)}{\cancel{4/3 \pi G}\, \rho (R)}$$

$$\frac{g'}{g} = \frac{R-d}{R}$$

$$\frac{g'}{g} = \frac{\cancel{R}}{\cancel{R}} - \frac{d}{R}$$

$$\frac{g'}{g} = 1 - \frac{d}{R}$$

$$g' = g\left(1 - \frac{d}{R}\right)$$

as, $\boxed{g' < g}$

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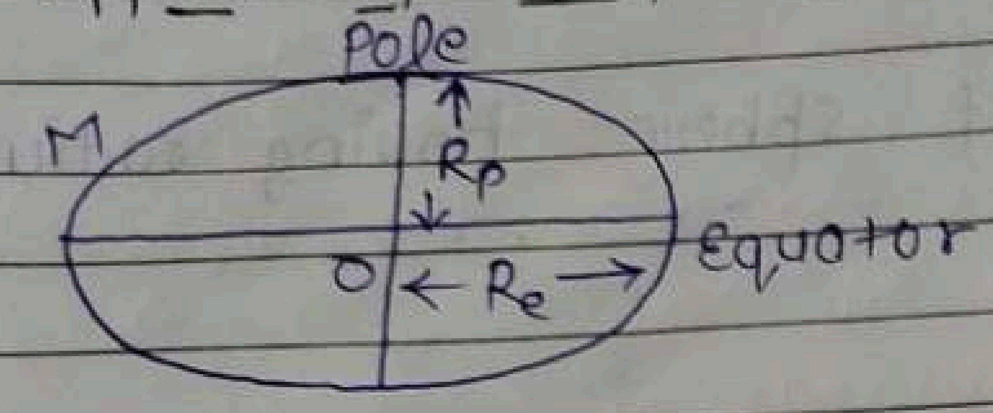
* Effect of Shape of earth on 'g':



consider earth as an ellipse of Mass'M'
R_p and R_e be the radius of pole and equator line.
g_p and g_e be the value of acc. due to g on pole and equator respec.
As we know,

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

M

$$g \propto \frac{1}{R^2}$$

as, $\Rightarrow R_e > R_p$

So, $g_e < g_p$
Thus value of acc. due to g will be maximum at pole.

* Gravitational field:
The space around a body in which gravitational force due to that body can be felt/expesinced is called gravitational field of that body.

* Intensity of Gravitational field:
The strength of gravitation field is called intensity of gravitational field.

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It is denoted by I. It is a vector quantity

$$\vec{I} = \frac{\vec{F}}{m}$$

where 'M' is mass of test body
as, $\vec{F} = \frac{GMm}{r^2}$
where m is mass of body

$$\vec{I} = \frac{\frac{GM\cancel{m}}{r^2}}{\cancel{m}}$$

$$\vec{I} = \frac{GM}{r^2}$$

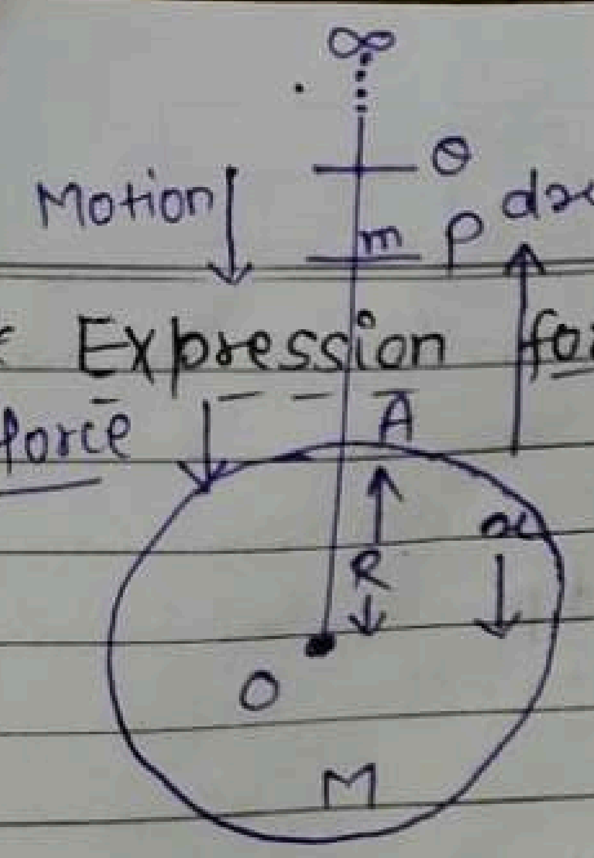
S.I unit = Nkg^{-1}
It's direction is similar to the direction of gravitational force.
Dimensional formula of $I = \frac{M^1L^1T^{-2}}{M} \Rightarrow [M^0L^1T^{-2}]$

* Gravitational potential:
It may be defined as the amount of workdone in bringing a unit mass from infinite to a point against the gravitation force of earth. It is denoted by 'V'.

$$\left[V = \frac{W}{M}\right]$$

Where V is equal to gravitational potential
W = workdone
m = unit mass
S.I unit is Jkg^{-1}
Dimensional formula = $\frac{[M^1L^2T^{-2}]}{[M]} \Rightarrow [M^0L^2T^{-2}]$

It is a scalar quantity.



* Expression for gravitational potential at a point:

Consider earth as a sphere of mass 'M' and Radius 'R' let 'm' be the unit mass moving from infinite to a point 'P'. 'x' be the dist. of P from centre of earth.

let $PQ = dx$ be the small displacement then, work done will be also small 'dW' be the small work done.

'F' be the gravitational force

$dW = \vec{F} \cdot dx \quad \because Fdx\cos\theta$

$= Fdx\cos\theta$

$dW = Fdx$

using newton's gravitational law

$F = \frac{GmM}{x^2}$

$dW = \frac{GMm \cdot dx}{x^2}$

for total work done

$W = \int dW = \int_{\infty}^{R} \frac{GMm \cdot dx}{x^2}$

$GMm \int_{\infty}^{R} x^{-2} dx$

$W = GMm \left[\frac{x^{-2+1}}{-2+1}\right]_{\infty}^{R}$

$W = GMm \left[\frac{x^{-1}}{-1}\right]_{\infty}^{R}$

$= GMm \left[\frac{-1}{x}\right]_{\infty}^{R}$

$W = GMm \left[-\frac{1}{R} + \frac{1}{\infty}\right]$

$W = \frac{-GMm}{R}$

let V be the gravitational potential

$V = \frac{W}{m}$

$V = -\frac{GM\cancel{m}}{R \cancel{m}}$

$$\boxed{V = -\frac{GM}{R}}$$

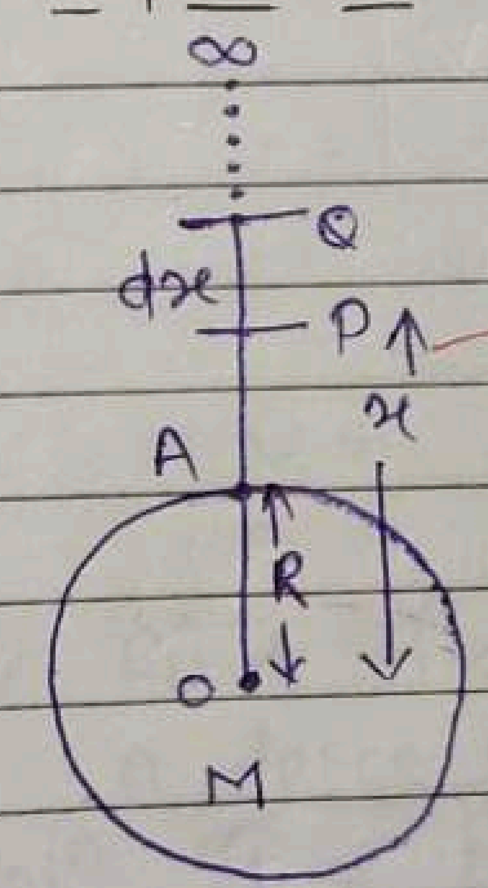
* Gravitational potential Energy:

Gravitational P.E may be defined as the amount of workdone in bringing a body from infinite to a point in the field of another body.

S.I unit is Joule while C.G.S unit is erg

Dimensional formula = $[ML^2T^{-2}]$

* Expression for Gravitational potential energy?



Consider earth as a sphere of Mass 'M' and radius 'R'. A body of mass 'm' is bringing from infinite to a point against gravitational force of earth.

Let $PQ = dx$ be small displacement then dW be the small work done

Taking cube root both side

$$\left(\frac{GM\cdot T^2}{4\pi^2}\right)^{1/3} = R+h$$

$$h = \left(\frac{GM\cdot T^2}{4\pi^2}\right)^{1/3} - R$$

In terms of 'g'

$$GM = gR^2$$

$$h = \left(\frac{gR^2\cdot T^2}{4\pi^2}\right) - R$$

* Angular mom. of Satellite :

let $\vec{L}$ be the angular mom. of satellite

$$L = mv_0\cdot r \quad \text{— i)}$$

as,

$$v_0 = \frac{\sqrt{GM}}{r}$$

Put this value in eq^n 1st

$$L = m\frac{\sqrt{GM\cdot r}}{r}$$

$$\boxed{L = m\sqrt{GM\cdot r}}$$

let $r = R+h$

$$\boxed{L = m\sqrt{GM(R+h)}}$$

* Energy of Satellite :

Energy of satellite is equal to sum of it's K.E and gravitational P.E.

$$E = K.E + P.E \quad \text{— (1)}$$

$$K.E = \frac{1}{2}mv_0^2$$

$$= v_0 = \frac{\sqrt{GM}}{R+h}$$

$$K.E = \frac{1}{2}m\left(\frac{\sqrt{GM}}{R+h}\right)^2$$

$$K.E = \frac{GMm}{2(R+h)}$$

as, gravitational p.e is given by

$$P.E = -\frac{GMm}{(R+h)}$$

Put value in eq^n (i)

$$E = \frac{GMm}{2(R+h)} - \frac{GMm}{R+h}$$

$$E = \frac{GMm - 2GMm}{2(R+h)}$$

$$\boxed{E = -\frac{GMm}{2(R+h)}} \qquad \boxed{E = -K.E}$$

$$\boxed{P.E = 2T.E}$$

* Binding Energy of Satellite :

The energy required to remove a satellite from its orbit is called binding energy of satellite.

Binding Energy = − T. Energy

$$B.E = -T.E$$

Total energy is given by:

$$E = \frac{-GMm}{2(R+h)}$$

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*** Special case:** When satellite is very close to earth's surface then $R >> h$, h will be neglected then,

$$V_o = \sqrt{\frac{GM}{R}} \quad \text{— (i)}$$

Here, $G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

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

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

$$\boxed{V_o \approx 7.92\ kms^{-1}}$$

In terms of acc. due to gravity

as, $g = \frac{GM}{R^2}$

$GM = gR^2$

put this value in eq^n i)

$$V_o = \sqrt{\frac{gR^{\cancel{2}}}{\cancel{R}}}$$

$$\boxed{V_o = \sqrt{gR}}$$

where, $g = 9.8\ ms^{-2}$

*** Time period of satellite:** It is the time taken by satellite to complete one revolution around earth. It is denoted by 'T'.

As, we know

$$\text{velocity} = \frac{\text{Dist.}}{\text{Time}}$$

$$V_o = \frac{2\pi(R+h)}{T} \quad \text{— (1)}$$

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Where 'V_o' is called orbital velocity

$$V_o = \sqrt{\frac{GM}{R+h}}$$

Put value in eq^n i)

$$\sqrt{\frac{GM}{R+h}} = \frac{2\pi(R+h)}{T}$$

$$T = 2\pi(R+h)\sqrt{\frac{R+h}{GM}}$$

$$T = 2\pi\sqrt{\frac{(R+h)^3}{GM}}$$

*** Special case:** When satellite is very close to earth surface then, $R >> h$, h will be neglected.

$$T = 2\pi\sqrt{\frac{R^3}{GM}}$$

In terms of 'g'

$GM = gR^2$

$$T = 2\pi\sqrt{\frac{R^{\cancel{3}}}{g\cancel{R^2}}}$$

$$T = 2\pi\sqrt{R/g}$$

*** Height of satellite:** As time period of satellite is given by

$$T = 2\pi\sqrt{\frac{(R+h)^3}{GM}}$$

Squaring both side

$$T^2 = \frac{4\pi^2 (R+h)^3}{GM}$$

$$\frac{T^2 GM}{4\pi^2} = (R+h)^3$$

* The Gravitational field intensity at a point 20,000 km from centre of earth is 2.4 N/kg. Calculate the G.P at that point.

Soln $I = \frac{F}{m} = \frac{\frac{GMm}{r^2}}{m} = \frac{GM}{r^2}$

or, $V = -\frac{GM}{r} \Rightarrow \frac{V}{I} = \frac{-\frac{GM}{r}}{\frac{GM}{r^2}} = \frac{-r^2}{r} = -r$

$\boxed{-I \cdot r = V}$

$= -2.4 \times 20 \times 10^6$
$= -48 \times 10^6 \ J/kg$

* Satellite:

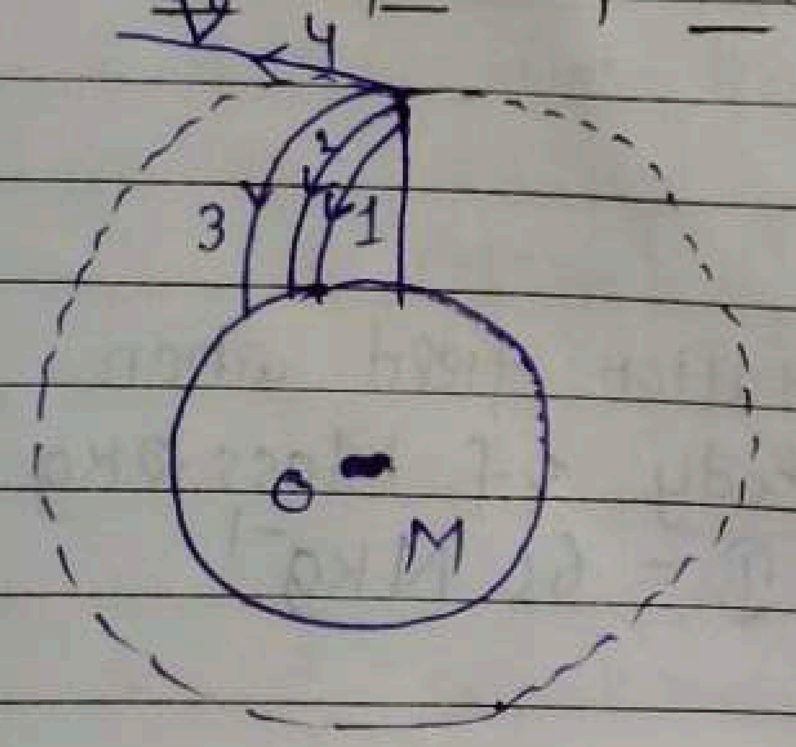
Satellite is body which is revolving continuosly in an orbit around a comparatively much larger body. For ex: Moon is a satellite of earth.

There are two types of satellite -

1) Natural Satellite And ii) Artificial Satellite

Moon is a natural satellite of earth. Arybhatta is a artificial Satellite.

* Principle of launching a satellite:

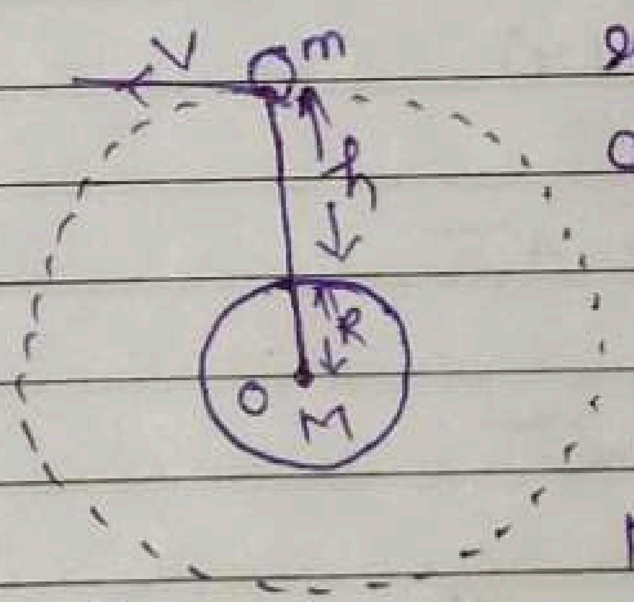


Consider a very high tower on the surface of earth whose height is more than height of earth atmosphere. Let a body is given some horizontal velocity from the top of tower. The body will follow a parabolic path due to gravity and hit earth surface following path 1st. But if we go increasing horizontal velocity the body will follow path 2, 3, 4. Finally body will start revolving around the earth.

There are two necessary conditions to launch a satellite:

i) First take the satellite to a height then give a suitable horizontal velocity.

* Orbital velocity of Satellite:



The minimum velocity required to put satellite into it's orbit around earth is called orbital velocity of satellite. It is denoted by V_0.

Consider earth as a sphere of Mass M and Radius R. A satellite of mass 'm' is placed at a height 'h' from earth's surface. 'V_0' be the orbital velocity of satellite. Centripetal force and gravitational force act on satellite.

Centripetal force = Gravitational force

$\frac{mv_0^2}{R+h} = \frac{GMm}{(R+h)^2}$

$mv_0^2 = \frac{GMm}{R+h} \Rightarrow V_0^2 = \sqrt{\frac{GM}{R+h}}$

$dW = \vec{F}\cdot dx$

$dW = F\,dx\cos\theta$

$dW = F\,dx$

using Gravitional law;

$F = \frac{GMm}{x^2}$

$dW = \frac{GMm \cdot dx}{x^2}$

Total work done will be

$W = \int dW = \int_{\infty}^{R} \frac{GMm \cdot dx}{x^2}$

$W = GMm \int_{\infty}^{R} \frac{1}{x^2}\, dx$

$= GMm \int_{\infty}^{R} x^{-2}\, dx$

$= GMm \left[\frac{x^{-2+1}}{-2+1}\right]_{\infty}^{R}$

$= GMm \left[\frac{x^{-1}}{-1}\right]_{\infty}^{R}$

$W = GMm \left[\frac{-1}{x}\right]_{\infty}^{R}$

$= GMm \left[-\frac{1}{R} + \frac{1}{\infty}\right]$

$= GMm\left[\frac{-1}{R} - 0\right]$

$W = -\frac{GMm}{R}$

as Workdone = Gravitational P.E

$W = V$

$$\boxed{V = -\frac{GMm}{R}}$$

* Find the G.P.E b/w two masses of 2kg and 50kg placed 10m apart

Soln- $G = 6.67 \times 10^{-11}\ kg^2/Nm^2$ As, $V = -\frac{GMm}{R}$

$m = 2\ kg$

$M = 50\ kg$

$R = 10\ m$

$U = \frac{6.67 \times 10^{-11} \times 50 \times 2}{10}$

$= -6.67 \times 10^{-10}\ J$

* What is the value of G.P on surface of earth

Soln $V = -\frac{GM}{R}$

$G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

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

$R = 6400\ km,\ 6.4 \times 10^{6}\ m$

$V = \frac{-6.67 \times 10^{-11} \times 6 \times 10^{24} \times 10}{6.4 \times 10^{6}}$

$V = -6.25 \times 10^{7}\ J\,kg^{-1}$

* Find the intensity of Gravitation field when a force of 120N act on a body of Mass 2kg

Soln $I = \frac{F}{M} \Rightarrow \frac{\cancel{120}\ 60}{\cancel{2}}$ $I = 60\ N\,kg^{-1}$

5) An artificial satellite revolve in orbit at a height of 1000Km find its orbital velocity?

Soln

$$V_0 = \sqrt{\frac{GM}{R+h}}$$

$G = 6.67 \times 10^{-11} Nm^2/kg^2$

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

$R = 6.4 \times 10^6 m$

$H = 10^6 m$

$$V_0 = \sqrt{\frac{6.67 \times 10^{-11} \times 6 \times 10^{24}}{(6.4 \times 10^6 + 10^6)}}$$

$$V_0 = \frac{6.67 \times 10^{-11} \times 6 \times 10^{24}}{10^6(6.4+1)}$$

$$= 7.4 \times 10^6$$

$$= \frac{6.67 \times 10^{-11} \times 6 \times 10^{24}}{7.4 \times 10^6}$$

$$= \frac{6.67 \times 6 \times 10^7 \times 10}{\cancel{7.4} \times 100}$$

$$= \frac{667 \times \cancel{6}^{3} \times 10^6}{\cancel{74}_{37}} \Rightarrow 7353 m/s$$

* A geostationary satellite of 500kg is revolving around earth at height of $3.6 \times 10^6 m$ find
i) K.E ii) P.E iii) Total E. iv) Binding E.

Soln Here, $r = R+h = 6.4 \times 10^6 + 3.6 \times 10^6 = 10^7 m$.

$$V_0 = \sqrt{\frac{GM}{(R+h)}} = \sqrt{\frac{6.67 \times 10^{-11} \times 6 \times 10^{24}}{10^7}}$$

$$= \sqrt{6.67 \times 10^6 \times 6} \; ms^{-1}$$

i) $K.E = \frac{1}{2} m v_e^2$

$$= \frac{1}{2} \times 500 \times 6.67 \times 10^6 = 10^{10} J$$

$$P.E = -\frac{GMm}{R+h}$$

$$- \frac{6.67 \times 10^{-11} \times (6 \times 10^{24}) \times 500}{10^7}$$

$$= -2 \times 10^{10} J$$

$T.E = K.E + P.E = 10^{10} - 2 \times 10^{10} = -10^{10}$ Joule.

Good

19/10/23

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***Weightlessness -**

It is a situation where effective weight of a body becomes zero.

i) At the centre of earth -

The value of acc. due to gravity at the centre of earth is zero

As,

$$W = mg$$

Where, $g = 0$

So, $\boxed{W=0}$ is called Weightless.

2) In freelyfalling lift:

$$W = mg$$

Where, $g = 0$

So, $\boxed{W=0}$ called Weightless.

3) When the body is taken at null points:

Null points are the points where gravitational forces due to diff. masses cancel out.

There will be no gravity. So, It is called weightless condition.

* If K.E of Satellite is $8.7 \times 10^9 J$ What will be P.E and total energy of Satellite.

Soln $E = -K.E$

$= -8.7 \times 10^9 J$

Potential energy $= 2E$

$= -2 \times 8.7 \times 10^9$

$= -17.4 \times 10^9 J$

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2) A Satellite revolving in an orbit has energy $-17.4 \times 10^9 J$ what will be the binding energy

Soln $B.E = -E$

$= -(-17.4 \times 10^9 J)$

$= 17.4 \times 10^9 J$

3) find or What is relation b/w escape and orbital velocity of a satellite orbiting near earth's surface.

Soln $V_o = \sqrt{gr}$

$V_e = \sqrt{2gr}$

$$\frac{V_o}{V_e} = \frac{\sqrt{gR}}{\sqrt{2gR}}$$

$$\frac{V_o}{V_e} = \frac{1}{\sqrt{2}}$$

$$\boxed{V_e = \sqrt{2}\, V_o}$$

4) find the G.P.E b/w 2 masses of 2kg and 50kg placed 10m apart.

Soln $P.E = -\frac{GMm}{r}$

$G = 6.67 \times 10^{-11} Nm^2/kg$

$M_1 = 2kg$

$M_2 = 50kg$

$r = 10m$

$$= -\frac{6.67 \times 10^{-11} \times 2 \times 50}{10}$$

$= -6.67 \times 10^{-10} J$

$$W = GMm\left[\frac{x^{-2+1}}{-2+1}\right]_R^{\infty}$$

$$W = GMm\left[\frac{x^{-1}}{-1}\right]_R^{\infty}$$

$$= GMm\left[\frac{-1}{x}\right]_R^{\infty}$$

$$W = GMm\left[\frac{-1}{\infty} - \left(\frac{-1}{R}\right)\right]$$

$$W = GMm\left[0 + \frac{1}{R}\right]$$

$$W = \frac{GMm}{R} \quad -(2)$$

Then, K.E of obj. will be

$$K.E = W$$

$$\frac{1}{2}\cancel{m}v_e^2 = \frac{GM\cancel{m}}{R}$$

$$v_e^2 = \frac{2GM}{R}$$

$$v_e = \sqrt{\frac{2GM}{R}} \qquad \text{as, } GM = gR^2$$

$$v_e = \sqrt{\frac{2gR^{\cancel{2}}}{\cancel{R}}}$$

$$v_e = \sqrt{2gR}$$

$$\boxed{v_e = 11.2\ kms^{-1}}$$

$$\frac{v_o}{v_e} = \frac{\sqrt{\frac{GM}{R}}}{\sqrt{\frac{2GM}{R}}}$$

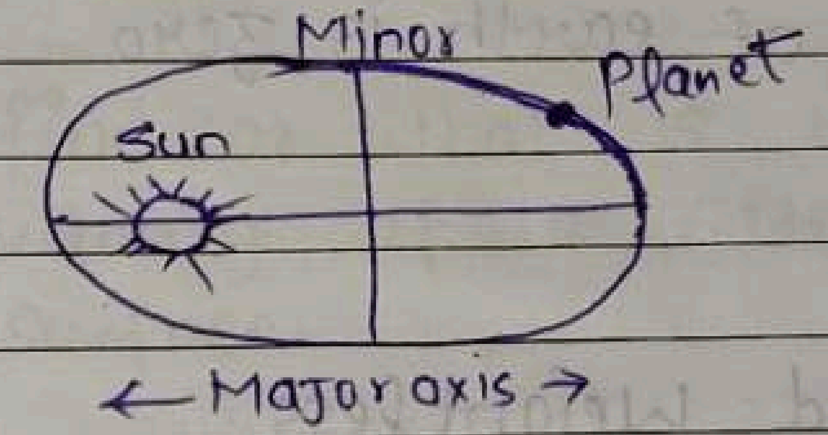
$$\frac{v_o}{v_e} = \frac{1}{\sqrt{2}}$$

$$\boxed{v_e = \sqrt{2}\,v_o}$$

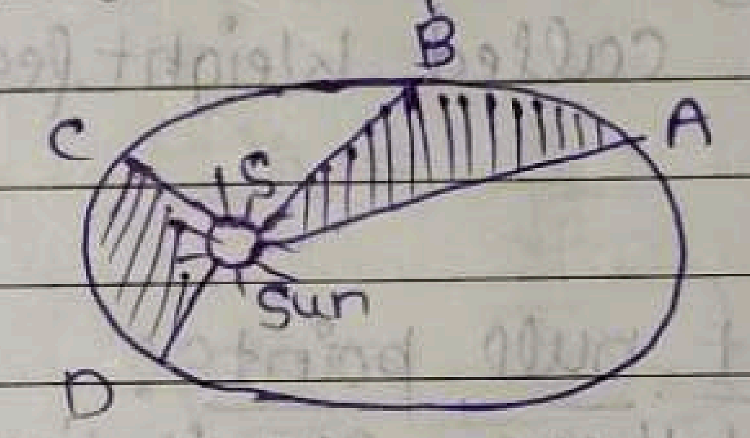
imp...

* Kepler's Laws:

i) I^{st} law: According to this law, every planet revolve around sun in an elliptical orbit, this is also called law of orbit



2) 2^{nd} law: Acc. to this law, the line joining planet and sun sweeps out equal area in equal interval of time. It is also called law of area.



Thus area SAB = area SCD
So, areal velocity of a planet around sun is constant.

3) 3^{rd} law: Acc. to this law, the square of time-period of revolution of planet around sun is directly prop. to cube of length of semi-major axis.

Let 'T' be the time period and R be the length of semi major axis

Then,

$$\boxed{T^2 \propto R^3}$$

36000 km

$B.E = -\left(-\frac{GMm}{2(R+h)}\right)$

$$\boxed{B.E = \frac{GMm}{2(R+h)}}$$

$\boxed{B.E = K.E}$ or $\boxed{B.E = -2 P.E}$

* Geostationary Satellite :

The satellite which appears to be at rest or at a fixed location w.r.t to earth is called Geostationary Satellite.

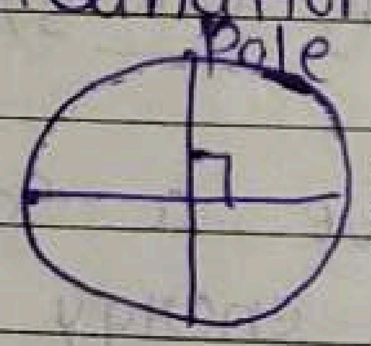
Conditions for geostationary Sattelite:

1) The height of Satellite is nearly 36000 km.
2) Orbital speed of satellite is nearly 3.1 km/sec
3) It's time period is 24 hours.
4) It should rotate in Anticlock wise direction. Such that from west to east.

* Polar Satellite :

The Satellite which revolve in Polar orbits around earth is called polar Satellite. It's angle of inclination should be 90° with equitorial plane.

A polar Satellite will pass over both north and south pole

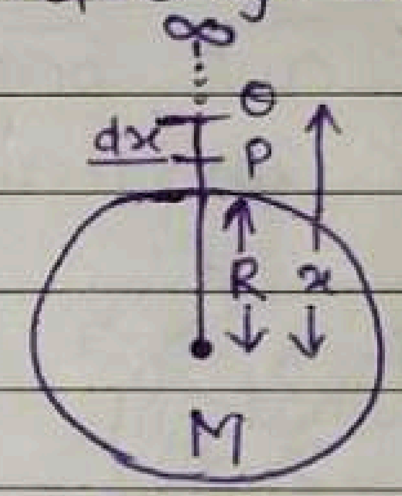


* Uses of Satellite :

i) In weather forcasting
2) In communication radio, T.V, mobile.
3) For getting information about atmosphere of earth.
4) In study of remote sensing.

* Escape Velocity :

The minimum velocity with which a body is thrown upward from the surface of earth so, that it overcome the gravitational field and never return to earth surface is called escape velocity. It is denoted by 'V_e'.



Consider earth as a sphere of mass M and radius 'R'. An obj of mass 'm' is thrown upward with a velocity 'V_e' from earth's surface.

let $PO = dx$ be the small displacement

Then workdone will also small i.e.- dw

$$dw = F.dx \quad -(i)$$

From gravitational law:

$$F = \frac{GMm}{x^2}$$

Put this value in eq^n(i)

$$dW = \frac{GMm.\,dx}{x^2}$$

Total workdone will be

$$W = \int dW = \int_R^\infty \frac{GMm.\,dx}{x^2}$$

$$W = GMm \int_R^\infty \frac{1}{x^2}.\,dx$$

$$W = GMm \int_R^\infty x^{-2}.\,dx$$