Conservation of energy

. Central force F(r) =n F(r) force is conservative

- $\vec{F}(\vec{r}) = \hat{n}F(r)..forcei.$

  $.is..conservative.....we..can..write...$

  $\vec{F}(\vec{r}) = -\vec{\nabla}V(r)...v(r)..is..scalar.....fuction..$

  $curl..of..gradient....of...sclar..po\,\text{int}...is..always..zero..$

  $\vec{\nabla}\times\vec{\nabla}V(r) = 0..\nabla\times\vec{F}(\vec{r}) = 0$

  a

Conservation of Angular Momentum

$\vec{F}(\vec{r}) = \hat{n}F(r)..forcei.$

$.is..conservative.....we..can..write...$

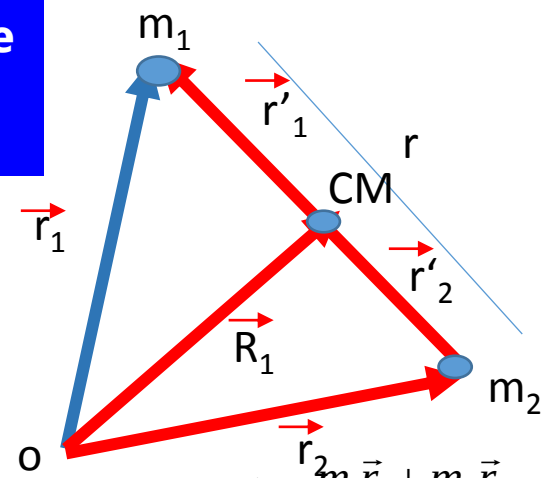
$\vec{F}(\vec{r}) = -\vec{\nabla}V(r)...v(r)..is..scalar.....fuction..$

$curl..of..gradient....of...sclar..po\,\text{int}...is..always..zero..$

$\vec{\nabla}\times\vec{\nabla}V(r) = 0..\nabla\times\vec{F}(\vec{r}) = 0$

a

Reduction of Two-body problem into Equivalent one Body Problem



- Let m_1 and m_2 be the masses of Particle 1 and 2 situated at point A and B. distances of separation between them is 'r'.
- Position vectors of particle 1 and 2 are r_1 and r_2 w.r.t origin O
- The position vector of particle 1 w.r.t particle 2 is r

$$\vec{r}_1 = \vec{r}_2 - \vec{r}$$

$$\therefore \vec{r} = \vec{r}_1 - \vec{r}_2$$

*Eq..of ..motion..of ..particle…1..and..2are..*exp *ressed*

$$m_1 \frac{d^2\vec{r}_1}{dt^2} = -\frac{Gm_1m_2}{r^3}\vec{r} \quad ---(1)$$

$$m_2 \frac{d^2\vec{r}_2}{dt^2} = -\frac{Gm_1m_2}{r^3}\vec{r} \quad ---(2) adding..eq.we..have$$

$$m_1 \frac{d^2\vec{r}_1}{dt^2} + m_2 \frac{d^2\vec{r}_2}{dt^2} = 0 \int \; w.r.to.t.we.get$$

$$m_1 \frac{d\ \vec{r}_1}{dt} + m_2 \frac{d\ \vec{r}_2}{dt} = cons\tan t ----(3)$$

$$m_1v_1 + m_2v_2 = cons\tan t ---(4) where.. \frac{d\ \vec{r}_1}{dt} = v_1 ..and \frac{d\ \vec{r}_2}{dt} = v_2$$

according ..to..law..of ..conservation..of ..linear ..momentum.

$$position..vector..ofC.M\ is..\vec{R} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2} ---(5)$$

we..know..position..vector..of .C.M .is.. $\vec{R} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2}{m_1 + m_2} ---(5)..diff\ ..w.r.t.$

$$\frac{d\vec{R}}{dt} = \frac{m_1\frac{d\vec{r}_1}{dt} + m_2\frac{d\vec{r}_2}{dt}}{m_1 + m_2} = cons\tan t --(6)$$

$$m_1 \frac{d^2\vec{r}_1}{dt^2} = -\frac{Gm_1m_2}{r^3}\vec{r} \quad ---(1) \therefore \frac{d^2\vec{r}_1}{dt^2} = \frac{1}{m_1}\left(-\frac{Gm_1m_2}{r^3}\vec{r}\right) --(7)$$

$$m_2 \frac{d^2\vec{r}_2}{dt^2} = -\frac{Gm_1m_2}{r^3}\vec{r} \quad ---(2). \therefore \frac{d^2\vec{r}_2}{dt^2} = \frac{1}{m_2}\left(-\frac{Gm_1m_2}{r^3}\vec{r}\right) ---(8)$$

sin *ce..sub..these..eq..we..get..*

$$\frac{d^2(\vec{r}_1 - \vec{r}_2)}{dt^2} = \frac{1}{m_1} + \frac{1}{m_2}\left(-\frac{Gm_1m_2}{r^3}\vec{r}\right) ----(9)$$

$$substitution..\vec{r} = (\vec{r}_1 - \vec{r}_2) and .. \frac{1}{\mu} = \frac{1}{m_1} + \frac{1}{m_2} \therefore eq..(9)$$

$$\frac{d^2\vec{r}}{dt^2} = \frac{1}{\mu}\left(-\frac{Gm_1m_2}{r^3}\right)\vec{r}$$

Equation of Orbit

- Consider motion of particle in X-Y plane with center force at the origin 'O'
- 'r' and 'θ' be the plane polar coordinates at a point 'P' let m is mass of particle
- The velo. and acceleration of particle moving along the curve are expressed by

$\vec{a} = (\ddot{r} - r\dot{\theta}^2)\hat{e}_r + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\hat{e}_\theta ---(1)$

$where...\hat{e}_r..is..unit..vector..along..\vec{r}..and..\hat{e}_\theta..is..unit..vector...perpandicular..\vec{r}...at..P$

$but..\vec{F}(\vec{r})..is..along..\vec{r}$

$Eq..of..motion..along..r..and..\theta$

$m(\ddot{r} - r\dot{\theta}^2) = F(r)..--(2)..and..m(r\ddot{\theta} + 2\dot{r}\dot{\theta}) = 0---(3)$

$\times..eq(3)..by..r..we..get..$

$mr^2\ddot{\theta} + 2r\dot{r}\dot{\theta} = 0$

$\therefore \frac{d}{dt}(mr^2\dot{\theta}) = 0..\therefore mr^2\dot{\theta} = cons\tan t..say.L = mr^2\dot{\theta}.$

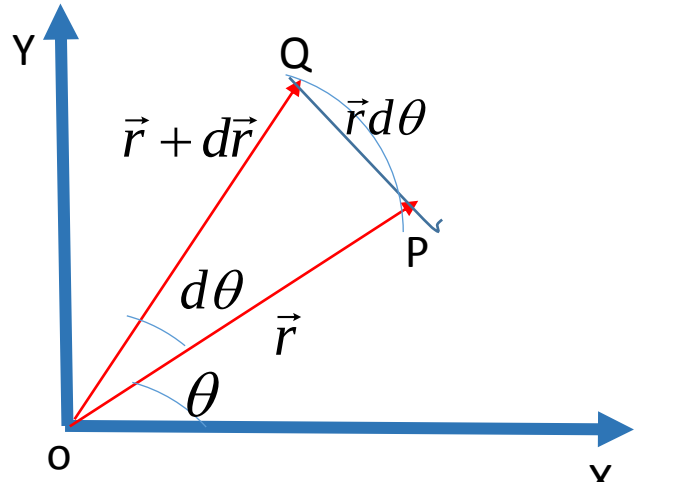
$angular..moment(L) = mr^2\dot{\theta}....(4)$

$in..time..dt..area..dA..swept..by..radius..vector..r.is$

$dA = \frac{1}{2}r.rd\theta = \frac{1}{2}r^2.d\theta$

$\therefore \frac{dA}{dt} = \frac{1}{2}r^2\frac{d\theta}{dt}Or\frac{1}{2}r^2\dot{\theta}$

$\frac{dA}{dt} = \frac{L}{2m} = cons\tan t----(5)$



$\int\frac{1}{r^3} = \int r^{-3}dr = \frac{r^{-3+1}}{-3+1} + C = \frac{r^{-2}}{-2} = \frac{1}{-2}r^{-2} = \frac{1}{-2.r^2}$

$we..know..that...$

$m\ddot{r} - mr\dot{\theta}^2 = F(r)..--(6)$

$\therefore .L = mr^2\dot{\theta}\ \therefore \dot{\theta} = \frac{L}{mr^2}..u\sin g...this..value....in(6)$

$m\ddot{r} - mr(\frac{L^2}{m^2r^4}) = F(r).Or..m\ddot{r} = \frac{L^2}{mr^3} + F(r)---(7).$

$.we..know.F.is..consevative...F = -\frac{dV}{dr}\ \therefore eq..(7)..becomes.$

$m\ddot{r} = \frac{L^2}{mr^3} - \frac{dV}{dr}\ \therefore m\ddot{r} = -\frac{d}{dr}\left(\frac{L^2}{2mr^2} + V\right)----(8)..\times.by..\dot{r}..both..sides.$

$\dot{r}m\ddot{r} = -\frac{d}{dr}\left(\frac{L^2}{2mr^2} + V\right)\dot{r}..Or..\frac{d}{dt}\left(\frac{1}{2}m\dot{r}^2\right) = -\frac{d}{dr}\left(\frac{L^2}{2mr^2} + V\right).\frac{dr}{dt}....$

$\frac{d}{dt}\left(\frac{1}{2}m\dot{r}^2\right) = -\frac{d}{dt}\left(\frac{L^2}{2mr^2} + V\right).Or\frac{d}{dt}\left(\frac{1}{2}m\dot{r}^2 + \frac{L^2}{2mr^2} + V\right) = 0..(9)Or..cons\ ta$

$\neq$

Equation of Orbit..conti.....

we..know..that..Total..Energy..is

$$Total...energy = E = \frac{1}{2}m\dot{r}^2 + \frac{L^2}{2mr^2} + V(r) - - - (10)$$

$$E - V - \frac{L^2}{2mr^2} = \frac{1}{2}m\dot{r}^2 Or \frac{1}{2}m\dot{r}^2 = E - V - \frac{L^2}{2mr^2}$$

$$\dot{r}^2 = \left[\frac{2}{m}\left(E - V(r) - \frac{L^2}{2mr^2}\right)\right] - -(11)$$

$$\dot{r} = \left[\frac{2}{m}\left(E - V(r) - \frac{L^2}{2mr^2}\right)\right]^{\frac{1}{2}} but..\dot{r} = \frac{dr}{dt}$$

$$.\dot{r} = \frac{dr}{dt} = \left[\frac{2}{m}\left(E - V(r) - \frac{L^2}{2mr^2}\right)\right]^{\frac{1}{2}}$$

$$dt = \frac{dr}{\sqrt{\left[\frac{2}{m}\left(E - V(r) - \frac{L^2}{2mr^2}\right)\right]}} ....(12).at..time..t = 0..r..has..initial..value..r_0..\text{int}egrating..we..get$$

$$t = \int_{r_0}^{r} \frac{dr}{\sqrt{\left[\frac{2}{m}\left(E - V(r) - \frac{L^2}{2mr^2}\right)\right]}} - - - (13)$$

$$we..know..that..L = mr^2\dot{\theta}..Or..\dot{\theta} = \frac{L}{mr^2} \therefore d\theta = \frac{L}{mr^2}dt...(14)$$

$$\int with.\theta..to..\theta_0..we..get.. \int_{\theta_0}^{\theta} d\theta = \int_0^t \frac{L}{mr^2(t)}dt...(15) Or..\theta = \frac{L}{mr^2(t)}dt + \theta_0$$

$E\,\text{lim}\,inating\,..dt..between...eq..(14)..and..(15)$

$..polar..eq..r..and\,\theta..obtained...in..\text{int}egrals$

$$\theta = \int \frac{\frac{L^2}{r^2}dr}{\sqrt{\left[\frac{2}{m}\left(E - V(r) - \frac{L^2}{2mr^2}\right)\right]}} + \theta_0 .....(16)$$

General features Equation of Motion

we..know..that..Total..Energy..is

$$Total...energy = E = \frac{1}{2}m\dot{r}^2 + \frac{L^2}{2mr^2} + V(r) - - - (1)$$

$$Effective..P.E...is..defined.as.V'(r) = V(r) + \frac{L^2}{2mr^2} ....(2)$$

$$V(r)..is..actual..P.E..and..\frac{L^2}{2mr^2}..iscentrifigual..energy..for.radial.motion$$

$$and.\frac{1}{2}m\dot{r}^2 is..called...radial..K.E.$$

$$\frac{1}{2}m\dot{r}^2 = E - .V'(r)....(3).$$

diff ..eq..(2)..w.r.to..r..we.get..

$$\frac{dV'(r)}{dr} = \frac{dV(r)}{dr} - \frac{L^2}{2mr^3}$$

$$-\frac{dV'(r)}{dr} = -\frac{dV}{dr} + \frac{L^2}{2mr^3}..but..we..know..that..-\frac{dV}{dr} = F$$

$$F' = F + \frac{L^2}{2mr^3} - - - (4)$$

F'..is..Effective...force..which..composed.of ..central.force..and.centrifugal..force..

General features Equation of Motion

- Consider Eg. Of gravitational force $F=Gm_1m_2/r^2$ if $k=Gm_1m_2$
- $F(r)=-K/r^2$ $\quad Effective..P.E..V' = -\frac{k}{r} + \frac{L^2}{2mr^2}....$
- If we plot graph of V′ against r as shown in fig.
- This Graph shows 2 dotted curves and one continuous line
- dotted curves shows variation of **$L^2/2mr^2$** against **r**
- Second dotted curves shows variation of **$-K/r_2$** against **r**
- It shows that **V′ tent to infinity as r tent to zero**.
- And that **V′ tent to zero as r tent to infinity**.
- V′ is **minimum** at central value of r

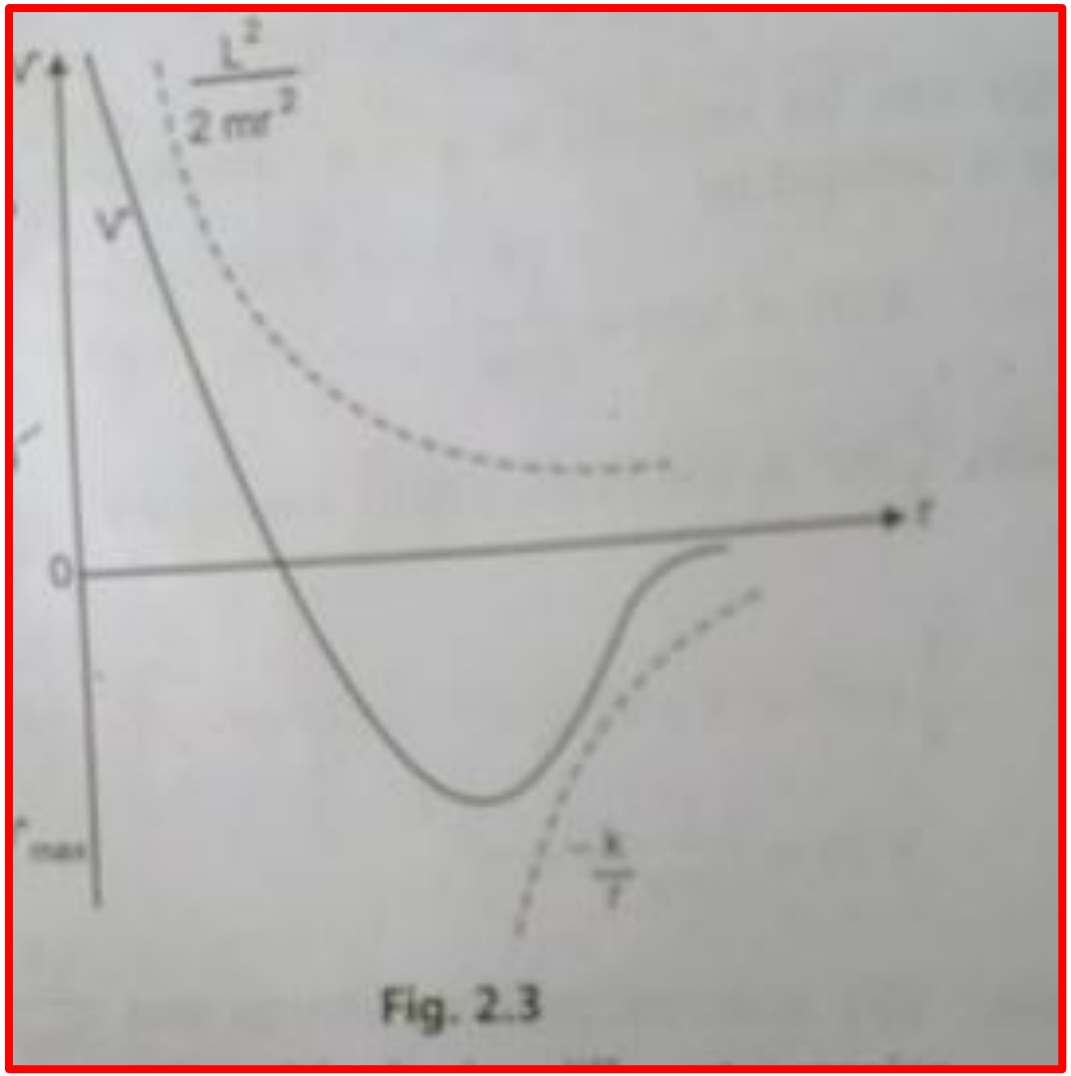
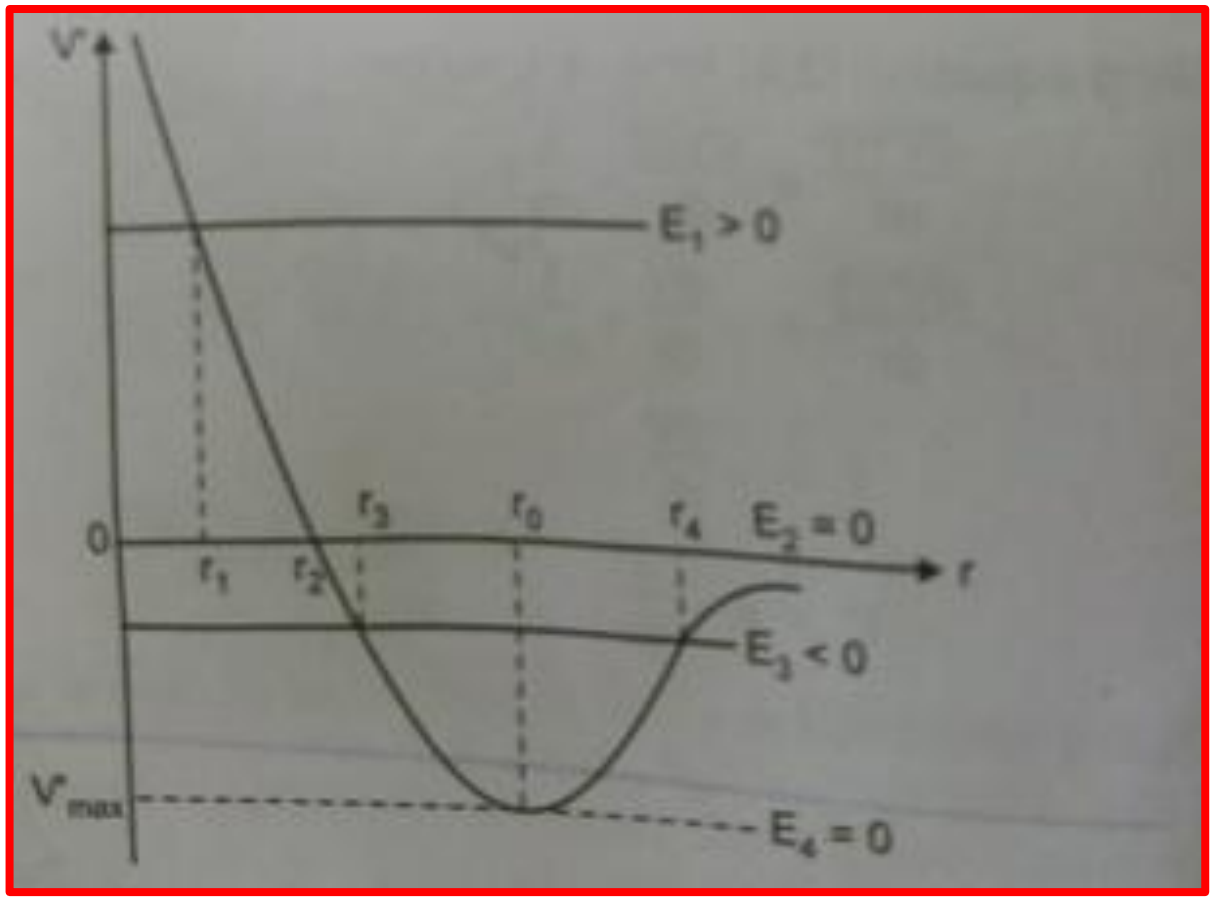
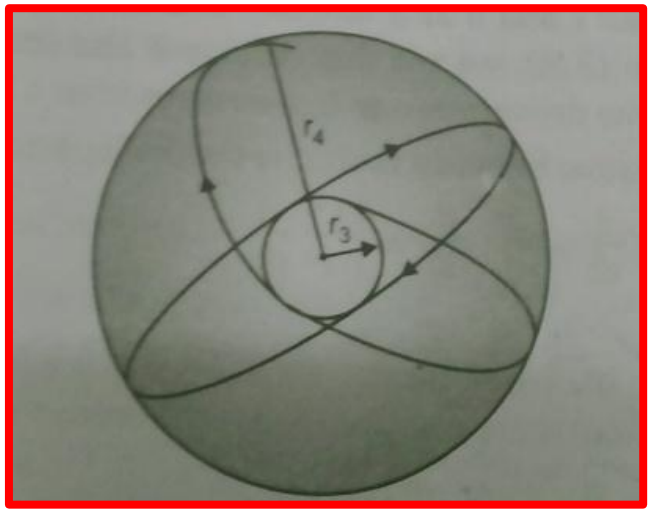


Fig. 2.3

- If we plot graph variation of V' against r as shown in fig.
- We have 4 different energy levels E_1,E_2,E_3,and E_4
- 1) for E is grater than zero:-The energy level cuts the
- Curve at.. r=r1 this is the closest approachable distance. For r is less than r_1 under this condition particle moves along a hyperbolic orbit. For r is less than r1 V is grater than E K. E becomes negative.

  This is not possible so particle comes from r is equal to infinity towards the Centre of force attain the position r=r1 and goes towards r=infinity along hyperbolic path.
- 2) E_2=0 total energy is zero The energy level cuts the Curve at.. r=r_2 this is the closest approachable distance. under this condition particle moves along a Parabolic orbit.
- 3)) $E_3$is less then zero The energy level cuts the Curve at.. r=r_3 and r=r4 particle moves along bounded orbit between two circles of radii r3 and r4 it follows an elliptical orbit under the action of central force obeying the inverse square





Differential Equation of the Orbit

$we..know..that...m\ddot{r} = \frac{L^2}{mr^3} + F(r) ---1$

$m\frac{d^2r}{dt^2} = F(r) + \frac{L^2}{mr^3} ...(2) we..know..L = mr^2\dot{\theta} = mr^2\frac{d\theta}{dt} ...(3)$

$we..are..solving..eq.of\ .motion.\ for..r..and..\theta..as..\ function..of\ ..t$

$we.change..the..time..derivative..\text{int}\ o..\theta..derivative.$

$derivative..w..r..t..t..and\theta$

$\frac{d}{dt} = \frac{d\theta}{dt}.\frac{d}{d\theta} = \frac{L}{mr^2}\frac{d}{d\theta} ....(3A) Or..\frac{dr}{dt} = \frac{L}{mr^2}\frac{dr}{d\theta}.Or$

$\frac{dr}{dt} = -\frac{L}{m}\frac{d}{d\theta}(\frac{1}{r}) ...(3B).and..\frac{d^2r}{dt^2} = \frac{d}{dt}\left(\frac{dr}{dt}\right) = \frac{L}{mr^2}\frac{d}{d\theta}\left[-\frac{L}{m}\frac{d}{d\theta}(\frac{1}{r})\right] ...(acc..3A and..3B$

$\therefore..\frac{d^2r}{dt^2} = -\frac{L^2}{m^2r^2}.\frac{d^2}{d\theta^2}(\frac{1}{r}) ...(4)$

$let..change..the..\text{var}\ iable..as$

$u = \frac{1}{r} ....(5)..\frac{d^2r}{dt^2} = -\frac{L^2u^2}{m^2}.\frac{d^2u}{d\theta^2} --(6)$

$u\ \text{sin}\ g..eq(5)..and..(6).in(2)$

$m\frac{d^2r}{dt^2} = F(r) + \frac{L^2}{mr^3} ---(2)$

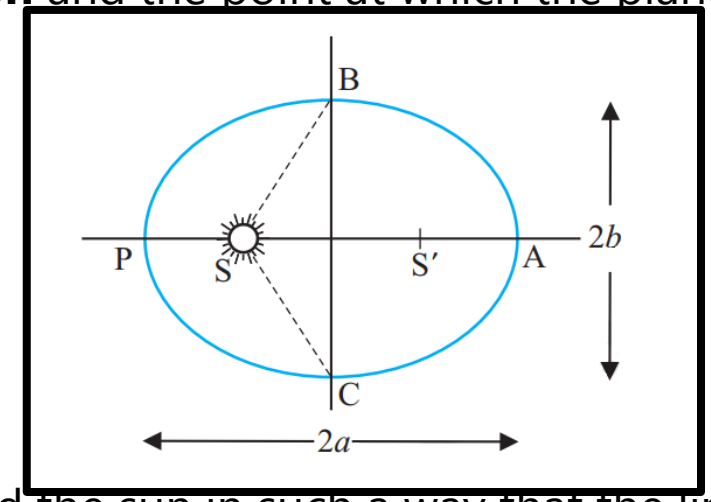
$-m\frac{L^2u^2}{m^2}.\frac{d^2u}{d\theta^2} = F(\frac{1}{u}) + \frac{L^2u^3}{m} ...(7) \therefore \frac{d^2u}{d\theta^2} = -\frac{m}{L^2u^2}F(\frac{1}{u}) - \frac{m}{L^2u^2}.\frac{L^2u^3}{m}$

$\frac{d^2u}{d\theta^2} = -\frac{m}{L^2u^2}F(\frac{1}{u}) - u ...(8)..\frac{d^2u}{d\theta^2} + u = -\frac{m}{L^2u^2}F(\frac{1}{u}) .....(9)$

- Eq.(9) is diff.. eq. of the orbit if force is know
- Here r is function of theta we can obtain force law F(r)..

- **Kepler's first law:** According to Kepler's first law, all the planets revolve around the sun in elliptical orbits having the sun at one of the foci Or The planets move in elliptical orbits around the sun, with the sun at one of the two foci of the elliptical orbit. This means that the orbit or path of a planet around the sun is an ellipse i.e. an oval-shaped and not an exact circle.
- An elliptical path has two foci and the sun is at one of the two foci of the elliptical path.. The point at which the planet is close to the sun is known as **perihelion** and the point at which the planet is great distance from the sun is known as **aphelion.**

Kepler's laws of planetary motion



Kepler's second law: Each planet revolves around the sun in such a way that the line joining the planet to the sun sweeps over equal areas in equal intervals of time. it means that a planet moves faster when it is closer to the sun and moves slowly when it is great distance from the sun.

Kepler's third law: square period of revolution of the planet is directly proportional of l to cube of a semi-major axis of ellipse. Or The cube of the mean distance of a planet from the sun is directly proportional to the square of time it takes to move around the sun.

Kepler's First laws of planetary motion

we..know..that...central..force..$F(r)$..various..with..squre..of..distance..

$F(r) = .\frac{k}{r^2}.k..is.the..constant..and..P.E = V(r) = -\frac{k}{r}$

$Differential..eq.of..orbit..is..\frac{d^2u}{d\theta^2} + u = -\frac{m}{L^2u^2}F(\frac{1}{u})..where.u = \frac{1}{r}$

$\frac{d^2u}{d\theta^2} + u = -\frac{m}{L^2u^2} \times -ku^2 ...where..F(\frac{1}{u}) = -ku^2$

$\frac{d^2u}{d\theta^2} + u = \frac{mk}{L^2} ...Or \frac{d^2u}{d\theta^2} + \left(u - \frac{mk}{L^2}\right) = 0.....(1)$

$Introduce..variable..y = u - \frac{mk}{L^2}$

$\therefore \frac{d^2u}{d\theta^2} + y = 0...(2)..is.second..order.linear..diff.eq.in..y..as.function.of\theta$

$solution..of..eq(2)is...y = A\cos(\theta - \theta_0)..where..A..and..\theta_0..are..constant$

$\therefore u - \frac{mk}{L^2} = A\cos(\theta - \theta_0)..Or..u = \frac{mk}{L^2} + A\cos(\theta - \theta_0)$

$\therefore ..\frac{1}{r} = \frac{mk}{L^2} + A\cos(\theta - \theta_0)....(3)..Or \frac{1}{r} = \frac{mk}{L^2}\left[1 + \frac{L^2A}{mk}\cos(\theta - \theta_0)\right]$

$\frac{L^2/mk}{r} = 1 + \frac{L^2A}{mk}\cos(\theta - \theta_0)...(4)..this.Eq..similar..to$

$\frac{l}{r} = 1 + e\cos(\theta - \theta_0)...(5)$

$If..we..have..\theta_0 = 0..then..\frac{l}{r} = 1 + e\cos\theta...(6)$

$which..is..eq..of..conic..section..with..origin...at.the..focus$

$compare..eq..(4)..and..(6)$

$semi-latus..rectum..l = \frac{L^2}{mk}..and..eccentricity..e = \frac{L^2A}{mk}$

$\cos in..angle..various.between..+1..and..-1 \therefore ..eq..(3)..can..writ$

$turing..points...\frac{l}{r_1} = \frac{mk}{L^2} + A..and \frac{l}{r_2} = \frac{mk}{L^2} - A..(7)$

$at..turning..point..E = V' we..know..E = V + \frac{L^2}{2mr^2}..$

$\therefore E - V - \frac{L^2}{2mr^2} = 0.Or \frac{L^2}{2mr^2} - \frac{k}{r} - E = 0....(8)$

$Eq..(8)..is..quadratic..in \frac{1}{r} root..are$

$\frac{1}{r} = \frac{+k \pm \sqrt{k^2 + \frac{4L^2E}{2m}}}{2\frac{L^2}{2m}} Or$

–

$$\frac{1}{r}=\frac{+k\pm\sqrt{k^2+\frac{4L^2E}{2m}}}{2\frac{L^2}{2m}}Or$$

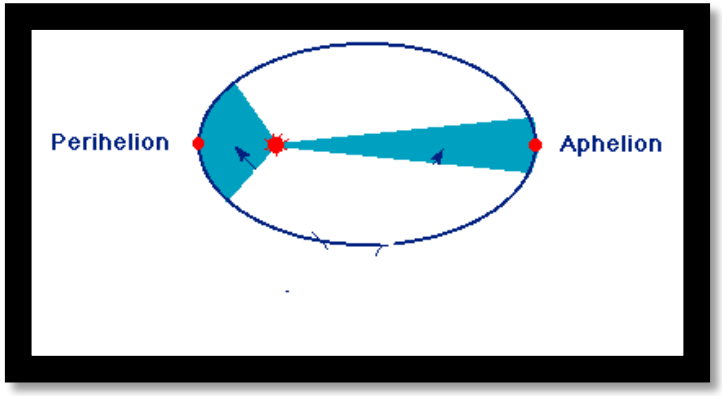
$$\frac{1}{r}=+\frac{mk}{L^2}\pm\frac{m}{L^2}\sqrt{k^2+\frac{4L^2E}{2m}}$$

$$\frac{1}{r}=+\frac{mk}{L^2}\pm\frac{m}{L^2}\sqrt{k^2(1+\frac{2EL^2}{mK^2})}$$

$$\frac{1}{r}=+\frac{mk}{L^2}\pm\frac{mk}{L^2}\sqrt{1+\frac{2EL^2}{mK^2}}$$

$$\frac{1}{r_1}=+\frac{mk}{L^2}+\frac{mk}{L^2}\sqrt{1+\frac{2EL^2}{mk^2}}$$

$$\frac{1}{r_2}=+\frac{mk}{L^2}-\frac{mk}{L^2}\sqrt{1+\frac{2EL^2}{mk^2}}...(9)$$



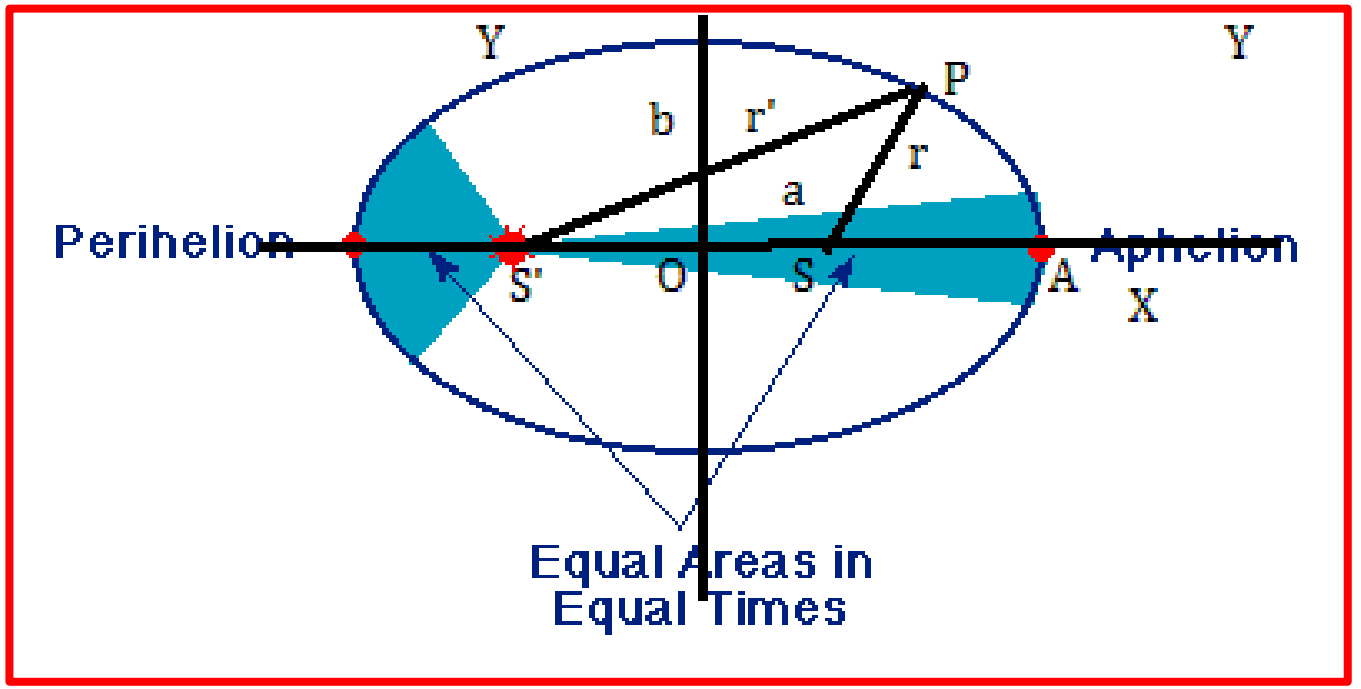
$comparing..eq..(7)..and..(9)..$

$$A=\frac{mk}{L^2}\sqrt{1+\frac{2EL^2}{mk^2}}...(10)and..eccenticity..e=\sqrt{1+\frac{2EL^2}{mk^2}}...(11)$$

$$we..have..eq..of..orbit..\frac{l}{r}=1+e\cos\theta..with..semi-latus..rectum.(l)..and..eccenticity..(e)$$

_

Eccentricity	Energy	Orbit
e > 0	E>0	Hyperbola
e=1	E=1	Parabola
0 < e <1	V_{min}< E < 0	Ellipse
e=0	E=V_{min}	circle



Nature of the orbit entirely determine by value of eccentricity e of the orbit Value of eccentricity e dependent on total energy E, Thus energy of the particle will determine the shape of orbit

$$e = \sqrt{1 + \frac{2EL^2}{mk^2}} \ldots$$

Kepler's second laws of planetary motion

Kepler's Second law: Each planet revolves around the sun in such a way that the line joining the planet to the sun sweeps over equal areas in equal intervals of time.

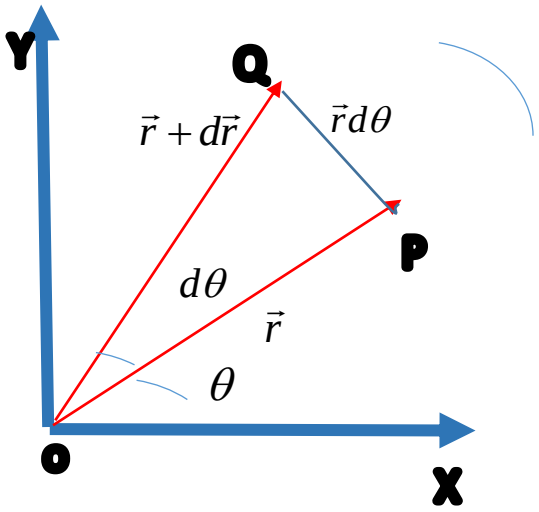
it means that a planet moves faster when it is closer to the sun and moves slowly when it is great distance from the sun.

$$In..the..C.F.field..angular..moment(L)is..always..cons\tan t$$

$$L = mr^2\dot{\theta} = cons\tan from..fig...in..time..t..the..area..dA.swept..by..radius..vector..\vec{r}$$

$$dA = \frac{1}{2}r.rd\theta = \frac{1}{2}r^2 d\theta..\frac{dA}{dt} = \frac{1}{2}r^2\frac{d\theta}{dt} = \frac{1}{2}r^2\dot{\theta}...(1)$$

$$L = mr^2\dot{\theta}..Or..\dot{\theta} = \frac{L}{mr^2} \therefore \frac{dA}{dt} = \frac{1}{2}r^2.\frac{L}{mr^2} = \frac{L}{2m} = cons\tan t$$



Kepler's 3rd laws of planetary motion

Kepler's 3rd law: square period of revolution of the planet is directly proportional of to **cube** of a semi-major axis of ellipse. Or The cube of the mean distance of a planet from the sun is directly proportional to the square of time it takes to move around the sun.

A and B are turning planets situated at the distance r_1 and r_2 from S $r_1+r_2=2a$(**property of ellipse**)

we..know..eq..of .the..elliptical ..orbit.

$\frac{l}{r}=1+e\cos(\theta-\theta_0)...(1).at..turnig..po\,\text{int}\ A,(\theta-\theta_0)=0..and..\cos(\theta-\theta_0)=1$

$value..of\ ..r=r_1\ \therefore..eq..(1)..becomes$

$\frac{l}{r_1}=1+e.....(2)..similarly$

$at..turnig..po\,\text{int}\ B,(\theta-\theta_0)=\pi..and..\cos(\theta-\theta_0)=-1$

$value..of\ ..r=r_2\ \therefore..eq..(1)..becomes$

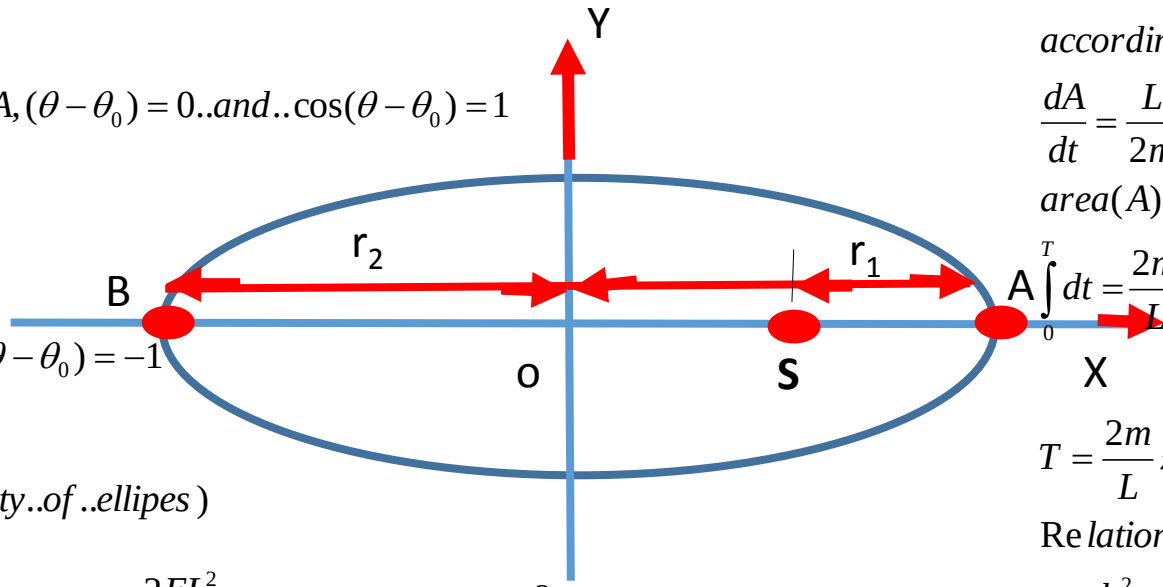
$\frac{l}{r_2}=1-e.....(3).\therefore\frac{l}{1+e}+\frac{l}{1-e}=2a(\,poperty..of\ ..ellipes\,)$

$2a=\frac{2l}{1-e^2}...(3)..we..know..that.l=\frac{L^2}{mk}..and.e^2=1+\frac{2EL^2}{mk^2}$

$\therefore..2a=\frac{2l}{1-e^2}\,sub..value.l..and..e^2$

$a=\frac{k}{-2E}..Or|E|=\frac{k}{2a}...(4)$

$\therefore..eq..(4)..indicates\ ..that.Total..E..dependent.on..majar.axies$



$$T^2=\frac{4\pi^2m}{k}a^3$$

$Here..m,k,are..cons\,\text{tan}\,t$

$T^2\propto..a^3$

we..know..eq..of .the..elliptical ..orbit.

according..to..sec ond..law..area..velocity.i.e

$\frac{dA}{dt}=\frac{L}{2m}..Or..dt=\frac{2m}{L}dA....(5)$

$area(A)enclosed\ ..by..the..ellipes...swept..during..the..peri$

$\int_0^T dt=\frac{2m}{L}\int_0^T dA..Or.T=\frac{2m}{L}A..A=\pi ab$

$T=\frac{2m}{L}\pi ab.....(6)..$

$\text{Re}\,lation..between..semimajar-axis.and..\text{min}\,or..axies$

$a=\frac{b^2}{l}..Or..b=\sqrt{al}...(7).$

$u\,\text{sin}\,g..(6)..and(7)$

$T=\frac{2m}{L}\pi a\sqrt{al}$

$T^2=\frac{4m^2\pi^2}{L^2}a^3l..but..l=\frac{L^2}{mk}..T^2=\frac{4\pi^2m}{k}a^3$

- A geostationary satellite is an earth-orbiting satellite, placed at an altitude of approximately 35,800 kilometers (22,300 miles) directly over the equator, that revolves in the same direction the earth rotates (west to east). These satellites take 24 hours to complete one rotation around the earth

Geostationary satellite

- At this altitude, one orbit takes 24 hours, the same length of time as the earth requires to rotate once on its axis. The term geostationary comes from the fact that such a satellite appears nearly stationary in the sky as seen by a ground-based observer. BGAN, the new global mobile communications network, uses geostationary satellites.. These satellites appear to be stationary above a particular point which is due to the synchronization. This type of satellite provides a distinct benefit of fixing the receiving antennas at one place, hence making them more economical than regular tracking antennas. Over the years, these satellites have helped in revolutionizing the global communications, weather forecasting and television broadcasting. When the orbit of a geosynchronous satellite is not aligned directly over the equator, the orbit is known as an inclined orbit.

