Gravitation

Gravitational potential

Gravitational potential at a point is equal to the change in potential energy per unit mass, as the mass is brought from the reference point to the given point.

Gravitational field

It is assumed that a body say A, creates a gravitational field in the space around it. The field has its own existence and has energy and momentum. When another body B is placed in gravitational field of a body, this field exerts a force on it. The direction and intensity of the field is defined in terms of the force it exerts on a body placed in it.

The intensity of gravitational field vector E at a point is defined by the equation

vector E = force vector F/mass

where F is the force vector exerted by the field on a body of mass m placed in the field. The intensity of gravitational field is abbreviated as gravitational field. Its SI unit is N/kg.

By the way they are defined, intensity of gravitational field and acceleration due to gravity have equal magnitudes and directions, but they are two separate physical quantities.

Gravitational potential and field

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Obtaining gravitational potential from gravitational field: If intensity of gravitational field E is defined in term of r the distance from the body exerting the gravitational force, its potential can be obtained by integrating e with respect to r ($\int Edr$).

If the potential is known, then its partial derivatives with respect to x, y, and z can be taken and they can be combined to get E, the intensity of gravitation field.

Gravitation

$E = iEx + jEy + kEz$

Gravitation:-

- **Kepler's first law (law of elliptical orbit):-** A planet moves round the sun in an elliptical orbit with sun situated at one of its foci.

- **Kepler's second law (law of areal velocities):-** A planet moves round the sun in such a way that its areal velocity is constant.

Kepler's third law (law of time period):- **A planet moves round the sun in such a way that the square of its period is proportional to the cube of semi major axis of its elliptical orbit.**

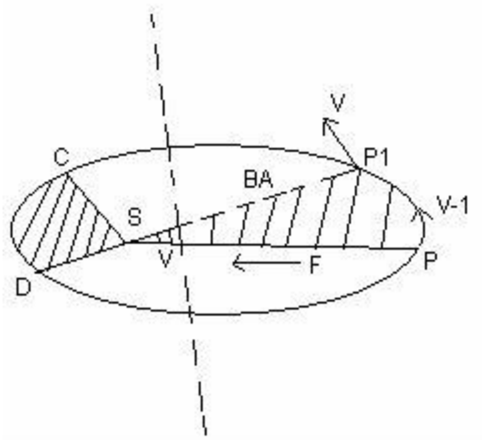
Introduction :

- In our dairy life we have noticed things falling freely downwords towards earth when thrown upwards or dispped from some hight.
- Fact that all bodies irrespective of their masses are accelerated towards the earth mith a constant aceeleation was first recognized by galive (1564-1642)
- The motion of celesh'al bodies such as moon. earth plametes etc. and attrachieve of moon towards earth and arth towards sun is an interasting subject of study since long time.
- Now the question's what is the force that produces such acceleration is which earth attract all bodies towards the centre and what is the law governing this force.
- Is this law is same for both earthly and weshal bodies.
- Answer to this question was given by Newton as he declared that "laws of nature are same for earthly and weshal Bodies".
- The force between any object falling freely towards earth and that between earth and moon are gowerned by the same laws.
- Johnaase kepler (1571-1631) Studied the planetary motion in detail and formulated his three laws of planetary motion, which were available Universal law of grawitation.

Law of orbits :-

Each planet revolues around the sun in an elliptical orbit with sun at one of the foci of the ellipse asd shown in fig (a) below.

Fig (a) An ellipse traced by planet sevolary round the sun.



AO = a - Sewi major axis
BO = b - Sewi minor axis
P - hearest point between planet and sun k/as perihetion
A - farthest point between planet and sun apheiton.

Acceleration due to gravity of earth :-

- Earth attracts every object lying an its surface towards its centre with a force known as gravitational towards its centre with a force known as gravitational pull or gravity.
- Whenever force acts on any body it produces acceleration and in case of gravitation this acceleration produced under effect of gravity is known as accelesation due to gravity (g)
- Value of accelesation due to gravity is independent of mass of the body and its value near surface of earth is 9.8 ms^{-2}
- Expression for acceleration due to gravity
  Consider mass of earth to be as M_E and its redius be R_E Suppose a body of mass M (much smaller then that fo earth) is kept at the earth surface. Force eseerted by earth on the body of mass m is