Artificial Satellites

Q → What is Artificial Satellites

Ans →: The earth and other planets revolve round the Sun in their specified orbits. The moon revolves rounds the earth and the planets. All these are the examples of natural satellites. ~~Ea~~ Each one of these satellites is attracted by its primary with a force,

Scientists have also been able to placed man made satellites, revolving round the earth or ~~the~~ Sun. They are called artifical satellites. The theory discussed above for the orbites and planetry motion is valid for the discussion of satellites. the

An artificial satellite of the earth is a body place in a stable orbite around the earth with the help of multistage roket. In order to lunch a satellite in a stable orbit, first it is necessary to take the satellite to the altitude h. where at the point P by some mechanism, it is given the necessary orbitting velocity, called the insertion velocity V_2 in fig.

Elliptical path of a body projected horizontally from a ~~hightt~~ hight h above the earth's surface for

$V_2^2 < 2GM/R+h$

The total energy of the satellite at ~~p~~ P relative to the earth is given by

$$E = \frac{1}{2} m v_i^2 - \frac{GMm}{R+h} \quad \text{---} (i)$$

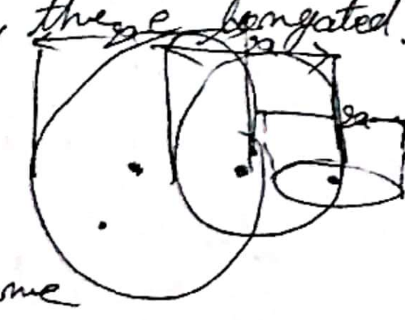
Where m is the mass of the satellite of ~~and~~ the earth, having radius R.

The orbit will be an ellipse, a parabola or hyperbola, depending on whether E is negative, zero or positive. In each case, the centre of the earth is at one focus of the path. Therefore, the satellite will be moving in an elliptical orbit as in fig, if $v_i^2 < \frac{2GM}{R+h}$

The total energy E determines the size or semi-major axis of the orbit. The shape ~~and~~ or eccentricity e of the orbit is determined by both total energy E and angular momentum J by the relation

$$\varepsilon = \sqrt{1 + \frac{2EJ^2}{mk^2}} \quad \text{---} (ii)$$

With k is equal to GMm. For elliptical orbits. layer the angular momentum, the e longated is the orbit..



In fig Elliptical orbits for different values of the angular momentum J with same energy E various orbits have the same focus and semi Major axis but different in eccentricity.

For circular orbit the injection velocity is found by equating the centripetal force mv^2/r to the gravitational force GMm/r^2 that is

$$\frac{mv_i^2}{r} = \frac{GMm}{r^2} \text{ or, } v_i^2 = \frac{GM}{r} = \frac{GM}{R+h} \quad \text{(iii)}$$

~~we ar~~ For circular orbit $e=0$. So that

$$1 + \frac{2EJ^2}{mK^2} = 0, \text{ i.e.,}$$

$$1 + 2\times\left(-\frac{K}{2a}\right) = \frac{m^2 v_i^2 a^2}{mK^2}$$

$$\text{or, } v_i^2 = \frac{GM}{R+h}$$

Where $r = a = R+h$; $K = GMm$ and $J = mv(R+h)$

For the circular orbit at the hight h above the earth surface, the period of revolution is

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