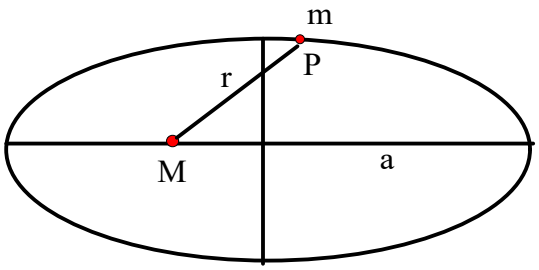
If a satellite is revolving around a planet of mass 'M' in an elliptic orbit of semi-major axis 'a', the orbital speed of the satellite when it is at a distance 'a' from the focus is:

(A) $\sqrt{\frac{GM}{a}}$ (B) $\sqrt{\frac{3GM}{a}}$ (C) $\frac{GM}{a}$ (D) $\frac{3GM}{a}$

Solution



TME = $-\frac{GMm}{2a}$

Since mechanical energy is conserved,

$-\frac{GMm}{2a} = \frac{1}{2}mv^2 - \frac{GMm}{r}$ at some point P distance r from the focus

$\therefore v^2 = GM\left(\frac{2}{r} - \frac{1}{a}\right)$

When r = a, $v^2 = GM\left(\frac{2}{a} - \frac{1}{a}\right) = \frac{GM}{a}$

$\therefore v = \sqrt{\frac{GM}{a}}$

Hence, (A)