A particle is moving with a uniform speed in a circular orbit of radius R in a central force inversely proportional to the n^{th} power of R. If the period of rotation of the particle is T, then:

(1) $T \propto R^{3/2}$ for any n.

(2) $T \propto R^{\frac{n}{2}+1}$

(3) $T \propto R^{\frac{n+1}{2}}$

(4) $T \propto R^{n/2}$

Based on JEE Main 2018 - 123IITJEE

Centripetal Force $F = \frac{mv^2}{R} \propto \frac{1}{R^n}$, where m and v are the mass and speed of the particle respectively.

$\therefore v \propto R^{\frac{1-n}{2}}$

Time period $T = \frac{2\pi R}{v}$

$\therefore T \propto \frac{R}{R^{\frac{1-n}{2}}}$ or $T \propto R^{1-\frac{1-n}{2}}$ or $T \propto R^{\frac{n+1}{2}}$

Hence, option (3).