Question

The ratio of the weights of a body on the Earth's surface to that on the surface of a planet is 9 : 4. The mass of the planet is $\frac{1}{9}$th of that of the Earth. If 'R' is the radius of the Earth, what is the radius of the planet ? (Take the planets to have the same mass density)

A $\frac{R}{3}$

B $\frac{R}{2}$

C $\frac{R}{4}$

D $\frac{R}{9}$

Solution

Correct option is B)

Since mass of the object remains same

$\therefore$ Weight of object will be proportional to 'g' (acceleration due to gravity)

Given

$$\frac{W_{earth}}{W_{planar}} = \frac{9}{4}\frac{g_{earth}}{g_{planet}}$$

Also, $g_{surface} = \frac{GM}{R^2}$ (M is mass planet, G is universal gravitational constant, R is radius of planet)

$$\therefore \frac{9}{4} = \frac{GM_{earth}R^2_{planet}}{GM_{planet}R^2_{earth}} = \frac{M_{earth}}{M_{planet}} \times \frac{R^2_{planet}}{R^2_{earth}} = 9\frac{R^2_{planet}}{R^2_{earth}}$$

$$\therefore R_{planet} = \frac{R_{earth}}{2} = \frac{R}{2}$$