Question

Find the height at which the weight will be same as at the same depth from the surface of the earth.

A $\frac{R}{2}$

B $\sqrt{5}R - R$

C $\frac{\sqrt{5}R - R}{2}$

D $\frac{\sqrt{3}R - R}{2}$

Medium

Solution

Verified by Toppr

Correct option is C)

Let the height and depth be 'd'

$$\Rightarrow \quad \frac{g}{\left(1+\frac{d}{R}\right)^2} = g\left(1-\frac{d}{R}\right)$$

$$\Rightarrow \left(1+\frac{d}{R}\right)^2\left(1-\frac{d}{R}\right) = 1$$

$$\Rightarrow \left(1+\frac{d^2}{R^2}+\frac{2d}{R}\right)\left(1-\frac{d}{R}\right) = 1$$

$$\Rightarrow \left(\frac{d}{R}\right)^3 + \left(\frac{d}{R}\right)^2 - \left(\frac{d}{R}\right) = 0$$

$$\Rightarrow \quad d = \frac{\sqrt{5}R - R}{2}$$