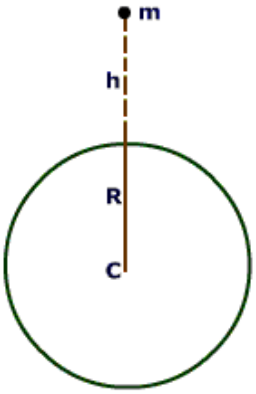
Answer on Question #40852, Physics, Mechanics

At what altitude above the earth's surface would the acceleration due to gravity be $4.9 ms^{-2}$? Assume the mean radius of the earth is 6.4×10^6 meters and the acceleration due to gravity $9.8 ms^{-2}$ on the surface of the earth.

Solution:

The velocity of a freely falling body increased at a steady rate i.e., the body had acceleration. This acceleration is called acceleration due to gravity g.



Let a body of mass m be placed on the surface of the Earth:

$$g = G\frac{M}{R^2}$$

where M is the mass of the Earth, R is the radius of the Earth and G is the gravitational constant.

et the body be now placed at a height h above the Earth's surface. Let the acceleration due to gravity at that position be g'.

Then,

$$g' = G\frac{M}{(R+h)^2}$$

For comparison, the ratio between g' and g is taken

$$\frac{g'}{g} = G\frac{M}{(R+h)^2}\frac{R^2}{GM} = \left(\frac{R}{R+h}\right)^2$$

Thus,

$$h = R\left(\sqrt{\frac{g}{g'}} - 1\right)$$

$$h = 6.4 \cdot 10^6 \cdot \left(\sqrt{\frac{9.8}{4.9}} - 1\right) = 2.65 \cdot 10^6 \text{ m}$$

Answer. $h = 2.65 \cdot 10^6$ m.