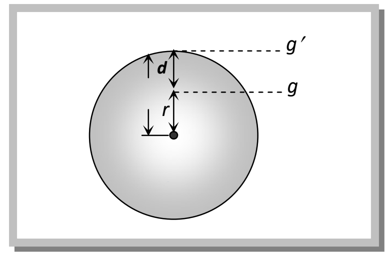
Variation in g with Depth.

Acceleration due to gravity at the surface of the earth

$$g = \frac{GM}{R^2} = \frac{4}{3}\pi\rho GR \quad .....(i)$$



Acceleration due to gravity at depth d from the surface of the earth

$$g' = \frac{4}{3}\pi\rho G(R-d) \quad .....(ii)$$

From (i) and (ii) $$g' = g\left[1 - \frac{d}{R}\right]$$

Important points

(i) The value of g decreases on going below the surface of the earth. From equation (ii) we get $g' \propto (R-d)$.

So it is clear that if d increase, the value of g decreases.

(ii) At the center of earth $d = R \therefore\ g' = 0$, i.e., the acceleration due to gravity at the center of earth becomes zero.

(iii) Decrease in the value of g with depth

Absolute decrease $$\Delta g = g - g' = \frac{dg}{R}$$

Fractional decrease $$\frac{\Delta g}{g} = \frac{g-g'}{g} = \frac{d}{R}$$

Percentage decrease $$\frac{\Delta g}{g} \times 100\,\% = \frac{d}{R} \times 100\,\%$$

(iv) The rate of decrease of gravity outside the earth ($\text{if } h << R$) is double to that of inside the earth.

$$\Rightarrow \frac{d}{R} = 1 - \frac{1}{n} \Rightarrow d = \left(\frac{n-1}{n}\right)R$$