Brainbox learn easy

CHAPTER EIGHT

GRAVITATION

Variation of 'g' w.r.t depth:

Let us consider a body of mass 'm' at a depth 'd' from the surface of earth.

From the relationship between g and G.

$g_d = \frac{GM'}{r^2}$, where r = (R - d)

$\Rightarrow g_d = \frac{GM'}{(R-d)^2} \text{------}(1)$, M' is mass of the earth up to a point of 'r'.

Let $M = \frac{4}{3}\pi R^3 \rho$

$$\rho = \frac{3}{4}\frac{M}{\pi R^3}$$

$$\therefore M' = \frac{4}{3}\pi (R-d)^3 \rho$$

$$= \frac{\cancel{4}}{\cancel{3}}\cancel{\pi}(R-d)^3 \times \frac{\cancel{3}}{\cancel{4}}\frac{M}{\cancel{\pi} R^3}$$

$$M' = m\frac{(R-d)^3}{R^3} \text{------}(2)$$

Substituting (2) in (1),

$$g_d = \frac{G \times M(R-d)^3}{R^3} \times \frac{1}{(R-d)^2}$$

$$= \frac{GM}{R^2}\left[\frac{R-d}{R}\right]$$

$$\boxed{g_d = g\left(1-\frac{d}{R}\right)}$$

$\therefore$ $g_d < g$ which means 'g' value decreases with depth.

If d = R, then g = 0 at the centre of the earth.

Variation of 'g' w.r.t latitude:

$$g_\phi = g - rw^2 \cos\varphi$$

At poles $\phi = 90^o$

$$\therefore \boxed{g_{poles} = g} \rightarrow \text{Max}$$

At equator $\phi = 0^o$

$$\therefore \boxed{g_{equator} = g.w^2r} \rightarrow \text{Min}$$

Variation of 'g' w.r.t local conditions:

'g' value increases where mineral deposits are present. The lines joining the places with same 'g' values on the surface of earth are called Isograms.