B.Sc Physics Part-I

Paper-II, Group B

Gravitational field due to a spherical :—

In the last lecture notes, we have calculated gravitational potential due to a spherical shell. Here we obtain gravitational field for the same problem. (See earlier note for details).

(i) Field at a point outside the shell:

Potential at a point outside the shell is given by $V = -\frac{GM}{r}$, $r > R$ {R → radius of spherical shell}

Thus, intensity of gravitational field is given by

$$E = -\frac{dV}{dr} = -\frac{d}{dr}\left(-\frac{GM}{r}\right) =$$

or $$\boxed{E = -\frac{GM}{r^2}}$$

(ii) Gravitational field on the surface of the shell:

Potential on the surface of the shell is

$$V = -\frac{GM}{R} \quad \{\because r = R\} \quad \{\because r = R \text{ in this case}\}$$

Gravitational Intensity $$E = -\frac{dV}{dR} = -\frac{d}{dR}\left(\frac{GM}{R}\right)$$

$$\boxed{E = -\frac{GM}{R^2}} \quad \{r^2 = R^2\}$$

(iii) Field at a point inside the shell:

We have seen in earlier class note that gravitational potential at all points inside the shell is same.

Therefore gravitational field intensity $E = -\frac{dV}{dr} = 0$. {V = const}.

→ Intensity inside the spherical shell is zero at all points.