Q (3) (i) Define an equipotential family of surfaces.

(ii) Show that the attraction at any point of an equipotential surface is normal to the surface.

Ans. (i) A family of surfaces

$$\phi(x,y,z) = c \quad \text{——} \quad (1)$$

where $c$ is a parameter) is called a family (or system) of equipotential surfaces if the potential $V$ at any point $(x,y,z)$ of (1) depends solely on $c$.

(ii) Let $\vec{F}$ be the force of attraction at any point $\vec{r} = (x,y,z)$ of an equipotential surface $\phi(x,y,z) = c$ —— (1)

Due to displacement $\vec{dr}$ along the surface (1), the work done by $\vec{F}$ is $\vec{F} \cdot \vec{dr}$. Since the difference of potentials on any two points on the equipotential (1) is zero, it follows that no work is done by $\vec{F}$ due to any displacement $\vec{dr}$ along the surface.

Hence,

$$\vec{F} \cdot \vec{dr} = 0$$

$\therefore \vec{F}$ is normal to the surface (1).