Q5. A region is specified by the potential function given by $\emptyset = 4x^2 + 3y^2 - 9z^2$. Calculate electric field strength.

Given:- $\emptyset = 4x^2 + 3y^2 - 9z^2$.

Formula:- $\vec{E} = -grad(potential\ function)$

Solution:-

$$\begin{aligned}\vec{E} &= -grad(potential\ function)\\ &= -grad\ \emptyset = -\nabla[4x^2 + 3y^2 - 9z^2]\\ &= -\left(\hat{\imath}\frac{\partial}{\partial x} + \hat{\jmath}\frac{\partial}{\partial y} + \hat{k}\frac{\partial}{\partial z}\right)(4x^2 + 3y^2 - 9z^2)\end{aligned}$$

Therefore, $\vec{E} = -8x\hat{\imath} - 6y\hat{\jmath} + 18z\hat{k}$

Ans:- The electric field strength is $\vec{E} = -8x\hat{\imath} - 6y\hat{\jmath} + 18z\hat{k}$.