

Ques: 6-6.9

$$\phi = x^2 - y^2 z$$

$$(a) \nabla \phi = (2x)i - (2yz)j - y^2 k$$

$$\text{at pt } (1, 1, 1) \quad \nabla \phi = 2i - 2j - k$$

$$(b) \text{directional derivative along } i - 2j + k = D$$

$$|D| = \sqrt{1^2 + 4^2 + 1^2} = \sqrt{6}$$

$$m = \frac{1}{\sqrt{6}}(i - 2j + k)$$

$$\nabla \phi \cdot m = \frac{1}{\sqrt{6}}(i - 2j + k) \cdot (2i - 2j - k)$$

$$= \frac{1}{\sqrt{6}}(2 + 4 - 1) = \frac{5}{\sqrt{6}}$$

$$(c) \quad \mathbf{r} - \mathbf{r}_0 = (x-1)i + (y-1)j + (z-1)k$$

$$\text{then } \frac{x-1}{2} = \frac{y-1}{-2} = \frac{z-1}{-1}$$

$$\text{or } \mathbf{r} - \mathbf{r}_0 = 0t \Rightarrow \mathbf{r} = \mathbf{r}_0 + 0t$$

$$\mathbf{r} = (i + j + k) + (2i - 2j - k)t$$