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DEPARTMENT OF MATHEMATICS

Unit Normal:

A unit normal to the given surface q at

the point is $\nabla \varphi$

Directional Derivative:

The directional derivative of q in the direction

a is given by ,

 $\nabla \varphi \cdot \overrightarrow{a}$ (or) $\nabla \varphi \cdot \overrightarrow{h}$ where $\overrightarrow{h} = \overrightarrow{a}$

The directional derivative is maximum in the direction of the normal to the given surface. Its maximum Value is 1 Vpl.

Angle between two surfaces:

$$Coso = \nabla \varphi_1 \cdot \nabla \varphi_2$$

$$|\nabla \varphi_1| |\nabla \varphi_2|$$

Note:

If the swifaces cut orthogonally then,

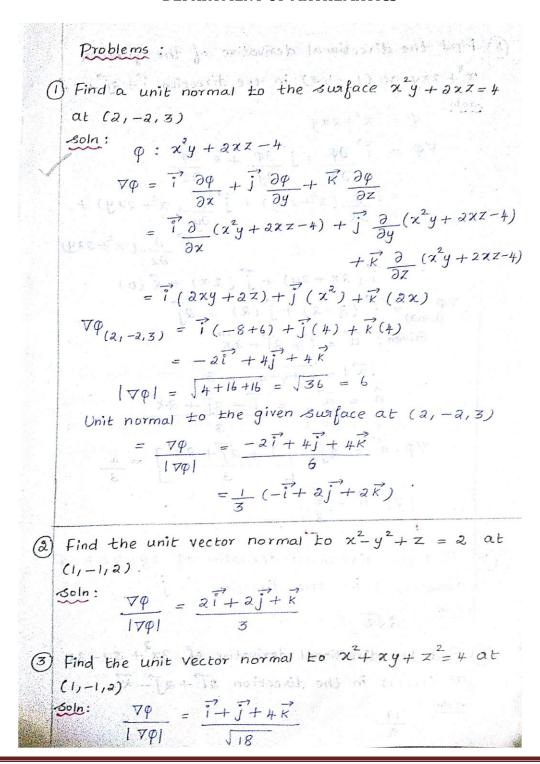
$$\nabla \varphi_1 \cdot \nabla \varphi_2 = 0$$





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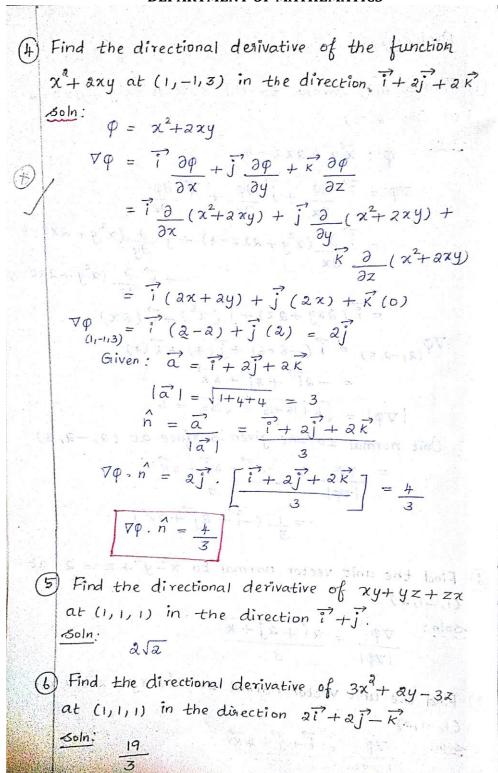






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What is the greatest rate of increase of
$$\varphi = xyz^2$$
 at $(1,0,3)$?

Soln:

Let $\varphi = xyz^2$

$$= i \frac{\partial \varphi}{\partial x} + j \frac{\partial \varphi}{\partial y} + k \frac{\partial \varphi}{\partial z}$$

$$= i \frac{\partial}{\partial x} (xyz^2) + j \frac{\partial}{\partial y} (xyz^2) + k \frac{\partial}{\partial z} (xyz^2)$$

$$= i (yz^3) + j (xz^2) + k (2xyz)$$

$$\forall \varphi (1,0,3) = i (0) + j (9) + k (0)$$
Maximum (or) Greatest rate of increase = $|\nabla \varphi|$

$$= 9i$$

To what direction from the point $(1,-1,2)$ is the directional derivative of $\varphi = x^3y^2z^3$ a maximum?

What is the magnitude of this maximum?

What is the magnitude of this maximum?

Soln:
$$\varphi = x^2y^2z^2$$

$$\forall \varphi = i \frac{\partial \varphi}{\partial x} + j \frac{\partial \varphi}{\partial y} + k \frac{\partial \varphi}{\partial z}$$

$$= i \frac{\partial}{\partial x} (x^2y^2z^2) + j \frac{\partial}{\partial y} (x^2y^2z^3) + k \frac{\partial}{\partial z} (x^2y^2z^3)$$

$$= 2xy^2z^2i + 2x^2yz^2j + 2x^2y^2z^3$$

$$\forall \varphi (1,-1,2) = 16i - 16j + 12k is the directional derivative.

Magnitude is $|\nabla \varphi| = \sqrt{16^2 + 16^4 + 12^4} = \sqrt{656}$$$



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