

attendance quiz for Lecture 8

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Section 22

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②  
1. Find the directional derivative of the function  
 $f(x,y,z) = xy^2z^3$  at the point  $(2,1,1)$  in the  
direction  $\langle 3, 4, -1 \rangle$

$$f_x = y^2z^3 \quad f_y = 2yxyz^3 \quad f_z = 3xy^2z^2$$

$$\nabla f = \langle 1x1, 2x1x2x1, 3x2x1x1 \rangle$$

$$= \langle 1, 4, 6 \rangle$$

$$u = \frac{\langle 2, -1, -1 \rangle}{\sqrt{4+1+1}} = \frac{\langle 2, -1, -1 \rangle}{\sqrt{6}} = \frac{2}{\sqrt{6}} \langle \frac{\sqrt{6}}{3}, -\frac{\sqrt{6}}{6}, -\frac{\sqrt{6}}{6} \rangle$$

$$\nabla f \cdot u = \frac{2}{\sqrt{6}} \langle \frac{\sqrt{6}}{3}, -\frac{\sqrt{6}}{6}, -\frac{\sqrt{6}}{6} \rangle \cdot \langle 1, 4, 6 \rangle$$

$$= \frac{\sqrt{6}}{3} - \frac{4\sqrt{6}}{6} - \sqrt{6}$$

$$= -\frac{1}{3}\sqrt{6} - \sqrt{6}$$

$$= -\frac{4}{3}\sqrt{6}$$

$$\text{ANS: } -\frac{4}{3}\sqrt{6}$$

2. Find the maximum rate of change of  $f(x,y) = x^2y^3$  at the point  $(3,1)$  and the direction in which it occurs.

$$f_x = 2x$$

$$f_y = 3y^2$$

$$\nabla f(3,1) = \langle 4, 3 \rangle$$

$$|\langle 4, 3 \rangle| = 5$$

$$\text{unit} = \langle \frac{4}{5}, \frac{3}{5} \rangle$$

ANS: The maximum rate of change is 5 and it follows the ~~the~~  ~~$\langle \frac{4}{5}, \frac{3}{5} \rangle$~~  direction.  $\langle \frac{4}{5}, \frac{3}{5} \rangle$ .