

Math 241 Fall 1997 exam 4

101

59

PRINT Your Name: _____

There are 10 problems on 5 pages. Each problem is worth 10 points. SHOW your work. **CIRCLE** your answer. **NO CALCULATORS!** CHECK your answer, whenever possible.

1. Find the equations of the line normal to $z = 3x^2 + 6y^2$ when $x = 1$ and $y = -1$.

$\vec{\nabla}$ + level set

My surface is the level set

$$0 = 3x^2 + 6y^2 - z$$

$$\vec{\nabla}(3x^2 + 6y^2 - z) = 6x\vec{i} + 12y\vec{j} - \vec{k}$$

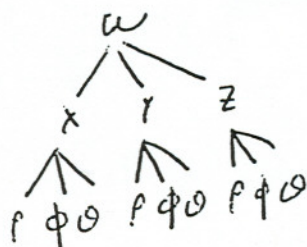
my pt is (1, -1, 9)

$$\vec{\nabla}|_{pt} = 6\vec{i} - 12\vec{j} - \vec{k}$$

my line is $\frac{x-1}{6} = \frac{y+1}{-12} = \frac{z-9}{-1}$



2. Suppose that $w = f(x, y, z)$, and x, y, z are written spherical coordinates (that is, $x = \rho \sin \phi \cos \theta$, $y = \rho \sin \phi \sin \theta$, and $z = \rho \cos \phi$). Express $\frac{\partial w}{\partial \phi}$ in terms of $\frac{\partial w}{\partial x}$, $\frac{\partial w}{\partial y}$, and $\frac{\partial w}{\partial z}$.



$$\frac{\partial w}{\partial \phi} = \frac{\partial w}{\partial x} \frac{\partial x}{\partial \phi} + \frac{\partial w}{\partial y} \frac{\partial y}{\partial \phi} + \frac{\partial w}{\partial z} \frac{\partial z}{\partial \phi}$$

$$\frac{\partial w}{\partial \phi} = \frac{\partial w}{\partial x} \rho \cos \phi \cos \theta + \frac{\partial w}{\partial y} \rho \cos \phi \sin \theta - \frac{\partial w}{\partial z} \rho \sin \phi$$