Math 241 Fall 1997 exam 4

101

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 writen 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 $\frac{\partial w}{\partial z}$.

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

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