Math 5B: Quiz 1

Name *Solutions* Perm # ____________

Circle your section number: 1 2 3 4 5 6

There is a second side to the quiz!

1. The equation $2x - y + 3z = 7$ defines a plane. (a) Find a normal vector to this plane (write it in terms of the standard coordinate vectors $\mathbf{i}, \mathbf{j}$, and $\mathbf{k}$.)

Note: If (x_0, y_0, z_0) is a point on the plane (here, we could take $(2,0,1)$ e.g.), then the equation of the plane is

$\boxed{\mathbf{n} = 2\hat{\imath} - \hat{\jmath} + 3\hat{k}}$

$\vec{n} \cdot (x-2, y, z-1) = 0$ If $\vec{n} = (a,b,c)$, this is $a(x-2) + b \cdot y + c(z-1) = 0$

(b) Compute $\mathbf{n} \cdot \mathbf{v}$ where $\mathbf{v} = 3\mathbf{i} + 3\mathbf{j} - \mathbf{k}$. Comparing with the given equation $\vec{n} = (2,-1,3)$

$$\vec{n} \cdot \vec{v} = (2)(3) + (-1)(3) + (3)(-1) = 6 - 3 - 3 = 0$$

$\boxed{\mathbf{n} \cdot \mathbf{v} = 0}$

(c) Is the point $(3, 3, -1)$ on the plane? Write your reason, then also circle your answer in the box below.

The point $(3,3,-1)$ does not satisfy the equation $2x - y + 3z = 7$ $(2 \cdot 3 - 3 + 3(-1) = 0 \neq 7)$

Circle one:	yes	no

2. Consider a scalar function $f(x, y)$ of two variables.

(a) Write down the definition of $\frac{\partial f}{\partial x}(a, b)$. (Hint: The definition must involve a limit.)

$$\boxed{\frac{\partial f}{\partial x}(a, b) = \lim_{h \to 0} \frac{f(a+h, b) - f(a, b)}{h}} \text{ OR } = \lim_{x \to a} \frac{f(x,b) - f(a,b)}{x-a}$$

Problem 2 is continued on the back. Note that this is the limit of $\frac{\Delta f}{\Delta x}$ when only the x-variable is changing. ($y = b$ is held constant)

(b) If $f(x,y) = x\arctan(xy) + e^{y^2}$, compute $\dfrac{\partial f}{\partial x}(1,1)$.

(Note: You don't need to use the definition, just compute the partial derivative as usual.)

$$\frac{\partial f}{\partial x} = 1 \cdot \arctan(xy) + x \frac{\partial}{\partial x}(\arctan(xy)) + \frac{\partial}{\partial x}(e^{y^2})$$

$$= \arctan(xy) + x \frac{1}{1+(xy)^2} \cdot \frac{\partial}{\partial x}(xy) + 0$$

$$= \arctan(xy) + \frac{xy}{1+(xy)^2}$$

Then,

$$\frac{\partial f}{\partial x}(1,1) = \arctan(1) + \frac{1}{1+1} = \pi/4 + 1/2$$

$$\boxed{\frac{\partial f}{\partial x}(1,1) = \pi/4 + 1/2}$$