Math 273 | Thing 1 | Name: ______________
Due: 7 Oct 2016 | Show appropriate work. | Point Values in $\boxed{\text{boxes}}$.

1. $\boxed{1}$ Proper notation.

2. $\boxed{3}$ Find an equation for the plane containing the point $(1, 2, 3)$ and the line $\mathbf{r}(t) = \langle 1 + 2t, t, 2 - t \rangle$.

Let $P = (1,2,3)$

$Q = (1,0,2)$

$\vec{PQ} = \langle 0,-2,-1 \rangle$

$\vec{v} = \langle 2,1,-1 \rangle$

$$\vec{PQ} \times \vec{v} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 0 & -2 & -1 \\ 2 & 1 & -1 \end{vmatrix} = \langle 3,-2,4 \rangle$$

So an equation is

$$3(x-1) - 2(y-2) + 4(z-3) = 0$$

or

$$3x - 2y + 4z = 11$$

3. $\boxed{3}$ Find an equation for the plane containing the lines $\mathbf{r}(t) = \langle 1, 2 + t, 3 - 2t \rangle$ and $\mathbf{s}(t) = \langle 1 - t, 2 + 2t, 3 + t \rangle$.

$(1,2,3)$ is a point on both lines.

The direction vectors of the lines are $\vec{u} = \langle 0,1,-2 \rangle$ & $\vec{v} = \langle -1,2,1 \rangle$.

A normal vector is then $\vec{u} \times \vec{v} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 0 & 1 & -2 \\ -1 & 2 & 1 \end{vmatrix} = \langle 5,2,1 \rangle$.

So an equation is

$$5(x-1) + 2(y-2) + (z-3) = 0$$

or

$$5x + 2y + z = 12$$

4. $\boxed{3}$ Find an equation for the tangent plane to $f(x, y) = \dfrac{x^2y^2}{x^2 + y^2}$ at $(1, 2)$.

$$f_x = \frac{(x^2+y^2)(2xy^2) - x^2y^2(2x)}{(x^2+y^2)^2} \qquad f_x(1,2) = \frac{5 \cdot 8 - 8}{5^2} = \frac{32}{25} \qquad f(1,2) = \frac{4}{5}$$

$$f_y = \frac{(x^2+y^2)(2x^2y) - x^2y^2(2y)}{(x^2+y^2)^2} \qquad f_y(1,2) = \frac{5 \cdot 4 - 16}{5^2} = \frac{4}{25}$$

so an equation is

$$z = \frac{4}{5} + \frac{32}{25}(x-1) + \frac{4}{25}(y-2)$$