Name : ____________ Math 1C, Lesson 6, Part 1: In-Class Problems **Class Number**: ____

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1. Let $\mathbf{n} = \langle a, b, c \rangle$ be a normal vector to a plane containing the point $P_0(x_0, y_0, z_0)$. Derive the equations for a plane in $\mathbb{R}^3$. To do so, complete each of the following:
   a. Draw a diagram of a plane one which you identify P_0, $\mathbf{n}$ and a general vector in the plane $\mathbf{x} = \overrightarrow{P_0P}$
   b. Explain how to use the orthogonality theorem for the dot product to get an equation for the plane.
   c. Use your work in parts a. and b. above to derive the scalar equation for a plane.
   d. Graph a plane in Mathematica

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2. Find an equation of the line through the point $(1, 2, 3)$ in the direction of the normal vector to the plane

$$x - y + z = 100.$$

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3. Find a parametric equation for line L in the intersection of the planes $x + 2z = 1$ and $x + y - z = 0$.

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4. Compute the distance from the origin $(0, 0, 0)$ to the plane $2x + y - 2z = 6$.

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5. Consider the following plane:

Plane 1:	$x + y - z = 0$
Plane 2:	$x - y = 0$
Plane 3:	$x + y + z = 0$
Plane 4:	$-2x - 2y + 2z = 5$
Plane 5:	$x + y = 0$

Which pairs of planes are parallel or orthogonal.

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6. Challenge problem: Consider the lines

$$\mathbf{L}_1(t) = \begin{bmatrix} x(t) \\ y(t) \\ z(t) \end{bmatrix} = \begin{bmatrix} t \\ 2t \\ 1-t \end{bmatrix} \quad \text{and} \quad \mathbf{L}_2(s) = \begin{bmatrix} x(s) \\ y(s) \\ z(s) \end{bmatrix} = \begin{bmatrix} 1-s \\ 2+s \\ -2s \end{bmatrix}$$

and the plane M given by equation $10x - 2y + 3z = 0$. The line $\mathbf{L}_1(t)$ intersects plane M at point Q. The line $\mathbf{L}_2(s)$ intersects plane M at point R. Lines $\mathbf{L}_1(t)$ and $\mathbf{L}_2(s)$ intersect at point P. Compute the area of the triangle PQR. The diagram below may help you visualize this problem.