Challenge Set #1

1) Find the scalar equation of each of the following planes.

a) $\begin{cases} x = 4 + 3s - 2t \\ y = 2 + 4s + 4t \\ z = 1 - 2s - 3t \end{cases}$ {4x-13y-20z+30=0}

b) $\begin{cases} x = -2t \\ y = 2 - s - 3t \\ z = 5 + 3s \end{cases}$ {9x-6y-2z+22=0}

2) Determine whether the following planes are coincident (identical), parallel, or neither.

a) $x + 3y - z - 2 = 0$ *and* $2x + 6y - 2z - 8 = 0$ {parallel}

b) $2x + y + z - 3 = 0$ *and* $6x + 2y + 2z - 9 = 0$ {neither}

c) $3x - 3y + z - 2 = 0$ *and* $6x - 6y + 2z - 4 = 0$ {identical}

d) $2x - 4y + 2z - 6 = 0$ *and* $3x - 6y + 3z - 9 = 0$ {identical}

3) Find the angles between the planes $\pi_1 : 2x - 2y - 4z = 12$, $\pi_2 : x - 5y - 2z = 3$ { 41.8° *and* 138.2° }

4) Find a vector equation for the plane with scalar equation:

a) $2x - y + 3z - 24 = 0$ b) $3x - 5z + 15 = 0$ {many answers for both}

5) Do the equations $\pi_1 : (x, y, z) = (6,0,1) + t(1,1,2) + r(4,2,3)$ and $\pi_2 : (x, y, z) = (1,1,-9) + k(5,3,5) + l(3,1,1)$ represent the same plane?

6) Do the equations $\pi_1 : (x, y, z) = (4,0,3) + t(-8,1,-9) + r(-1,5,7)$ and $\pi_2 : (x, y, z) = (-14,12,-1) + k(1,1,3) + l(-2,1,-1)$ represent the same plane? {identical}

7) Determine the value of k for which the planes $\pi_1 : (x, y, z) = (1,2,7) + t(4,2,0) + r(k,1,2)$ and $\pi_2 : (x, y, z) = (3,0,5) + m(1,0,5) + n(0,1,-1)$ are perpendicular. $k = -12$

8) Given the plane $2x - 3y + 1z - 12 = 0$ and the point $Q(1,1,1)$ which is not on the plane, find the point P which is on the plane and is the closest point to Q.