Math 254 ASSIGNMENT 1, SPRING 2018 **Due at the start of class on 4/11**

Do each of the following on additional paper. Show clearly how answers are obtained, by showing equations used, how you solve them, etc.

1. The vector equation of the line through two points P and Q is

$$\vec{\mathbf{x}} = \overrightarrow{OP} + t\overrightarrow{PQ},$$

where $\overrightarrow{OP}$ is the position vector for point P, but given as a vector) and $\overrightarrow{PQ}$ is the vector from P to Q. The vector PQ is called a **direction vector** of the line. Answer the following, referring to the examples in Section 1.9 of my notes as needed.

   (a) Give the vector equation of the line through $P(3, 4, -1)$ and $Q(1, -1, 5)$.

   (b) Give the parametric equations of the line through $P(3, 4, -1)$ and $Q(1, -1, 5)$.

   (c) Any vector parallel to the direction vector $\overrightarrow{PQ}$ is a directoin vector. Give three more direction vectors for the line you've been working with, with one of them being in the direction opposite $\overrightarrow{PQ}$.

2. Consider the four lines with parametric equations

Line 1:	$x = 5 + t,$	$y = 8 + 3t,$	$z = -3 - 2t$
Line 2:	$x = 2 - 2t,$	$y = -4 - 6t,$	$z = 3 + 4t$
Line 3:	$x = -2 + 2t$	$y = 1 - t,$	$z = 1 + t$
Line 4:	$x = 3 - 4t,$	$y = 2 - 12t,$	$z = 1 + 8t$

   (a) Give the vector form of each of the lines. See Example 1.9(c) of my notes if you don't know how to do this. **The direction vector in that example is** $\langle 3, 1\rangle$.

   (b) If the direction vectors of two lines are scalar multiples of each other, then the lines are either parallel or the same line. For which lines is this the case?

   (c) Lines 1 and 2 are either parallel or the same line. Give a point on Line 2. What value would t have to have in the x equation from Line 1 in order to give the x-coordinate of the point on Line 2? Does that value of t give the y-coordinate of the point on Line 2? The z-coordinate? If the answers are yes, then the lines are the same line. Otherwise they are parallel. Are Lines 1 and 2 parallel, or the same line?

   (d) Repeat part (c) for Lines 1 and 4.

3. Refer to Section 1.10 of my notes for the following if needed. **Show work indicating how you get your answers.**

   (a) Determine the equation of the plane containing $(-2, 1, 3)$ and with normal vector $\vec{\mathbf{n}} = \langle 4, 5, -2\rangle$.

   (b) Determine the equation of the plane containing the points $P(3, 4, -1)$, $Q(1, -1, 5)$ and $R(2, 2, 1)$.