Math 215: Linear Algebra

Problem Set 1 : Due October 30

(18 points) Make sure you are familiar with the Academic Honesty policies for this class, as detailed on the syllabus. All work is due on the given day by 3 PM Grinnell Time, or 7 PM if you LaTeX the assignment. These questions are review from Calculus II. You may find old notes or books to be helpful.

1. (6 points) Write each of the lines described below as a set $\{c \cdot \vec{v} + \vec{w} : c \text{ is in } \mathbb{R}\}$ (i.e. fill in $\vec{v}$ and $\vec{w}$ in the set notation above).

   (a) The line through the point $(1, 2, -8)$ and in the direction of vector $\vec{v} = \begin{pmatrix} 2 \\ 1 \\ 3 \end{pmatrix}$.

   (b) The line containing the point $(1, 1, 1)$ and parallel to the line containing the points $(2, 0, -1)$ and $(4, 1, 3)$.

2. (3 points) Determine whether the following lines are parallel and explain your answer **in complete sentences**.

$$\left\{ c \cdot \begin{pmatrix} 3 \\ 2 \\ -1 \end{pmatrix} + \begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix} : c \text{ is in } \mathbb{R} \right\} \text{ and } \left\{ c \cdot \begin{pmatrix} -6 \\ -4 \\ 2 \end{pmatrix} + \begin{pmatrix} 1 \\ 3 \\ -1 \end{pmatrix} : c \text{ is in } \mathbb{R} \right\}$$

3. (3 points) Without graphing the lines below, determine if they intersect. Explain your answer **in complete sentences**.

$$\left\{ c \cdot \begin{pmatrix} 3 \\ 2 \\ -1 \end{pmatrix} + \begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix} : c \text{ is in } \mathbb{R} \right\} \text{ and } \left\{ c \cdot \begin{pmatrix} 2 \\ 1 \\ -1 \end{pmatrix} + \begin{pmatrix} -1 \\ 1 \\ -1 \end{pmatrix} : c \text{ is in } \mathbb{R} \right\}$$

4. (a) (1 point) What is the formula for the dot product of two vectors $\vec{v} = \begin{pmatrix} v_1 \\ v_2 \\ v_3 \end{pmatrix}$ and $\vec{w} = \begin{pmatrix} w_1 \\ w_2 \\ w_3 \end{pmatrix}$ in $\mathbb{R}^3$?

   (b) (1 point) Given a nonzero vector $\vec{v}$ in $\mathbb{R}^3$, what is the unit vector in the direction of $\vec{v}$?

   (c) (4 points) Find a unit vector which is orthogonal to both the vectors $\begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$.