**Math 2130 Homework 2: 13.1-13.4**

Complete the following exercises on separate sheets of paper. Be sure to read over the presentablity guidelines (on the 2130 webpage) first.

(1) Write out the vector from the point $(1, 2, 3)$ to the origin in $\vec{i}, \vec{j}, \vec{k}$ format.

(2) Let $\vec{v} = (-1, 1)$ and $\vec{w} = (1, 1)$. In a single diagram, plot out the 9 points $a\vec{v} + b\vec{w}$ for $a = -1, 0,$ and 1 and $b = -1, 0,$ and 1. Clearly label each point (e.g. label the point $\vec{v} - \vec{w}$ as "$\vec{v} - \vec{w}$").

(3) Find the unit vector in the direction of $(1, 2, 3)$.

(4) Describe when $||\vec{v} + \vec{w}|| = ||\vec{v}|| + ||\vec{w}||$.

(5) Given a nonzero vector $\vec{v}$, for what values of $a$ is $a\vec{v}$ a unit vector?

(6) Find the coordinates of the point of length 3 in two dimensions oriented at an angle of $\frac{\pi}{3}$ clockwise from the $x$-axis.

(7) If $\vec{v} = (1, 2, 3)$ and $\vec{w} = (1, 0, 1)$ compute $\vec{v} \cdot \vec{w}$ and $\vec{v} \times \vec{w}$.

(8) If $\vec{v} = (1, 2, 3)$ and $\vec{w} = (1, 0, 1)$, find the perpendicular and parallel components of $\vec{v}$ in the direction of $\vec{w}$.

(9) If $\vec{v} = (1, 0, 1)$ and $\vec{w} = (0, 1, 1)$, find the angle between $\vec{v}$ and $\vec{w}$.

(10) Find a unit vector which is perpendicular to $(1, 0, 1)$ and $(0, 1, 1)$.

(11) If $a$ and $b$ are scalars and $\vec{v}$ and $\vec{w}$ are vectors, which of the following expressions make sense? Do they represent vectors or scalars?

    (a) $a + b\vec{v}$

    (b) $||\vec{v}|| + a$

    (c) $\frac{||\vec{v}||}{\vec{v}}$

    (d) $(a + b)\vec{v}$

    (e) $\vec{v} + b\vec{w}$

    (f) $(\vec{v} \cdot \vec{w}) + a$

    (g) $(\vec{v} \cdot \vec{w}) + \vec{v}$

    (h) $\vec{v} \cdot (\vec{w} + \vec{v})$

    (i) $\vec{v} \cdot (\vec{v} \cdot \vec{w})$

    (j) $(\vec{v} \times \vec{w}) + a$

    (k) $(\vec{v} \times \vec{w}) + \vec{v}$

    (l) $\vec{v} \times (\vec{w} + \vec{v})$

    (m) $\vec{v} \times (\vec{v} \times \vec{w})$

(12) If $\vec{v}$ and $\vec{w}$ are vectors, write $(\vec{v} + \vec{w}) \cdot (\vec{v} - \vec{w})$ in terms of the lengths of $\vec{v}$ and $\vec{w}$.

(13) Write the equation of a plane through the point $(1, 2, 3)$ and perpendicular to the vector $(1, 0, 1)$.

(14) Use the algebraic properties of the cross product (not either of the definitions of the cross product) to compute $((\vec{i} + \vec{j}) \times \vec{j}) \times \vec{i}$ where $\vec{i}, \vec{j}$ and $\vec{k}$ are the standard basis vectors.

(15) If $\vec{v}$ and $\vec{w}$ are vectors in this page, and $\vec{v}$ is pointing to the top of the page, and $\vec{w}$ is pointing to the right side of this page, in what direction is $\vec{v} \times \vec{w}$ pointing? Does your answer change if $\vec{v}$ and $\vec{w}$ rotate a few degrees within the page?

(16) Find the volume of the parallelpiped formed by the vectors $(1, 0, 1), (0, 1, 1),$ and $(1, 2, 0)$.