Math 2415
Paper Homework #2

1. **[12.4, Cross Products]**

   Let $\mathbf{a} = 2\mathbf{i} + \mathbf{j} - \mathbf{k}$, $\mathbf{b} = \mathbf{i} + \mathbf{k}$ and $\mathbf{c} = \mathbf{j} + 2\mathbf{k}$.

   (a) Compute $\mathbf{a} \times \mathbf{b}$.

   (b) Find the length of $\mathbf{a}$ and a unit vector in the direction of $\mathbf{a}$.

   (c) Find a vector that is orthogonal to both $\mathbf{a}$ and $\mathbf{b}$.

   (d) Calculate the area of the parallelogram determined by the vectors $\mathbf{a}$ and $\mathbf{b}$.

   (e) Calculate the volume of the parallelipiped determined by the vectors $\mathbf{a}$, $\mathbf{b}$, and $\mathbf{c}$.

   (f) Consider the parallelogram with vertices $(10, 7, 13)$, $(1, 2, 3)$, $(4, 1, 7)$, $(7, 8, 9)$.

      i. Find a point $\mathbf{p}$ and two vectors $\mathbf{u}$ and $\mathbf{v}$ so that that the parallelogram has $\mathbf{p}$ as a vertex and the vectors $\mathbf{u}$ and $\mathbf{v}$ as edges.

      ii. Use your answer to 1(f)i to find the area of the paralleogram.

2. **[12.5A, Lines]**

   (a) Find a vector parametrization for the line, $\mathcal{L}$, passing through the points $P = (1, 2, 3)$ and $Q = (9, -4, 7)$.

   (b) Which of the points are on the line $\mathcal{L}$? Which are on the line and are between P and Q?

      i. $(17, 10, -11)$,

      ii. $(5, -1, 5)$,

      iii. $(17, -10, 11)$.

   (c) Determine whether the line, $\mathcal{L}$,

      i. intersects the xy-plane,

      ii. intersects with the z-axis.

   (d) Find a parametrization for a line whose intersection with the y-axis is one point.