University of Delaware
Department of Mathematical Sciences

MATH-243 – Analytical Geometry and Calculus C
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Spring 2013

Homework 2

Due date: February 18, 2012

Problems

Based on Sections 12.3–12.5 of the book *Calculus: Early Transcendentals* 7th edition by J. Stewart.

1. Find the scalar and vector projections of $\vec{b}$ onto $\vec{a}$.
   a) $\vec{a} = \langle -2, 3, -6 \rangle$, $\vec{b} = \langle 0, 1, 1/2 \rangle$
   b) $\vec{a} = \hat{\imath} + \hat{\jmath} + \hat{k}$, $\vec{b} = \hat{\imath} - \hat{\jmath} + \hat{k}$

2. A boat sails south with the help of a wind blowing in the direction S36°E with magnitude 400 lb. Find the work done by the wind as the boat moves 120 ft.

3. If $\vec{a} = \langle 2, -2, -1 \rangle$ and $\vec{b} = \langle -1, 2, 3 \rangle$, find $\vec{a} \times \vec{b}$ and $\vec{b} \times \vec{a}$.

4. Find a nonzero vector orthogonal to the plane through points P, Q, and R. Find the area of the triangle PQR.
   a) $P(0, 1, 1)$, $Q(-2, 1, 3)$, $R(-1, 0, 4)$
   b) $P(0, -2, 0)$, $Q(4, 1, -2)$, $R(5, 3, 1)$

5. a) Find all vectors $\vec{v}$ such that $\langle 1, 2, 1 \rangle \times \vec{v} = \langle 3, 1, -5 \rangle$. b) Explain why there is no vector $\vec{v}$ such that $\langle 1, 2, 1 \rangle \times \vec{v} = \langle 3, 1, 5 \rangle$.

6. Use the scalar triple product to verify that the vectors $\vec{u} = \langle 1, 5, -2 \rangle$, $\vec{v} = \langle 3, -1 \rangle$, and $\vec{w} = \langle 5, 9, -4 \rangle$ are coplanar.

7. Find parametric and symmetric equations for the line through $(-7, 2, 4)$ and $(0, 1, 3)$.

8. Find the point of interception of lines $L_1 : \langle 1, 1, 0 \rangle + t\langle 1, -1, 2 \rangle$ and $L_2 : \langle 2, 0, 2 \rangle + t\langle -1, 1, 0 \rangle$. (Remember that the parameters for different lines are independent of each other. You may need to rename parameters to avoid confusion.)

9. In class, we derived an expression to find the distance between two nonintersecting lines. The denominator of that expression is $||\vec{v}_2 \times \vec{v}_1||$, which means that this expression works only when the lines are nonparallel (if they are parallel, $||\vec{v}_2 \times \vec{v}_1|| = 0$ (verify this). Using a reasoning similar to the one we used in class, derive an expression to find the distance between two parallel lines in a three-dimensional space.

10. Verify that the lines given by their parametric equations are parallel, and find the distance between them.

    L_1: $x = 2 - t$, $y = 3 + 2t$, $z = 4 + t$
    L_2: $x = 3t$, $y = 1 - 6t$, $z = 4 - 3t$