University of Delaware
Department of Mathematical Sciences

MATH-243 – Analytical Geometry and Calculus C
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Fall 2012

Homework 1

Due date: September 10, 2012

Problems

Taken, adapted or inspired by problems in Sections 12.1 and 12.2 of the book *Calculus: Early Transcendentals* 7th edition by J. Stewart.

1. What does the equation $y = x^2$ represent in a two-dimensional space (denoted by $\mathbb{R}^2$)? What does it represent in a three-dimensional space ($\mathbb{R}^3$)? Illustrate with sketches.
2. Find the distance from $(1, 1, -5)$ to each of the following.
   (a) The xy-plane
   (b) The point $(0, 1, 10)$
   (c) The plane $z = 2$
   (d) The x-axis
   (e) The plane $z = 0$
   (f) The z-axis
3. Find an equation of the sphere that passes through the point $(6, -2, 3)$ and has center $(-1, 2, 1)$.
4. Suppose $\vec{a} = \langle 2, -1, 1\rangle$, $\vec{b} = \langle 1, -3, -2\rangle$, and $\vec{c} = \langle -2, 1, -3\rangle$. Write $\vec{r} = \langle 1, 3, 2\rangle$ as a linear combination of $\vec{a}, \vec{b}, \vec{c}$; that is, find scalars α, β, γ such that $\vec{r} = \alpha\vec{a} + \beta\vec{b} + \gamma\vec{c}$.
5. Find a vector $\vec{a}$ with representation given by the directed line segment $\vec{AB}$. Draw $\vec{AB}$ and the equivalent representation, that is $\vec{a}$, starting at the origin.
   (a) $A(-1, 1)$, $B(3, -1)$
   (b) $A(-2, 0, 4)$, $B(1, 2, 1)$

6. Suppose $\vec{a} = \langle 3, -1, -4 \rangle$, $\vec{b} = \langle -2, 4, -3 \rangle$, and $\vec{c} = \langle 1, 2, -1 \rangle$. Find $2\vec{a} - \vec{b} + 3\vec{c}$, $||\vec{a} + \vec{b} + \vec{c}||$, $||3\vec{a} - 2\vec{b} + 4\vec{c}||$, and a unit vector parallel to $3\vec{a} - 2\vec{b} + 4\vec{c}$.

7. Show that the vectors $\vec{a} = \langle 3, 1, -2 \rangle$, $\vec{b} = \langle -1, 3, 4 \rangle$, and $\vec{c} = \langle 4, -2, -6 \rangle$ can form the sides of a triangle.

8. If $\vec{a}$ lies in the first quadrant and makes an angle $\pi/3$ with the positive x-axis and $||\vec{a}|| = 5$, find the x and y components of $\vec{a}$.

9. Find the unit vectors that are parallel to the tangent line to the curve $y = 2\sin(x)$ at the point $(\pi/6, 1)$.

10. Suppose the midpoints of the consecutive sides of a quadrilateral are connected by straight lines. Using vectors, verify that the resulting quadrilateral is a parallelogram.