Math 126 - Spring 2013
Exam 1
April 25, 2013

Name: ______________________________

Section: ______________________________

Student ID Number: ______________________________

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- There are 4 pages of questions. Make sure your exam contains all these questions.
- You are allowed to use a scientific calculator (**no graphing calculators and no calculators that have calculus capabilities**) and one **hand-written** 8.5 by 11 inch page of notes.
- You must show your work on all problems. The correct answer with no supporting work may result in no credit. **Put a box around your FINAL ANSWER for each problem and cross out any work that you don't want to be graded.** Give exact answers wherever possible.
- If you need more room, use the backs of the pages and indicate to the grader that you have done so.
- Raise your hand if you have a question.
- There may be multiple versions of the exam so if you copy off a neighbor and put down the answers from another version we will know you cheated. Any student found engaging in academic misconduct will receive a score of 0 on this exam. All suspicious behavior will be reported to the student misconduct board. In such an instance, you will be force to meet in front of a board of professors to explain your actions.
  DO NOT CHEAT OR DO ANYTHING THAT LOOKS SUSPICIOUS!
  WE WILL REPORT YOU AND YOU MAY BE EXPELLED!
- You have 50 minutes to complete the exam. Budget your time wisely.
  SPEND NO MORE THAN 10 MINUTES PER PAGE!

GOOD LUCK!

1. (11 points)

   (a) (5 pts) Consider the line through the points $P(1, 3, -2)$ and $Q(3, 5, 7)$. Find the (x, y, z) coordinates of the point at which this line intersects the xz-plane.

   (b) Consider the **plane**, P, that contains the point $(1, -1, 2)$ and is the orthogonal to the line given by

$$L : \begin{cases} x = -3t \\ y = 2 + 7t \\ z = 5 - t \end{cases}$$

      i. (4 pts) Find the equation for the plane, P.

      ii. (2 pts) At what point (x, y, z) does this plane intersect the x-axis?

2. (14 points)

(a) (6 pts) Assume $\mathbf{a}$ and $\mathbf{b}$ are nonzero three-dimensional vectors that are not parallel and are not perpendicular.

In each case below, determine if the two vectors are *always are orthogonal*, *always are parallel*, *always are neither parallel or perpendicular*, or *it depends on the vectors* (meaning depending on the vectors it is possible they could be perpendicular or parallel or neither).
Circle one for each (no work is necessary):

i. $\mathbf{a} \times \mathbf{b}$ and $2\mathbf{b}$.	orthogonal	parallel	neither	depends
ii. $\mathbf{a} \times \mathbf{b}$ and $\mathbf{b} \times \mathbf{a}$.	orthogonal	parallel	neither	depends
iii. $\mathbf{proj_a}(\mathbf{b})$ and $\mathbf{b}$.	orthogonal	parallel	neither	depends
iv. $\mathbf{proj_a}(\mathbf{b})$ and $\frac{1}{\lvert\mathbf{a}\rvert}\mathbf{a}$.	orthogonal	parallel	neither	depends
v. $\mathbf{a} - \mathbf{b}$ and $\mathbf{b} - \mathbf{a}$.	orthogonal	parallel	neither	depends

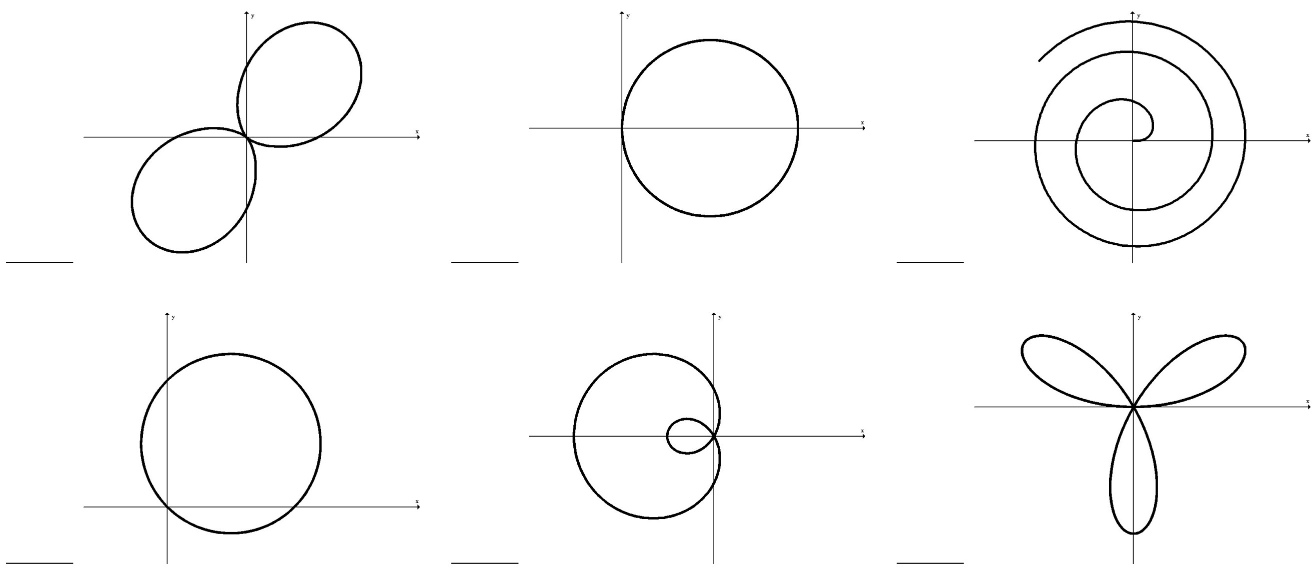
(b) (8 pts) Consider the three points $A(1, 3, 4)$, $B(0, 2, 1)$, $C(2, 3, 6)$.

i. Find the area of the triangle determined by the three points.

ii. For this same triangle, find the angle at the corner B.
(Give in degrees rounded to two places after the decimal).

3. (a) (6 pts) In the blanks provided to the left of each graph, put the number of the polar equation that matches the graph in the xy-plane (two graphs will not be labeled).

$$1.\ r = \sqrt{\theta} \qquad 2.\ r = 1 - 2\cos(\theta) \qquad 3.\ r = 1 + \sin(2\theta) \qquad 4.\ r = 9\cos(\theta)$$



(b) (4 pts) Find the (x, y) coordinates of all points on the curve $r = 1 + \sin(2\theta)$ that intersect the line $y = x$.

4. (a) (10 pts) Consider the vector function $\mathbf{r}(t) = \langle t^2 - 2t, t^3 - 4t \rangle$ and the corresponding parametric curve $x = t^2 - 2t$, $y = t^3 - 4t$.

   i. Find the value of $\dfrac{d^2y}{dx^2}$ at $t = -1$.

   ii. Find the value(s) of t at which the tangent line is parallel to the vector $\langle 1, 2 \rangle$.

(b) (5 pts) Find parametric equations for the tangent line to the curve given by $\mathbf{r}(t) = \langle 2\sin(3t), 3t, -2t\cos(t) \rangle$ at the time $t = \frac{\pi}{3}$.
(Give exact, simplified, numbers in your answer).