Math 126 - Spring 2014
Exam 1
April 24, 2014

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!

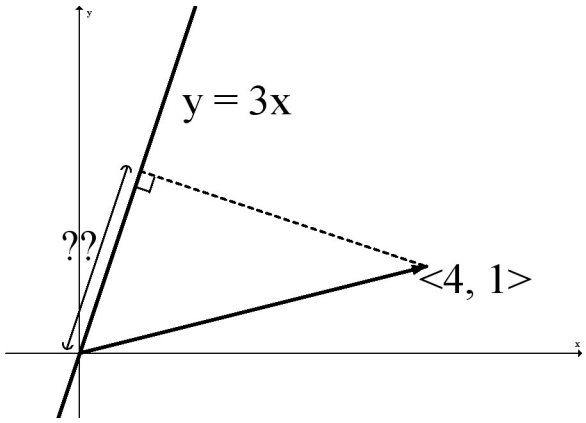
1. (12 points)

   (a) Find the equation of the plane that contains the point $(1, -2, 3)$ and the line given by $x = 4t$, $y = 1 - t$, $z = 5 + 2t$.

   (b) Consider the line through the point $(0, 3, 5)$ that is orthogonal to the plane $2x - y + z = 20$. Find the point of intersection of the line and the plane.
   (Hint: Start by finding parametric equations for the line).

2. (12 points)

(a) The vector $\langle 4, 1\rangle$ represents the force due to a heavy wind on the $xy$-plane. Find the length of the projection of this wind onto the line $y = 3x$. That is, find the indicated length in the picture below:




(b) The polar curve $r = 4 - 2\sin(\theta)$ has exactly two $x$-intercepts and two $y$-intercepts.

i. Give the $(x, y)$ coordinates for all the intercepts (fill in the blanks).

$x$-intercepts: (  , 0) and (  , 0).

$y$-intercepts: (0,  ) and (0,  ).

ii. Find the equation for the tangent line at the positive $x$-intercept.

3. (13 points) Consider the two curves given by the position vector functions $\mathbf{r}_1(t) = \langle t^2 + 6t, 12 - t^3 \rangle$ and $\mathbf{r}_2(u) = \langle 2u - 6, 4 \rangle$

   (a) Find the equation of the tangent line to the curve given by $\mathbf{r}_1(t)$ at $t = 1$.
   (Give your final answer into the form $y = mx + b$)

   (b) Find a vector $\mathbf{v} = \langle v_1, v_2 \rangle$ that has length 7 and is orthogonal to the tangent vector to $\mathbf{r}_2(u)$ at $u = 4$.

   (c) The two curves have one point of intersection.
   Find the (acute) angle of intersection between the curves at this point.
   (Round your final answer to the nearest degree).

4. (13 points) You are sitting at the origin on the surface $4z - x^2 - y^2 = 0$. You launch a water balloon into the air and its position at time $t$ seconds is given roughly by the vector function $\mathbf{r}(t) = \langle t, 2t, 20t - 5t^2 \rangle$.

   (a) Give the two word name of this surface.

   (b) Your math instructor just happens to be sitting at the location where the water balloon lands on the surface. Find the $(x, y, z)$ location where your math instructors is sitting.

   (c) Find parametric equations for the tangent line to the path at $t = 2$.

   (d) Find the curvature at time $t = 2$.