Print Your Name

Student ID #

Problem	Total Points	Score
1	12	
2	6	
3	4	
4	8	
5	10	
6	10	
Total	50	

Directions

- Please check that your exam contains a total of 7 pages.
- Write complete solutions or you may not receive credit.
- This exam is closed book. You may use one 8.5×11 sheet of notes and a calculator.
- You may not share notes or calculators. You may not use a graphing calculator or any electronic device other than a calculator.
- If you need more room, use the backs of the pages and indicate to the reader that you have done so.
- Raise your hand if you have a question.

Signature. Please sign below to indicate that you have not and will not give or receive any unauthorized assistance on this exam.

Signature: _____

1. (a) (4 points) Consider the triangle whose vertices are $A(1,1,2)$, $B(0,0,1)$, and $C(-1,0,-1)$. Find the angle of the vertex B. Give your answer to the nearest degree or to the nearest hundredth in radians.

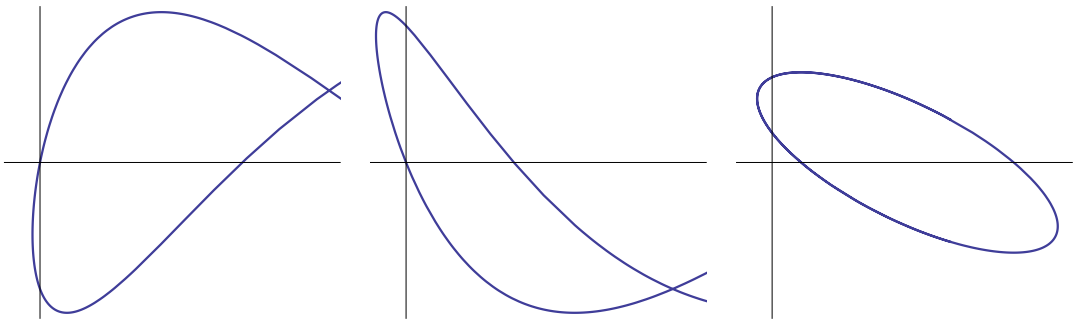
   (b) (4 points) Find an equation for the plane that is parallel to the plane $3x - y - 5z = 0$ and that contains the point $(1,1,1)$.

   (c) (4 points) Find the line of intersection of the two planes $x - 4y + 2z = 0$ and $x - y = 0$. Give your answer as a vector function. (Hint: the origin is a point on the line of intersection)

2. Consider the curve given parametrically by $x = t^2 + t, y = 5\sin t$

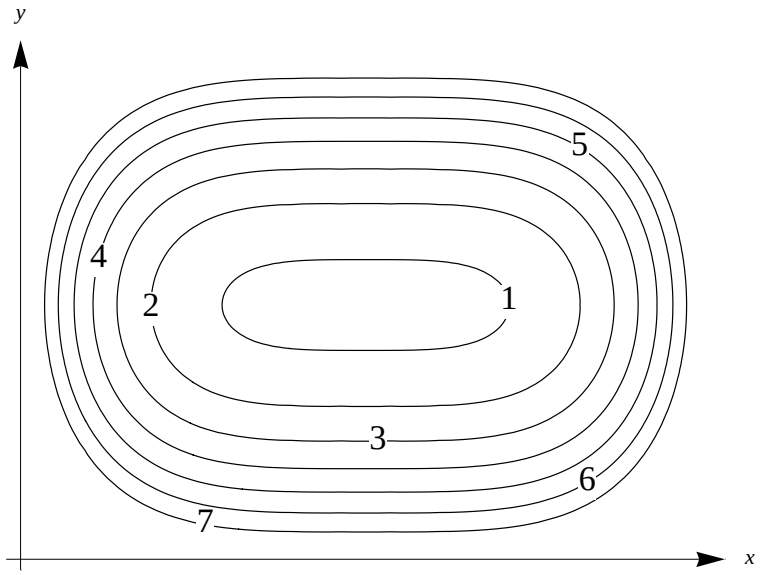
   (a) (4 points) Find $\dfrac{dy}{dx}$ at the point $(0, 0)$.

   (b) (2 points) Which of the following is the graph of the curve? Give a reason for your choice.



All three graphs are drawn to the same scale.

3. (4 points) Let $f(x, y)$ be the function of two variables whose contour map is drawn below:



(a) Draw and label a point A where f_x is positive and f_y is negative.

(b) Draw and label a point B where f_x is zero.

4. A charged particle is thrown horizontally and then falls through a magnetic field. The particle has a position function

$$\mathbf{r}(t) = \langle \cos t, \sin t, 9.8 - 4.9t^2 \rangle,$$

measured in meters. The particle is thrown at time $t = 0$, and the z coordinate corresponds to height above the ground.

(a) (3 points) Find the acceleration function $\mathbf{a}(t)$.

(b) (5 points) Find the speed of the particle when it hits the ground. Your answer should be a scalar.

5. Consider the curve $\mathbf{r}(t) = \langle t, t^2 - 1, 1 \rangle$

   (a) (6 points) Find the curvature of the curve at $t = 1$. (Hint: I recommend using the curvature formula that DOES NOT involve $\mathbf{T}$ or $\mathbf{T}'$)

   (b) (4 points) Find the normal plane of the curve at the point where $t = 1$.

6. Consider the following curve:

$$\mathbf{r}(t) = \langle 2t^2, 1 - 2t^2, 5 + t^2 \rangle$$

(a) (6 points) Reparametrize this curve with respect to arc length measured from the point where $t = 0$ in the direction of increasing t.

(b) (4 points) What is the length of the curve from $t = 0$ to $t = 3$?