Name: ______________________________

PID: ______________________________

Section: ______________________________

Question	Points	Score
1	10	
2	5	
3	21	
4	4	
Total:	40	

1. Write your Name, PID, and Section on the front of your Blue Book.
2. Write the Version of your exam on the front of your Blue Book.
3. Hand in the first page of the exam with your Blue book.
4. No calculators or other electronic devices are allowed during this exam.
5. You may use one page of notes, but no books or other assistance during this exam.
6. Read each question carefully, and answer each question completely.
7. Write your solutions clearly in your Blue Book
   (a) Carefully indicate the number and letter of each question.
   (b) Present your answers in the same order they appear in the exam.
   (c) Start each question on a new page.
8. Show all of your work; no credit will be given for unsupported answers.

1. Let $A = (1, 0, 3)$ and $B = (-3, 2, 1)$.
   (a) (3 points) Normalize $\overrightarrow{AB}$.
   (b) (3 points) Find the midpoint M of the segment AB.
   (c) (4 points) Find equation of the plane passing through M and perpendicular to AB.

2. (5 points) Evaluate the limit or determine that it does not exist.

$$\lim_{(x,y)\to(0,0)} \frac{xy}{x^2+y^2}.$$

3. Answer the following questions with short justifications:
   (a) (3 points) Find the length of $\frac{-3}{\|\mathbf{v}\|}\mathbf{v}$.
   (b) (4 points) Suppose $\mathbf{v} \times \mathbf{w} = (1, -2, 1)$ and $\mathbf{u} = (1, 1, -1)$. Find the the volume of the parallelepiped spanned by $\mathbf{v}, \mathbf{w}$ and $\mathbf{u}$.
   (c) (4 points) Suppose $\|\mathbf{v} \times \mathbf{w}\| = 3$. Find the area of the parallelogram spanned by $2\mathbf{v} + 3\mathbf{w}$ and $\mathbf{v} + \mathbf{w}$.
   (d) (4 points) Suppose $\|\mathbf{v}\| = 2$, $\|\mathrm{proj}_{\mathbf{v}}\mathbf{w}\| = 5$, and the angle between $\mathbf{v}$ and $\mathbf{w}$ is obtuse. Find $\mathbf{v} \cdot \mathbf{w}$
   (e) (3 points) Find a normal vector of a plane which is parallel to the line $\mathbf{l}(t) = t(1, 2, 3) + (1, 0, 1)$ and perpendicular to the plane $x - y + z = 1$. .
   (f) (3 points) Find a vector parallel to the line of intersection of the planes $x + y + z = 1$ and $-x + y - z = 0$.

4. (4 points) Match the following functions with the contour diagrams (a)-(d).

(1) $f_1(x,y) = x^3 - y$, (2) $f_2(x,y) = xy$, (3) $f_3(x,y) = x^2 - y^2$, (4) $f_4(x,y) = y - \ln x$.

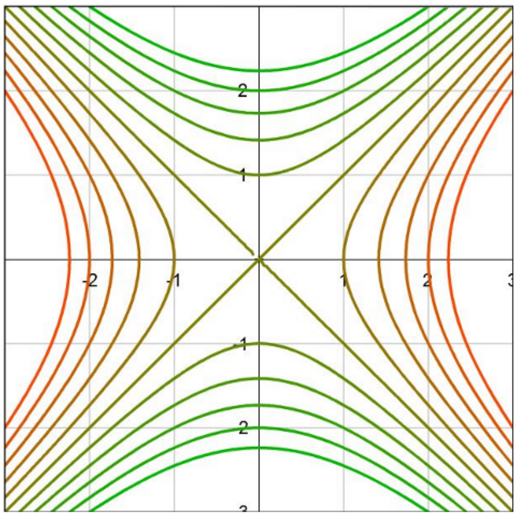

Figure (a)

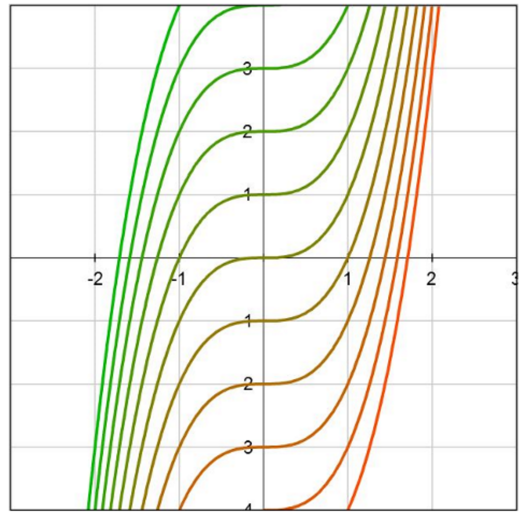

Figure (b)

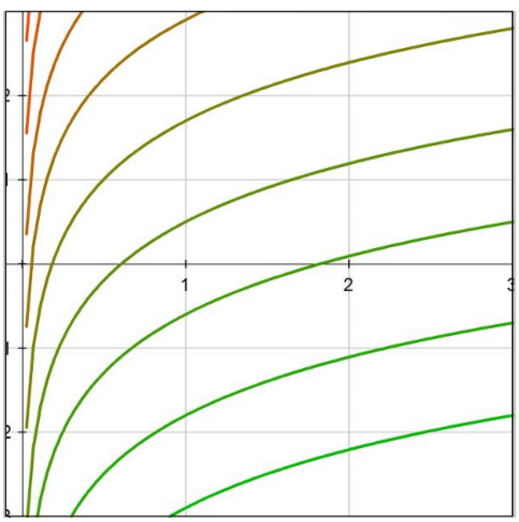

Figure (c)

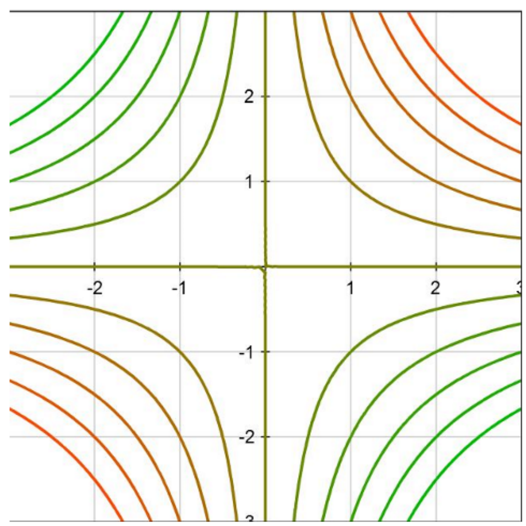

Figure (d)

Good Luck!