

Your Name

Your Signature

Student ID #

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

- This exam is closed book. You may use one  $8\frac{1}{2} \times 11$  sheet of notes.
- Do not share notes.
- Calculators are not allowed.
- In order to receive credit, you must show your work. You must also justify all conclusions you make. Do not assume something is obvious. If you feel something is clear enough to not necessitate algebra, write a sentence or two explaining your reasoning. Do not do computations in your head. Instead, write them out on the exam paper.
- Place a box around **YOUR FINAL ANSWER** to each question.
- 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.

1 (10 points) Consider the vectors

$$\vec{a} = \langle 1, 0, 0 \rangle, \vec{b} = \langle \frac{1}{2}, \frac{\sqrt{3}}{2}, 0 \rangle, \text{ and } \vec{c} = \langle \frac{1}{2}, \frac{1}{2\sqrt{3}}, \sqrt{\frac{2}{3}} \rangle$$

(a) (6 points) Show that the angle between each pair of the above vectors is  $\frac{\pi}{3}$ .

(b) (4 points) Find the magnitude of the vector  $\vec{c}$  in the direction of  $\vec{a} + \vec{b}$ .

2 (8 points) Find the third degree Taylor polynomial for  $f(x) = \sqrt[3]{x+3}$  centered at  $x = -1$ .

3 (10 points) Consider the points  $P = (-1, 2, 1)$ ,  $Q = (3, 2, 1)$ , and  $R = (-2, 3, 3)$ .

(a) (2 points) Find the equation of the line passing through  $P$  and  $Q$ .

(b) (4 points) Find the distance between  $R$  and the line found in part (a).

(c) (4 points) Now, **without using the cross product**, find the area of the triangle  $\triangle PQR$ .

4 (10 points)

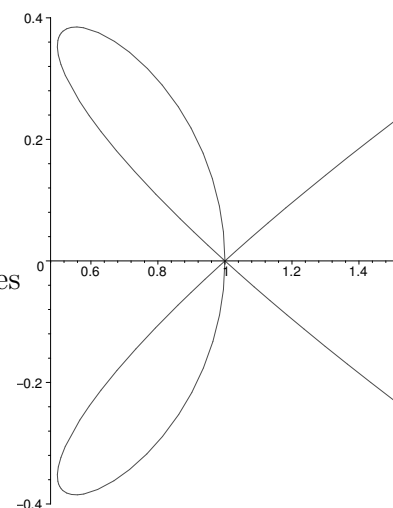
Find the equation of the plane which contains the two lines

$$\begin{aligned} \frac{x-1}{-2} &= y &= \frac{z-2}{3} \\ -x &= y+1 &= \frac{z+1}{3} \end{aligned}$$

5 (12 points) Consider the following parametric equation:

$$\begin{aligned}x(t) &= 2t^4 - 2t^2 + 1 \\y(t) &= t^3 - t.\end{aligned}$$

- (a) (6 points) Find the equations for each of the tangent lines to this parametric equation through the point  $(1,0)$ .



- (b) (6 points) Find the area contained inside the loop of the graph which is above the x-axis. The leftmost edge of this graph above the x-axis occurs at time  $t = -\frac{1}{\sqrt{2}}$ .