Math 126 C - Autumn 2021
Midterm Exam Number One
October 28, 2021

Name: _____ Student ID no. : _____

Signature: _____

1	15	
2	6	
3	9	
4	8	
5	7	
6	15	
Total	60	

This grid is purely decorative.
The exam is graded online.

- This exam consists of **SIX** problems on **FOUR** double-sided pages. The fourth page is left blank for scratch work.
- Show all work for full credit.
- You may use a TI-30X IIS (or equivalent) calculator during this exam. Other calculators and electronic devices are not permitted.
- You do not need to simplify your answers.
- If you use a trial-and-error or guess-and-check method when a more rigorous method is available, you will not receive full credit.
- Draw a box around your final answer to each problem.
- **Do not write within 1 centimeter of the edge!** Your exam will be scanned for grading.
- If you run out of room, write on one of the scratch work pages **and indicate that you have done so**. If you still need more room, raise your hand and ask for an extra page.
- You may use one hand-written double-sided 8.5" by 11" page of notes.
- You have 50 minutes to complete the exam.

You may use this page for scratch-work.

All work on this page will be ignored unless you write & circle "see first page" below a problem.

1. **[5 points per part]** For this problem, consider the following planes:

$$P_1: \quad 5x + y + 4z = 1 \qquad \text{and} \qquad P_2: \quad 10x + 2y = 3$$

(a) Find the point on P_1 closest to $(11, 3, 12)$.

(b) Find the acute angle of intersection between P_1 and P_2.

(c) Find parametric equations for the line of intersection of P_1 and P_2.

2. **[1 point per part]** Let $\mathbf{u}$, $\mathbf{v}$, and $\mathbf{w}$ be vectors in 3-space. Indicate whether each of the following expressions is a vector, a scalar, or nonsense.

You do not need to show work on this problem.

(a)	$\lvert\mathbf{u}\rvert + \mathbf{v} \cdot \mathbf{w}$	**Vector**	**Scalar**	**Nonsense**
(b)	$\lvert\mathbf{u}\rvert\mathbf{v} - \lvert\mathbf{w}\rvert$	**Vector**	**Scalar**	**Nonsense**
(c)	$\mathbf{u} \cdot (\mathbf{v} \cdot \mathbf{w})$	**Vector**	**Scalar**	**Nonsense**
(d)	$\mathbf{u} \times (\mathbf{v} \times \mathbf{w})$	**Vector**	**Scalar**	**Nonsense**
(e)	$\text{proj}_{\mathbf{u}}(\mathbf{v} \times \mathbf{w})$	**Vector**	**Scalar**	**Nonsense**
(f)	$\text{comp}_{\mathbf{u}}(\mathbf{v} + \mathbf{w})$	**Vector**	**Scalar**	**Nonsense**

3. **[3 points per part]**

You do not need to show work on this problem.

(a) Give an example of two vectors $\mathbf{a}$ and $\mathbf{b}$ such that $\mathbf{a} \times \mathbf{b} = \langle 0, 6, 0 \rangle$.

(b) Give an example of two different vectors $\mathbf{a}$ and $\mathbf{b}$ such that $\text{proj}_{\langle 1,0,0 \rangle}\mathbf{a} = \text{proj}_{\langle 1,0,0 \rangle}\mathbf{b}$.

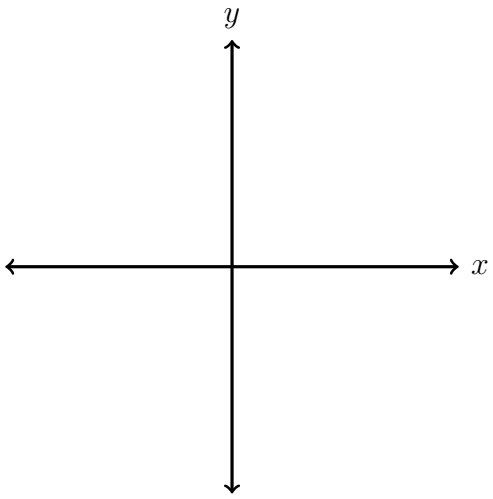
(c) Give an example of a vector $\mathbf{a}$ such that $\text{proj}_{\mathbf{a}}\langle 4, 5, 6 \rangle = 2\mathbf{a}$.

4. Suppose the surface $ax^2 + y^2 + 2z^2 = b$ contains the points $(2, 0, 1)$ and $(3, 5, 1)$.

   (a) **[6 points]** What are a and b?

   (b) **[2 points]** Give the name of this surface.

5. **[7 points]** Draw a graph of the polar curve $r = \dfrac{3}{\sin\theta + 2\cos\theta}$. Label your graph clearly.



6. **[5 points per part]** Consider the space curve of the following vector function:

$$\mathbf{r}(t) = \langle \sin(t), 4t + 3, t^2 + 8t \rangle$$

(a) Find all points where the space curve intersects the plane $z = y + 9$.

(b) Write parametric equations for the line tangent to the space curve at the point $(0, 3, 0)$.

(c) Find the curvature of the space curve at the point $(0, 3, 0)$.

You may use this page for scratch-work.

All work on this page will be ignored unless you write & circle "see back page" below a problem.

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