Math 126 F - Winter 2019
Midterm Exam Number One
February 7, 2019

Name: _____ Student ID no. : _____

Signature: _____

1	12	
2	8	
3	7	
4	8	
5	7	
6	10	
7	8	
Total	60	

- This exam consists of **SEVEN** problems on **FOUR** double-sided pages.
- Show all work for full credit.
- You may use a TI-30X IIS 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 the back of the first or last page 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 80 minutes to complete the exam.

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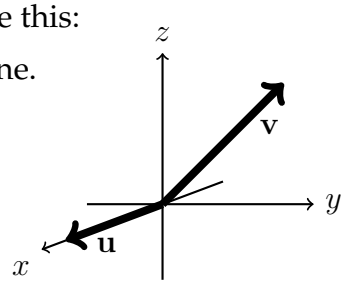
1. **[6 points per part]** Here are some short, unrelated plane problems.

   (a) Find the plane through the points $(1, 2, 3)$, $(2, 3, 4)$, and $(4, 6, 8)$.

   (b) Find the line of intersection of the planes $y = 2x + 3$ and $4x - 5y + 2z = 7$. Write your answer in parametric form.

2. **[2 points per part]** Suppose $\mathbf{u}$ and $\mathbf{v}$ are 3D vectors that look like this: That is, $\mathbf{u}$ points along the positive x-axis, and $\mathbf{v}$ is in the yz-plane. (You don't have to show work on this problem.)



Identify the following values as positive, negative, or zero. (Circle your answer.)

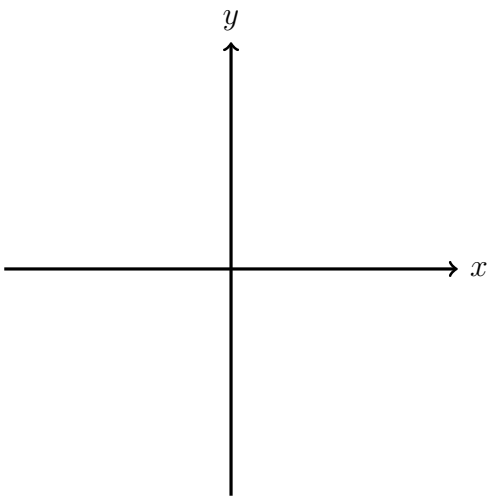
(a) $\mathbf{u} \cdot \mathbf{v}$: positive negative zero

(b) The x-component of $\mathbf{u} \times \mathbf{v}$: positive negative zero

(c) The y-component of $\mathbf{u} \times \mathbf{v}$: positive negative zero

(d) The z-component of $\mathbf{u} \times \mathbf{v}$: positive negative zero

3. **[7 points]** Graph the polar curve $r = \dfrac{1}{\sin(\theta) - \cos(\theta)}$. Please label the scales on your axes. (Hint: This is a graph you've seen before. Don't *just* draw a picture; do some algebra first.)



4. **[8 points]** You just got a job at Quadricorp, the company that builds quadric surfaces.

   Your first assignment: make a hyperboloid of **two sheets** following these specifications:

   - The hyperboloid "points" along the z-axis.
   - The hyperboloid goes through the points $(0, 0, 2)$, $(3, 0, 4)$, and $(6, 4, 8)$.

   Give the equation of this hyperboloid.

5. **[7 points]** Consider the vector function $\mathbf{r}(t) = \langle t^2 - 3t, \sqrt{t+1}, t^2 + t \rangle$.

   Let ℓ be the line tangent to the space curve of $\mathbf{r}(t)$ at the point $(0, 2, 12)$.

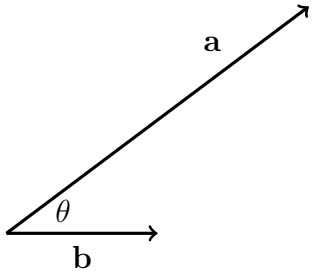
   Write parametric equations for ℓ.

6. **[10 points]** The acceleration of a friendly bee at time t is given by the vector function

$$\mathbf{a} = \langle 6, 6t, e^t \rangle.$$

At time $t = 0$, the bee is at the origin. At time $t = 2$, the bee is at the point $(4, 5, 6)$. Where is the bee at time $t = 3$?

7. I've got some vectors $\mathbf{a}$ and $\mathbf{b}$. Here's a picture:



(a) **[2 points]** In the picture to the right, draw $\mathbf{proj_a}\big(\mathbf{proj_b a}\big)$.
(Clearly label your work so I can see what's going on.)

(b) **[6 points]** Suppose I know the following:

- $\mathbf{a} = \langle 4, 2, 4 \rangle$.
- $\mathbf{proj_a}\big(\mathbf{proj_b a}\big) = \langle 3, \frac{3}{2}, 3 \rangle$.
- θ is acute.

What's θ?