

Math 126 F - Winter 2018  
Midterm Exam Number One  
February 1, 2018

Name: \_\_\_\_\_

Student ID no. : \_\_\_\_\_

Signature: \_\_\_\_\_

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

- This exam consists of **six** 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.

1. [6 points per part] Let  $\mathcal{P}$  be the plane

$$2x + 3y - 5z = -9.$$

(a) Find the point on  $\mathcal{P}$  that's closest to the point  $(-9, -2, 16)$ .

(b) Let  $\ell$  be the line

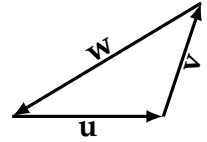
$$x - 2 = -y = \frac{z - 1}{3}.$$

Give parametric equations for the line within  $\mathcal{P}$  that intersects  $\ell$  at a right angle.

2. [3 points per part]

The 3-dimensional vectors  $\mathbf{u}$ ,  $\mathbf{v}$ , and  $\mathbf{w}$  point along the edges of a triangle, as shown below.

The area of the triangle is 3, and  $|\mathbf{u}| = 5$ .



(a) Compute  $|\mathbf{v} \times \mathbf{w}|$ .

(b) Compute  $|\mathbf{u} \times (\mathbf{v} \times \mathbf{w})|$ .

(c) Compute  $|(\mathbf{u} \times \mathbf{v}) \times (\mathbf{v} \times \mathbf{w})|$ .

(d) Suppose  $\text{comp}_{\mathbf{v}} \mathbf{u} = 4$ . What's  $|\mathbf{v}|$ ?

3. [4 points per part] Suppose the position of a particle at time  $t$  is given by  $\mathbf{r}(t) = \langle t, t^2, e^t \rangle$ .

(a) Compute the tangential and normal components of acceleration at time  $t = 0$ .

(b) Compute the curvature at time  $t = 0$ .

(c) Let  $P$  be the point where the particle intersects the plane  $x = 2$ . Find the acute angle between the velocity of the particle at  $P$  and a normal vector to the plane.

4. Consider the following vector function:

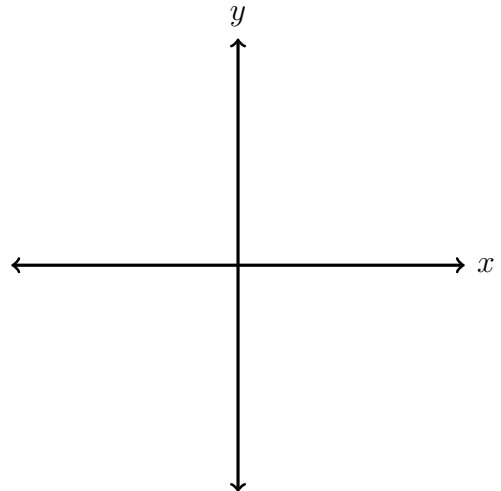
$$\mathbf{r}(t) = \langle 2t \sin(t), \sqrt{t^2 + 1}, 3t \cos(t) \rangle$$

(a) [6 points] Give the equation for a quadric surface containing  $\mathbf{r}(t)$ .

(b) [2 points] Write the name of the surface you found in part (a).

5. [8 points] Sketch the curve  $r = 4 \sec(\theta)$ . Please label the scales on your axes.

(Don't *just* draw a picture. Show some reasoning.)



6. [8 points] The force applied to Gomba after  $t$  seconds, in newtons, is

$$\mathbf{F} = 36t\mathbf{i} + 3\sin(t)\mathbf{j} + e^{\frac{t}{3}}\mathbf{k}.$$

Gomba has a mass of 9 kg and starts at rest at the origin.

Write a vector function for Gomba's position after  $t$  seconds.