MATH 2550 G/J Midterm 1 Make-up
VERSION C
Fall 2025
COVERS SECTIONS 12.1-12.6, 13.1-13.4, 14.1-14.2

Full name: ______________________________ **GT ID:**______________

Honor code statement: I will abide strictly by the Georgia Tech honor code at all times. I will not use a calculator. **I do not have a phone within reach**, and I will not reference any website, application, or other CAS-enabled service. I will not consult with my notes or anyone during this exam. I will not provide aid to anyone else during this exam.

(   ) All of the knowledge presented in this exam is entirely my own. I am initialing to the left to attest to my integrity.

Read all instructions carefully before beginning.

- Print your name and GT ID neatly above.
- You have 50 minutes to take the exam.
- You may not use aids of any kind.
- Please show your work [J] and annotate your work using proper notation [N].
- Good luck!

Question	Points
1	2
2	10
3	12
4	10
5	8
6	8
Total:	50

For T/F problems choose whether the statement is true or false. If the statement is *always* true, pick true. If the statement is *ever* false, pick false. Also please be sure to neatly fill in the bubble corresponding to your answer choice. [A]

1. (2 points) If a fly is buzzing around the room along a curve with arc-length parameterization $r(s) = \left\langle \cos\left(\frac{s}{\sqrt{2}}\right), \sin\left(\frac{s}{\sqrt{2}}\right), \frac{1}{\sqrt{2}} \right\rangle$, $0 \le s \le 2\pi$ measured in meters, then when the fly is located at $r(\pi)$ the fly has travelled π meters.

   ○ **TRUE** ○ **FALSE**

2. (10 points) Let P be the plane defined by $x + y + z = 6$. Find (a) the vector equation for the line ℓ passing through the point $Q(1, 2, 1)$ which is orthogonal to P, and (b) find the intersection between this line ℓ and the plane P.

   [AJN]

(a)

(b)

3. (12 points) Find the coordinates of the point which is a distance of $\sqrt{2}\pi/2$ along the helix $\mathbf{r}(t) = \langle \cos t, \sin t, t \rangle$ in the direction of increasing parameter t from $(1, 0, 0)$. *Hint: find the arc-length parameter* $s(t) = \int_{t_0}^{t} |\mathbf{r}'(\tau)| \, d\tau$ *for a good choice of* t_0. [AJN]

4. (10 points) In this problem, you will work with the curve

$$\mathbf{r}(t) = (2t+3)\mathbf{i} + (5-t^2)\mathbf{j}$$

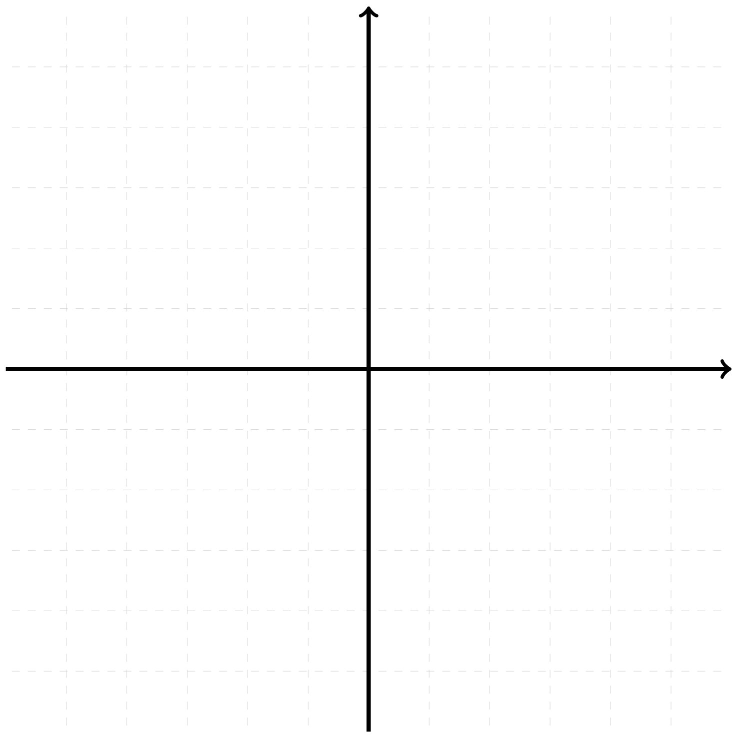
for $t \in \mathbb{R}$. [AJN]

(a) Compute the unit tangent vector $\mathbf{T}(t)$.

(b) Compute the principal unit normal vector $\mathbf{N}(t)$.

(c) Compute the curvature $\kappa(t)$.

5. (8 points) Let $f(x, y) = \frac{1}{\sqrt{4-x^2-y^2}}$. Graph the domain of f on the provided axes below, and clearly label the axes. Be sure to show all your work in finding the domain. Indicate whether or not each part of the boundary of the domain is included. [AJN]



6. (8 points) Find the limit or show that the limit does not exist. To receive full credit, you must show work supporting your answer, use proper limit notation, and mention the test that you are using. [AJN]

$$\lim_{(x,y)\to(8,8)} \frac{x+y-16}{\sqrt{x+y}-4}$$

FORMULA SHEET

- $\langle u_1, u_2, u_3\rangle \cdot \langle v_1, v_2, v_3\rangle = u_1v_1 + u_2v_2 + u_3v_3$
- $\mathbf{u} \cdot \mathbf{v} = |\mathbf{u}||\mathbf{v}| \cos(\theta)$
- $\langle u_1, u_2, u_3\rangle \times \langle v_1, v_2, v_3\rangle = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \end{vmatrix}$
- $|\mathbf{u} \times \mathbf{v}| = |\mathbf{u}||\mathbf{v}||\sin(\theta)|$
- $L = \displaystyle\int_a^b |\mathbf{r}'(t)| \, dt$
- $s(t) = \displaystyle\int_{t_0}^t |\mathbf{r}'(\tau)| \, d\tau$
- $\mathbf{T} = \dfrac{\mathbf{v}}{|\mathbf{v}|} = \dfrac{d\mathbf{r}}{ds}$
- $\kappa = \left|\dfrac{d\mathbf{T}}{ds}\right| = \dfrac{1}{|\mathbf{v}|}\left|\dfrac{d\mathbf{T}}{dt}\right| = \dfrac{|\mathbf{v} \times \mathbf{a}|}{|\mathbf{v}|^3}$
- $\mathbf{N} = \dfrac{1}{\kappa}\dfrac{d\mathbf{T}}{ds} = \dfrac{d\mathbf{T}/dt}{|d\mathbf{T}/dt|}$

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