MAT 203 MIDTERM I

THURSDAY SEPTEMBER 25, 2025
11:00–12:20PM

Name: _____ ID: _____

Instructions.

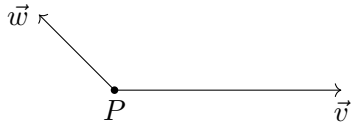
(1) Fill in your name and Stony Brook ID number.

(2) This exam is closed-book and closed-notes; no electronic devices.

(3) You have 80 minutes to complete this exam.

(4) You must justify all your answers and show all your work. Even a correct answer without any justification will result in no credit.

1. (a) (5 pts) In the diagram below, draw the vectors $-\vec{v}$ and $\vec{v}+\vec{w}$, such that both of their initial points are at P.



(b) (5 pts) Consider the vectors $\vec{u}=\langle 0,1,-2\rangle$, $\vec{v}=\langle -2,1,1\rangle$, and $\vec{w}=\langle 0,0,1\rangle$. Compute the following: $\vec{v}\cdot(\vec{u}+\vec{w})-\vec{w}\cdot(\vec{v}+\vec{u})$.

2. (a) (5 pts) Consider the line ℓ in the plane that passes through the point $(-1, -3)$, and has direction vector $\vec{v} = \langle 2, 1 \rangle$. Find the equation of the line and write your answer on the form $y = kx + m$.

(b) (5 pts) Find a unit normal vector to the plane $2x - y + 4z + 1 = 0$.

3. (10 pts) Find the three radii of the ellipsoid described by the equation

$$10x^2 - 20x + 5y^2 + 10y + 2z^2 = -5.$$

4. Consider the curve S that is parametrized by $\vec{r}(t) = \langle \cos t, \sin t, t^2 \rangle$.

(a) (5 pts) Recall that the *principal unit tangent vector* of a curve with parametrization $\vec{r}(t)$ is given by $\vec{T}(t) = \vec{r}\,'(t)/||\vec{r}\,'(t)||$.
Find the principal unit tangent vector of S.

(b) (5 pts) Compute the integral $\int_0^3 ||\vec{r}\,'(t)||^2 \, dt$.