

Math 241, Exam 2, Spring, 2023

You should KEEP this piece of paper. Write everything on the **blank paper provided**. Return the problems **in order** (use as much paper as necessary), use **only one side** of each piece of paper. Number your pages and write your name on each page. Take a picture of your exam (for your records) just before you turn the exam in. I will e-mail your grade and my comments to you. I will keep your exam. **Fold your exam in half** before you turn it in.

The exam is worth 50 points. Problem 2 is worth 8 points; each of the other problems is worth 7 points. **Make your work coherent, complete, and correct.** Please CIRCLE your answer. Please **CHECK** your answer whenever possible.

The solutions will be posted later today.

No Calculators, Cell phones, computers, notes, etc.

- (1) Find the point on the line

$$x = -t + 2, \quad y = t + 1, \quad z = 2t - 1$$

which is closest to the point $(2, 3, 1)$. **DEMONSTRATE that your answer is correct.**

- (2) Find an equation for the plane through the points $P_1 = (2, -1, 3)$, $P_2 = (2, 4, 1)$, and $P_3 = (1, 2, 3)$. **DEMONSTRATE that your answer is correct.**
- (3) Express $\vec{v} = 2\vec{i} + 3\vec{j}$ as the sum of a vector parallel to $\vec{w} = -\vec{i} + 4\vec{j}$ and a vector orthogonal to \vec{w} . **DEMONSTRATE that your answer is correct.**
- (4) Name, describe, and graph the set of all points in three-space which satisfy the equation $y^2 - x^2 - z^2 = 1$. Is the graph a curve, a surface, or a solid?

- (5) The position vector of an object at time t is

$$\vec{r}(t) = \cos 2t \vec{i} + \sin 2t \vec{j} + t \vec{k}.$$

How far does the object travel between $t = 0$ and $t = \pi$?

- (6) If $z = 2x^2y^4e^{3x^3y^2} + x^2y^3 \sin(xy)$, then find $\frac{\partial z}{\partial x}$.
- (7) Find the directional derivative of $f(x, y) = x^2y^3$ in the direction $\vec{v} = 2\vec{i} + 3\vec{j}$ at the point $P = (2, -2)$.