

Name: _____

Section: _____ Recitation Instructor: _____

READ THE FOLLOWING INSTRUCTIONS.

- **Do not open your exam until told to do so.**
- No calculators, cell phones or any other electronic devices can be used on this exam.
- Clear your desk of everything excepts pens, pencils and erasers.
- If you need scratch paper, use the back of the previous page.
- Without fully opening the exam, check that you have pages 1 through 9.
- Fill in your name, etc. on this first page.
- **Show all your work.** Write your answers clearly! Include enough steps for the grader to be able to follow your work. Don't skip limits or equal signs, etc. Include words to clarify your reasoning.
- Do first all of the problems you know how to do immediately. Do not spend too much time on any particular problem. Return to difficult problems later.
- If you have any questions please raise your hand and a proctor will come to you.
- There is no talking allowed during the exam.
- You will be given exactly 90 minutes for this exam.

I have read and understand the above instructions: _____

SIGNATURE

Multiple Choice. Circle the best answer. No work needed. No partial credit available.

1. (8 points) Consider the surface given by equation below and answer the questions that follow.

$$3z = x^2 + \frac{y^2}{9} + 2 \quad (1)$$

- (a) Horizontal traces or cross-sections (i.e., planes parallel to $z = k > 1$) of the surface defined by (1) are

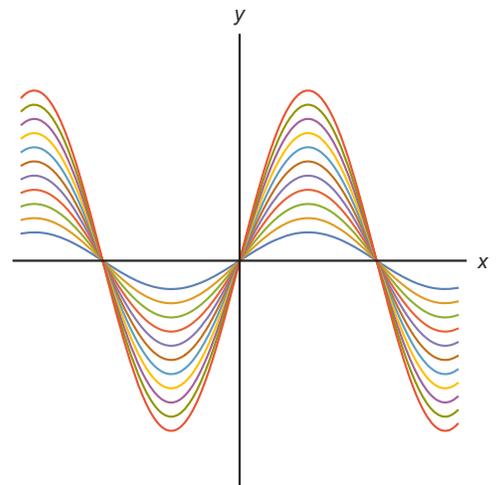
- A. Circles
- B. Parabolas
- C. Ellipses
- D. Hyperbolas
- E. None of the above

- (b) Vertical traces or cross-sections (i.e., planes parallel to either $x = k$ or $y = k$) of the surface defined by (1) are

- A. Circles
- B. Parabolas
- C. Ellipses
- D. Hyperbolas
- E. None of the above

2. (4 points) The contour plot (level curves) to the right could be from which function?

- A. $f(x, y) = \frac{x}{\sin y}$
- B. $f(x, y) = x \sin y$
- C. $f(x, y) = y \sin x$
- D. $f(x, y) = x \cos y$
- E. $f(x, y) = \frac{y}{\sin x}$
- F. None of the above



Extra Work Space.

Fill in the Blanks. No work needed. No partial credit available.

3. (10 points) Find the velocity and position functions of a particle that satisfies the following conditions.

$$\mathbf{a}(t) = -\sin t \mathbf{i} + 12e^{-2t} \mathbf{j} - 8 \mathbf{k}$$

$$\mathbf{v}(0) = \mathbf{i} - 6 \mathbf{j}$$

$$\mathbf{r}(0) = 3 \mathbf{j} + \mathbf{k}$$

(a) $\mathbf{v}(t) =$ _____

(b) $\mathbf{r}(t) =$ _____

4. (8 points) Let $\mathbf{u} = 3 \mathbf{i} + 2 \mathbf{j} - \mathbf{k}$ and $\mathbf{v} = \mathbf{i} - 5 \mathbf{j} + 2 \mathbf{k}$. Find each of the following.

(a) $2\mathbf{u} + 3\mathbf{v} =$ _____

(b) Let θ be the angle between \mathbf{u} and \mathbf{v} . Then $\cos \theta =$ _____

5. (6 points) The line segment from $(3, 7, 5)$ to $(-2, 4, 1)$ is given by the parametric equations

$$x(t) = \text{_____}$$

$$y(t) = \text{_____}$$

$$z(t) = \text{_____}, \quad t \in [0, 1]$$

Extra Work Space.

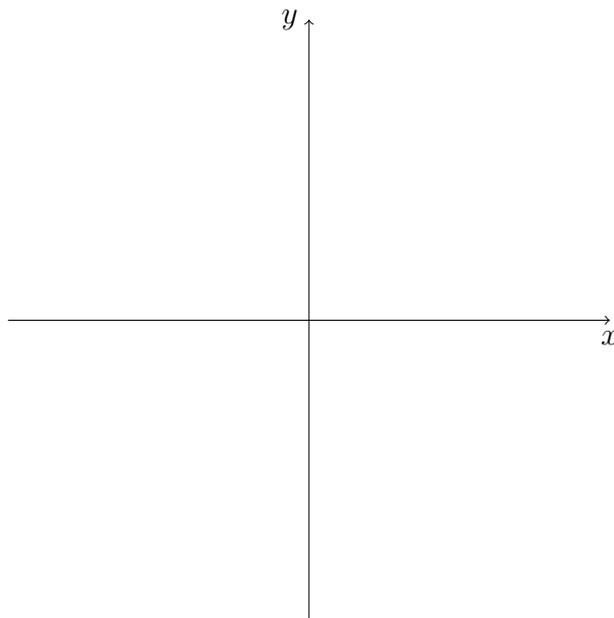
Standard Response Questions. Show all work to receive credit. Please **BOX** your final answer.

6. (12 points) Find the length of the curve below.

$$\mathbf{r}(t) = \frac{8t^{3/2}}{3} \mathbf{i} - 4t \mathbf{j} + t^2 \mathbf{k}, \quad 0 \leq t \leq 1$$

7. Let $f(x, y) = \frac{1}{\sqrt{2x^2 - 1 - y}}$.

(a) (8 points) Sketch the domain of f .



(b) (4 points) Give the range of f . *Express your answer using interval notation.*

8. (14 points) Find the following limits or show that they do not exist.

(a) $\lim_{(x,y) \rightarrow (0,0)} \frac{x^2 \sin^2 y}{2x^2 + y^2}$

(b) $\lim_{(x,y) \rightarrow (0,0)} \frac{xy^2}{8x^2 + 3y^4}$

9. Let $f(x, y) = x^2 e^y - 6y\sqrt{x}$.

(a) (12 points) Find the linearization of $f(x, y)$ at the point $(4, 0)$.

(b) (6 points) Use the linearization from part (a) to approximate $f(3.9, 0.2)$.

10. (12 points) Find the equation of the plane containing the points A , B , and C if

$$A = (3, 0, 1), \quad B = (1, 2, 2), \quad C = (6, -1, 3)$$

11. (10 points) Let $w = xy^2 + ye^{x-2}$ where $x = x(s, t)$ and $y = y(s, t)$ are differentiable. Suppose also that

$$\begin{aligned} x(1, 3) &= 2, & x_t(1, 3) &= -4, & x_s(1, 3) &= 5 \\ y(1, 3) &= -3, & y_t(1, 3) &= 6, & y_s(1, 3) &= 0 \end{aligned}$$

Find $w_t(1, 3)$.

12. (10 points) Let $g(x, y) = 5x^2y^3 - \frac{\ln 2y}{x}$. Find g_{xy} and g_{yy} .

$$g_{xy} = \underline{\hspace{10cm}}$$

$$g_{yy} = \underline{\hspace{10cm}}$$

13. (12 points) Find the parametric equations for the line tangent to the curve $\mathbf{r}(t) = \langle 2 - \ln t, t^2 + 3, 1 - 4t^3 \rangle$ at the point $(2, 4, -3)$.

$$x(t) = \underline{\hspace{10cm}}$$

$$y(t) = \underline{\hspace{10cm}}$$

$$z(t) = \underline{\hspace{10cm}}$$

14. (14 points) Let $f(x, y) = 3xy^2 - 2y$ and answer the questions below.

(a) Find the equation of the plane tangent to surface $z = f(x, y)$ at the point $P(2, 1, 4)$.

(b) Find the distance from the point $Q(-2, 4, 5)$ to the tangent plane from part (a).

Congratulations you are now done with the exam!

Go back and check your solutions for accuracy and clarity. Make sure your final answers are **BOXED**.

When you are completely happy with your work please bring your exam to the front to be handed in.

Please have your MSU student ID ready so that it can be checked.

DO NOT WRITE BELOW THIS LINE.

Page	Points	Score
2	12	
3	24	
4	24	
5	32	
6	22	
7	22	
8	14	
Total:	150	