

Your Name

Your Signature

Student ID #

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Your TA's name

Your Quiz Section Label and Time

Problem	Points	Possible
1		4
2		12
3		12
4		12
5		12
6		8
Total		60

- Turn off and put away cell phones, graphing calculators, books, and notebooks.
- You may use one $8\frac{1}{2} \times 11$ sheet of handwritten notes and a non-graphing calculator. Do not share notes or calculators.
- In order to receive credit, you must **show your work and explain your reasoning** (unless the problem instructions say otherwise).
- Give exact answers. You do not need to simplify answers algebraically.
- Place a box around YOUR FINAL ANSWER to each question.
- Raise your hand if you have a question or **need more paper**.

Please do not open the test until everyone has a copy and the start of the test is announced.

1. (4 points) The contour maps for the functions f and g appear below. For each map, the level curves are drawn for evenly spaced values of the function. *No reasoning need be shown for this problem.*

The contour map of $f(x, y) = \ln(x^2 + y^2)$ is _____ .

The contour map of $g(x, y) = x^2 + y^2$ is _____ .

NOTE FOR ON-LINE COPY OF TEST:

The hard copy of the test has three contour maps, all consisting of concentric circles.

Map A has evenly spaced circles.

Map B has circles that are more closely spaced far from the origin.

Map C has circles that are more closely spaced near the origin.

2. (12 points) Consider the curve described by $\mathbf{r}(t) = \langle t + 3, e^t, t^2 - 1 \rangle$.

(a) Find the curvature at the point corresponding to $t = 0$.

(b) Find the equation of the osculating plane at the point corresponding to $t = 0$.

3. (12 points) A curve is given in polar coordinates by the equation $r = \theta$. Find the Cartesian equation of the tangent line to the curve at the point on the curve corresponding to $\theta = \pi/2$.

4. (12 points) For the function $f(x, y) = x^2 \sin(\pi y)$,
- (a) Compute $f_x(x, y)$, $f_y(x, y)$, and $f_{xy}(x, y)$.
- (b) Find the equation of the tangent plane to the graph of $f(x, y)$ at the point where $(x, y) = (3, 1)$.
- (c) Find the equations of the line through $(3, 1, f(3, 1))$ and perpendicular to the tangent plane in part (b).

5. (12 points) (a) Find parametric equations for the ellipse whose cartesian equation is $4x^2 + 9(y + 1)^2 = 9$ so that at $t = 0$ your equations have $(x(0), y(0)) = (-3/2, -1)$.

(b) Does your answer from part (a) describe motion going

CLOCKWISE or *COUNTERCLOCKWISE*?

Circle one of the words above; no explanation required.

6. (8 points) Suppose that the only force \mathbf{F} acting on an object is parallel to the position function $\mathbf{r}(t)$ of the object. Prove that the angular momentum $\mathbf{L}(t) = m\mathbf{r}(t) \times \mathbf{v}(t)$ is constant.

(Use Newton's second law, $\mathbf{F} = m\mathbf{a}$. Physicists call a force that is parallel to the position vector a "central force.")

END OF EXAM