

NAME _____

STUDENT ID # _____

RECITATION INSTRUCTOR _____

RECITATION TIME _____

DIRECTIONS

- 1) Fill in the above information. Also write your name at the top of each page of the exam.
- 2) The test has 9 pages, including this one.
- 3) Problems 1 through 6 are multiple choice; circle the correct answer.
- 4) Problems 7 through 10 are problems to be worked out. Write your answer in the box provided. **YOU MUST SHOW SUFFICIENT WORK TO JUSTIFY YOUR ANSWERS. CORRECT ANSWERS WITH INCONSISTENT WORK MAY NOT RECEIVE CREDIT.**
- 5) Points for each problem are given in parenthesis in the left margin.
- 6) No books, notes, or calculators may be used on this test.

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(10) 1) Parametric equations for the line that contains the point $(1, -2, 3)$ and is perpendicular to the plane $3x - 4y + 2z = 8$ are:

- A. $x = 1 + 3t, y = -2 - 4t, z = 3 + 2t$
- B. $x = 3 + t, y = -4 + 2t, z = 2 + 3t$
- C. $x = 8 + 3t, y = 8 - 4t, z = 8 + 2t$
- D. $x = -1 + 3t, y = 2 - 4t, z = -3 + 2t$
- E. $x = -1 - 3t, y = 2 + 4t, z = -3 - 2t$

(10) 2) $\lim_{(x,y) \rightarrow (0,0)} \frac{\sin(x^2 + y^2)}{(x^2 + y^2)} \cdot (y + 2)$ is equal to:

- A. 0
- B. 1
- C. 2
- D. 4
- E. Does not exist.

- (10) 3) Symmetric equations for the line tangent to the curve $\vec{r}(t) = t^2\vec{i} + (3t - 4)\vec{j} + (2 - t^2)\vec{k}$ at the point $(4, 2, -2)$ are given by:

A. $\frac{x - 4}{4} = \frac{y - 2}{3} = \frac{z - 2}{-4}$

B. $x = 4$ and $\frac{y - 2}{2} = \frac{z + 2}{3}$

C. $\frac{x - 4}{4} = \frac{y + 2}{-3} = \frac{z - 2}{-4}$

D. $\frac{x - 4}{4} = \frac{y - 2}{3} = \frac{z + 2}{-4}$

E. $\frac{x - 4}{4} = \frac{y - 3}{2} = \frac{z + 4}{-2}$

- (10) 4) Let S be the level surface of $f(x, y, z) = x^2 - y^2 - \frac{z^2}{4}$ corresponding to $c = 1$. The intersection of S with the xy plane is:

A. two lines

B. a circle

C. a parabola

D. an ellipse

E. a hyperbola

5) An object has acceleration $\vec{a}(t) = e^t\vec{i} + 2\vec{k}$, initial velocity $\vec{v}(0) = \vec{i}$, and initial position $\vec{r}(0) = 2\vec{j}$. Find the position vector of the object at time $t = 1$.

A. $(e - 1)\vec{i} - 2\vec{j} + \vec{k}$

B. $(e - 1)\vec{i} + 2\vec{j} + \vec{k}$

C. $e\vec{i} - 2\vec{j}$

D. $e\vec{i} + 2\vec{j} + \vec{k}$

E. $e\vec{i} + 2\vec{j} - \vec{k}$

(10) 6) Let $f(x, y) = \ln(x^2 + y^2)$ with $x = g(t)$ and $y = h(t)$. Assuming that $g(0) = 1$, $h(0) = 3$, $g'(0) = 2$, and $h'(0) = 4$, the value of $\frac{d}{dt}(f(g(t), h(t)))$ when $t = 0$ is:

- A. $\frac{1}{5}$
- B. $\frac{2}{5}$
- C. $\frac{3}{5}$
- D. $\frac{7}{5}$
- E. $\frac{14}{5}$

7. Consider the plane containing the points $(0, 1, 2)$, $(1, 2, 3)$, and $(2, 1, 0)$.

(5) a) Find a vector \vec{n} which is perpendicular to the plane. (Put your answer in the box below.)

Answer to 7.a) $\vec{n} =$

(5) b) Find the equation for the plane.

Answer to 7.b)

8. Consider the curve given by:

$$\vec{r}(t) = t^2\vec{i} + 2t\vec{j} + (\ln t)\vec{k}, \quad 1 \leq t \leq e.$$

(6) a) Write down an integral that gives the arclength L of this curve (including limits of integration).

Answer to 8.a) $L = \int$

(4) b) Compute the integral in 8.a) to get the exact value of the arclength L .

Answer to 8.b) $L =$

9. Let $f(x, y) = x^2 e^{xy}$.

(6) a) Find $\frac{\partial^2 f}{\partial x \partial y}$.

Answer to 9.a) $\frac{\partial^2 f}{\partial x \partial y} =$

(4) b) What is $\frac{\partial^2 f}{\partial x \partial y}$ at the point $(1, 0)$?

Answer to 9.b) $\frac{\partial^2 f}{\partial x \partial y}(1, 0) =$

10. A function $f(x, y)$ is positive if $y > 2$, negative if $y < 2$. The graph of f is a plane which intersects the xy plane at a 45-degree angle.

(3) a) Find $\frac{\partial f}{\partial x}(0, 2)$.

Answer to 10.a) $\frac{\partial f}{\partial x}(0, 2) =$

(3) b) Find $\frac{\partial f}{\partial y}(0, 2)$.

Answer to 10.b) $\frac{\partial f}{\partial y}(0, 2) =$

(4) c) Find the directional derivative of f at $(0, 2)$ in the direction $\vec{i} - \vec{j}$.

Answer to 10.c)