INSTRUCTIONS:

1. **Do not open the exam booklet until you are instructed to do so.**
2. This exam has 12 problems in 8 different pages (including this cover page). Once you are allowed to open the exam, make sure you have a complete test.
3. Do any necessary work for each problem on the space provided or on the back of the pages of this test booklet. Circle your answers in this test booklet.
4. Each problem is worth 8 points. 4 points will be added to your total for a maximum of 100 points. No partial credit.
5. Use a #2 pencil to fill in the required information in your scantron and fill in the circles.
6. Use a #2 pencil to fill in the answers on your scantron.
7. After you have finished the exam, hand in your scantron and your test booklet to your recitation instructor.

RULES REGARDING ACADEMIC DISHONESTY:

1. Students must obey the orders and requests by all proctors, TAs, and lecturers.
2. No student may leave in the first 20 min or in the last 10 min of the exam.
3. Books, notes, calculators, or any electronic devices are not allowed on the exam, and they should not even be in sight in the exam room. Students may not look at anybody else's test, and may not communicate with anybody else except, if they have a question, with their TA or lecturer.
4. After time is called, the students have to put down all writing instruments and remain in their seats, while the TAs will collect the scantrons and the exams.
5. Any violation of these rules and any act of academic dishonesty may result in severe penalties. Additionally, all violators will be reported to the Office of the Dean of Students.

I have read and understand the above statements regarding academic dishonesty:

NAME ______________________________

STUDENT SIGNATURE ______________________

STUDENT PUID # ______________ SECTION NUMBER ______________

RECITATION INSTRUCTOR ______________________

1. The two values of x for which the vectors $\langle x^2, 1, 3\rangle$ and $\langle 1, -5x, 2\rangle$ are perpendicular are

A. $2, -3$

B. $-2, 3$

C. $0, 2$

D. $0, 3$

E. $2, 3$

2. The plane passing through the point $(0, 1, 0)$ and parallel to the plane $x + y - 2z = 3$ intersects the x-axis at the point:

A. $(-1, 0, 0)$

B. $(1, 0, 0)$

C. $(-2, 0, 0)$

D. $(2, 0, 0)$

E. $(-3, 0, 0)$

3. The arc-length of the curve defined by $\vec{r}(t) = \langle t^3, \, \frac{\sqrt{6}}{2}\, t^2, \, t \rangle$ for $-1 \le t \le 1$ is

A. 2

B. 3

C. 4

D. 5

E. 6

4. $\displaystyle\lim_{(x,y)\to(0,0)} \frac{x^2 y}{x^4 + y^2} =$

A. 0

B. 1/2

C. 1

D. ∞

E. Does not exist

5. Find the equation of the line that passes through the point (1, 2, 1) and that is parallel to the vector tangent to the curve $\vec{r}(t) = \langle t^2 + 3t + 2,\ e^t \cos t,\ \ln(t+1)\rangle$ at (2, 1, 0).

   A. $x = 1 + 3t,\ y = 2 + t,\ z = 1 + t$

   B. $x = 3 + 2t,\ y = e^t(\cos t - \sin t),\ z = \frac{1}{1+t}$

   C. $x = 1 + 2t,\ y = 2 + t,\ z = 1$

   D. $x = 2 + 3t,\ y = 1 + t,\ z = t$

   E. $x = 2 + 3t,\ y = 1 + 2t,\ z = -3t$

6. A particle starts at the origin with initial velocity $\vec{i} - \vec{j}$. Its acceleration is $\vec{a}(t) = t\vec{i} + t\vec{j} + \vec{k}$. Find its position at $t = 1$.

   A. $\vec{i} + \vec{j} + \vec{k}$

   B. $\vec{i} + \vec{j}$

   C. $\frac{3}{2}\vec{i} - \frac{1}{2}\vec{j} + \vec{k}$

   D. $\frac{7}{6}\vec{i} - \frac{5}{6}\vec{j} + \frac{1}{2}\vec{k}$

   E. $\frac{4}{3}\vec{i} + \frac{2}{3}\vec{j} + \frac{1}{2}\vec{k}$

7. Using the linear approximation to $f(x,y) = \sqrt{x^2 + 3y}$ at the point $(4,3)$, the approximate value of $\sqrt{(4.02)^2 + 3(2.97)}$ is:

A. 5.004

B. 5.05

C. 4.95

D. 4.093

E. 5.007

8. If $z = \sin(xy)$, $x = \pi t^2$, and $y = h(t)$ with $h(1) = \frac{1}{3}$ and $h'(1) = 2$, what is $\dfrac{dz}{dt}$ when $t = 1$?

A. $\dfrac{4\pi\sqrt{3}}{3}$

B. $\dfrac{4\pi}{3}$

C. $\pi + 1$

D. $(\pi + 1)\sqrt{3}$

E. $\sqrt{3}\pi + 1$

9. The directional derivative of $f(x,y,z) = y^2 e^{x-z}$ at the point $(3,1,2)$ in the direction $2\vec{i} + 5\vec{j} + \vec{k}$ is:

A. $\dfrac{13e}{\sqrt{30}}$

B. $13e$

C. $\dfrac{35e}{\sqrt{14}}$

D. $\dfrac{11e}{\sqrt{30}}$

E. $11e$

10. Reverse the order of integration to compute $\displaystyle\int_0^2 \int_x^2 e^{y^2}\, dy dx$.

A. $\frac{1}{2}(e^4 - 1)$

B. $(e^2 - 1)$

C. $\frac{1}{3}(e^3 - 1)$

D. $(e^2 - e)$

E. $\frac{1}{2}(e^2 - e)$

11. The function $f(x, y) = 2x^3 + 6xy + 3y^2$ has:

A. one local maximum and one local minimum

B. one local maximum and one saddle point

C. one local minimum and one saddle point

D. 2 saddle points

E. 2 local maxima

12. Find the absolute maximum and absolute minimum values of $f(x, y) = x^2 + y^2 + 2y$ on the ellipse $x^2 + 2y^2 = 8$.

A. max is 8, min is 0

B. max is 9, min is 0

C. max is 8, min is -2

D. max is 9, min is -2

E. max is 9, min is -4