Your Name

Student ID #

Your TA's name

Your Quiz Section Label and Time

Problem	Possible	Points
1	12	
2	12	
3	12	
4	14	
Total	50	

- No books allowed. You may use a scientific calculator and one $8\frac{1}{2} \times 11$ sheet of **handwritten** notes.

- Even if you have a calculator, give me **exact answers.**

- Do not share notes.

- In order to receive credit, you must show your work and explain your reasoning.

- **Place a box around** $\boxed{\textbf{YOUR FINAL ANSWER}}$ **to each question.**

- If you need more room, use the backs of the pages and indicate to the grader where to find your work.

- Raise your hand if you have a question or need more paper.

Don't open the test until everyone has a copy and the start of the test is announced.

1 (12 points total) Consider the curve given by the vector equation

$$\vec{r}(t) = \langle \sin(2t), t, \cos(2t) \rangle.$$

(a) (6 points) Verify that the point $P(0, \pi/2, -1)$ lies on the curve, and find the equation of the **normal plane** to the curve at P.

(b) (6 points) Find the curvature of the curve at all points (it may depend on t).

2 (12 points total)

(a) (6 points) Verify that the point $P(1, 2, 2)$ lies on the surface $z = f(x, y) = \sqrt{1 - x^3 + y^2}$, and find the equation of the tangent plane to this surface at P.

(b) (6 points) Use linear approximation for $f(x, y)$ based at $(1, 2, 2)$ to estimate the number $\sqrt{1 - (0.96)^3 + (2.02)^2}$.

3 (12 points) Find the points of local maximum and minimum and saddle points for the function

$$f(x, y) = x^2 + 2xy^2 - 4xy$$

4 (14 points total)

(a) (7 points) Evaluate the following integral (you may want to reverse the order of integration):

$$\int_0^1 \int_{\sqrt{y}}^1 \frac{ye^{x^2}}{x^3}\, dx\, dy$$

(b) (7 points) Convert the following integral to polar coordinates (**do not attempt to evaluate!**):

$$\int_1^{\sqrt{2}} \int_{\sqrt{2-x^2}}^x f(x,y)\, dy\, dx$$