Your Name

Your Signature

Student ID #

Quiz Section

- Don't open the exam until the start of the test is announced.
  Once the exam starts, check that you have 5 pages of problems, in addition to this cover page.
- This exam is closed book. You may use one $8\frac{1}{2} \times 11$ sheet of notes. Do not share notes.
- Graphing/integrating/differentiating calculators are NOT allowed.
  Please silence and put away your cell phone and all other electronics.
- **Unless otherwise instructed, you must show your work.** Answers with incomplete or incorrect work may receive little or no credit, even if the answer happens to be correct.
- There are different versions of this exam. Cheating is a serious offense and will be dealt with in accordance with the university's rules for academic misconduct.
- **Please place a box around YOUR FINAL ANSWER to each question.**
  Simplify, but leave your answers in exact form.
- If you need more room, use the backs of the pages and indicate to the grader that you have done so.
- Raise your hand if you have a question. Good luck!

Problem	Total Points	Score
1	8	
2	12	
3	8	
4	10	
5	12	
Total	50	

1. [**8 points**] An ant is standing on the surface $z = x^3 - 3xy + e^{xy}$ at the point $(1, 0)$.

(a) [**4 points**] If the ant were to walk East (that is, in the positive x direction), would it move up or down? Explain your reasoning.

(b) [**4 points**] Use differentials to estimate the ant's change in altitude when the ant travels from $(1, 0)$ to $(0.95, 0.12)$.

2. [**12 points**] Consider the function:

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

(a) Find and classify each of its critical points as a local minimum, local maximum, or saddle point.

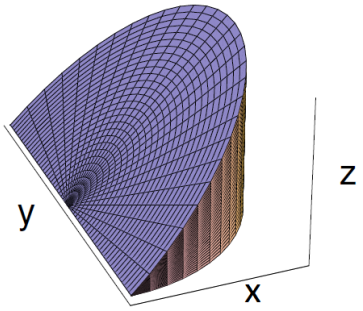
(b) Find the abolute maximimum value of this function on the region $D = \{(x, y)|x^2 + y^2 \leq 1\}$.

3. [**8 points**] Evaluate:

$$\int_0^8 \int_{y^{\frac{1}{3}}}^2 \frac{y^2 e^{x^2}}{x^8} dx dy$$

4. [**10 points**]

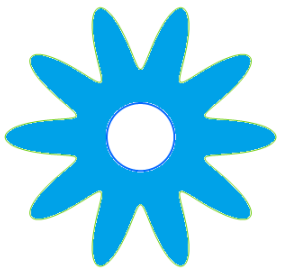
(a) Find the volume of the wedge shaped solid that lies above the xy-plane, below the plane $z = x$, and within the solid cylinder $x^2 + y^2 \leq 9$.



(b) Find the area of the flower-like region which is given in polar coordinates (r, θ) as

$$1 \leq r \leq 3 + \cos(10\theta)$$

The picture of this region can be admired to the right.



5. [**12 points**] A point on the outer rim of a badly thrown frisbee moves on a curve $\mathbf{r}(t)$, with **acceleration**:

$$\mathbf{r}''(t) =< 0, -\cos(t), -\sin(t) >$$

We know that $\mathbf{r}'(0) =< 1, 0, 1 >$ and $\mathbf{r}(0) =< 0, 1, 0 >$.

(a) [**3 points**] Find $\mathbf{r}(t)$.

(b) [**3 points**] Find the arclength of the curve from $t = 0$ to $t = 2\pi$.

(c) [**6 points**] Find the equation of the osculating plane at $t = \dfrac{\pi}{2}$.