Please show all work and **box your final answers**. If you need more room, you may use the backs of the pages. Calculators are not allowed. Good luck!

1. (8 points) Find all critical points of the function

$$f(x, y) = y^3 + 3x^2y - 6x^2 - 6y^2 + 2$$

and classify each as either a local maximum, local minimum, or saddle point.

2. (8 points) Find the absolute maximum and absolute minimum value(s) of f over the domain D, where

$$f(x, y) = 4x + 6y - x^2 - y^2,$$

$$D = \{(x, y) : 0 \le x \le 4, 0 \le y \le 5\}.$$

3. (8 points) Find the volume of the solid in the first octant bounded by the cylinder $z = 16 - x^2$ and the plane $y = 5$.

4. (8 points) Evaluate the integral by reversing the order of integration.

$$\int_0^4 \int_{\sqrt{x}}^2 \frac{1}{y^3 + 1} \, dy \, dx$$

Hint: First sketch the region D over which we are integrating.

5. (8 points) Find the volume of the solid contained in the first octant which is bounded by the cylinder $x^2 + y^2 = 4$, the paraboloid $z = 9 - x^2 - y^2$, and the planes $x = 0$, $z = 0$, and $y = x$.