1. (5 pts) What is the difference between a level curve and a level surface?

2. (10 pts)

   (a) (6 pts) Sketch several level curves of the function $f(x, y) = e^x + y$.

   (b) (4 pts) Describe in a few sentences what the graph of $f(x, y)$ looks like.

3. (10 pts) Suppose $z = e^x \sin y$ where $x = 3rs$ and $y = r^4s + rs^4$.
   Determine a formula for $\frac{\partial z}{\partial r}$ *written as a function of r and s.*

4. (10 pts)

   (a) (5 pts) In which direction is the function

   $$h(x, y, z) = 3x^2 + y^2 + z^2$$

   decreasing the fastest at the point $(1, -1, 4)$?

   (b) (5 pts) What is the directional derivative of h in the direction found in part (a) at the point $(1, -1, 4)$?

5. (15 pts)

   (a) (5 pts) Find all critical points of the function $g(x, y) = x^3 - 12xy + 8y^3 + 4$.

   (b) (5 pts) Classify each critical point as a local maximum, local minimum, or saddle point.

   (c) (5 pts) For **ONE** of the critical points found in part (a), give the equation of the tangent plane to the surface above that point.

6. (10 pts) Write at least two paragraphs that give a geometrical justification of why the method of Lagrange multipliers works.

   [*You may wish to include pictures to complement your discussion.*]