1. Let $f(x, y) = y^2 e^{xy}$.

[4] (a) Find the linearization of f at the point $(0, 1)$.

[3] (b) Find the derivative of f in the direction of $\mathbf{v} = \langle 3, -4 \rangle$ at the point $(0, 1)$.

[5] (c) If $x(t) = 2 - 2t$ and $y(t) = t^2$, use the chain rule to find the tangent vector to the curve $\mathbf{r}(t) = \langle x(t), y(t), z(t) \rangle$ when $t = 1$.

[3] (d) Verify that the tangent vector found in part (c) is tangent to the surface $z = f(x, y)$ at the point $(0, 1, 1)$.

2. Let $f(x, y) = 8x^3 + 12xy - y^3$.

[8] (a) Find and classify the critical points of f.

[7] (b) Find the absolute maximum and minimum of f on the set D given by the triangular region with vertices at $(0, 0)$, $(1, 0)$, and $(1, -2)$.

3. (a) Define what it means for a function $f(x, y, z)$ to be *continuous* at a point (a, b, c) in its domain. [2]

(b) Define what it means for a function $f(x, y, z)$ to be *differentiable* at a point (a, b, c) in its domain. [3]

(c) Show that if f is differentiable at a point (a, b, c), then it is continuous at (a, b, c). [5]
Hint: You can show this using only the above two definitions and the limit laws.