1. Let $f(x, y) = \dfrac{x^2}{y}$.

   (a) Find the gradient vector $\nabla f(x, y)$. Show your work

   (b) Find $D_{\mathbf{u}} f(2, -1)$ where $\mathbf{u}$ points in the same direction as $(2, -2)$. Show all of your work.

2. If a function $f(x, y)$ has a horizontal tangent plane at a point (x_0, y_0), what would be the normal vector for the tangent plane? What would be the value of the gradient vector $\nabla f(x_0, y_0)$?

$$\mathbf{n} =$$

$$\nabla f(x_0, y_0) =$$

3. Find the equation of the plane tangent to the surface

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

at the point $(2, -2, 8)$. Show all your work.