Name: ____________________

Pid: ____________________

Show all of your work. Full credit will be given only for answers with explanations.

1. (50 points) Check all the correct statements.
   - ◯ The tangent plane of the funciton $f(x, y) = xe^y + ye^x$ at $(1, 1, 2e)$ is defined by the equation
   $$2ex + 2ey = z + 2e.$$
   - ◯ The angle between $\frac{\partial f(\pi,0)}{\partial x}$ and $\frac{\partial f(\pi,0)}{\partial y}$ is $\pi/2$, where $f(x, y) = \langle \cos(x)+\sin(y), \sin(x)+\cos(y)\rangle$.
   - ◯ If $z = x^2 + y^2$, $x = \sin(t)$, and $y = \cos(t)$, then $\frac{dz}{dt} = 0$
   - ◯ The tangent planes of $f(x, y) = x^2 + y^2$ at $(1, 0, 1)$ and $(0, 1, 1)$ are parallel.
   - ◯ The vector $\langle 1, -1, 1\rangle$ is perpendicular to $\frac{df(\pi)}{dt}$ and $\frac{df(\pi/2)}{dt}$, where $f(t) = \langle \cos(t), \sin(t), t\rangle$.

2. Let $r = \langle x^y, y^x \rangle$, where $x = e^t$, and $y = t^2$.

   (a) (5 points) Find $\frac{dr}{dt}$.

   (b) (5 points) Find the tangent line of the curve described by the vector function r for $t = 1$

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

   (a) (5 points) Find the tangent planes to the surface defined by f at $(1, 1, 2)$ and $(-1, -1, -2)$.

   (b) (5 points) Check if these planes are intersectin; if they are intersecting, find symmetric equations for the line of intersection of the planes.

4. Let us consider a surfece defined implicitly by the equation $x^3 + y^3 + z^3 + 6xyz = 1$. Find the tangent plane of the surface at $(1, -3, -3)$.