Partial Derivatives Review

Please staple your work and use this page as a cover page.

1. For each of the following functions, find all partial first derivatives.
   (a) $f(x,y) = \ln(xy^3) - \dfrac{5}{y}$
   (b) $f(x,y) = \dfrac{x\sec y - 4x}{e^{2y}+1}$
   (c) $f(x,y,z) = \sqrt{yz}\cos^3(xz)$

2. Find and classify all critical points of $f(x,y) = x^3 + y^2 - 3xy^2$ (if you obtain an inconclusive result from the Second Derivative Test, you can leave that as your answer).

3. Let $f(x,y) = e^{x/y} - xy$.
   (a) Find $\vec{\nabla} f$, the gradient of f.
   (b) Find the maximum value of the derivative of f at $(3,1)$, and say what the direction of steepest ascent is at this point.
   (c) Find an equation for the tangent plane to the surface $z = f(x,y)$ at the point $(3,1)$.

4. Suppose we are on a hill modeled by the surface $z = f(x,y)$, and assume that north is the positive y-direction. At the point $(-1,7)$, we know the slope in the north direction is $\frac{1}{2}$, and the slope in the southeast direction is $3\sqrt{2}$. What is the initial slope at this point in the east direction?