Show all work and no calculators allowed.

Name and section: _____

1. Compute the following limits if they exist. If not show why.

   (a) $\lim\limits_{(x,y)\to(0,0)} \dfrac{1-e^{x^2+y^2}}{\sin(x^2+y^2)}$

   (b) $\lim\limits_{(x,y)\to(0,0)} \dfrac{x^4+xy^3+x^3y+y^4}{x^4+y^4}$

2. Let $f(x, y) = \sin(x^2 + y^3 - 1) - xy^2$. Find the tangent plane to $f(x, y)$ at the point $(3, -2)$. Use that plane to estimate $f(3.1, -1.9)$.

3. Find and classify extremma for $f(x, y) = -x^3 + 4xy - 2y^2 + 13$.

4. Find and classify extremma for $f(x, y, z) = x^2 + 2y^2 + z^2$ subject to $x - y + 3z = 1$.

5. $\iint_R y + 2\,dA$ over the triangle with vertices $A(0,0)$, $B(4,0)$ and $C(2,2)$.

6. $\iint_R \frac{x^2+y^2}{\arctan(y/x)}\,dA$ over the region insdie the circle $x^2+y^2=4$ outside the circle $x^2+y^2=1$ in the second quadrant.

7. $\iint_R \frac{e^{y-2x}}{y+3x}\,dA$ over the region defined the lines $y = 2x + 2$, $y = 2x + 4$, $y = -3x + 1$ and $y = -3x + 2$.