

Name: ANSWERSInstructions: No calculators! Answer all problems in the space provided!

1. Suppose  $F(x, y, z) = 0$  defines a level surface. Write down an equation for the tangent plane to  $F(x, y, z) = 0$  at the point  $(a, b, c)$ .  $F_x(x-a) + F_y(y-b) + F_z(z-c) = 0$  ( $F_x, F_y, F_z$  evaluated at  $(a, b, c)$ )
2. Given a function  $f(x, y)$ , what criteria must be fulfilled for the function to have critical point(s)?  
 $f_x = 0$  and  $f_y = 0$  or  $f_x$  and/or  $f_y$  undefined.
3. What is the function "D", used to classify the critical points of  $f(x, y)$ ?  $D = f_{xx}f_{yy} - (f_{xy})^2$
4. Find an equation of the tangent plane to the surface  $2x + yz^2 = 6e^{xyz}$  at the point  $(3, 0, 2)$ .  
 $2(x-3) - 32y = 0$
5. Find the classify the critical points of  $f(x, y) = xy(1 - x - y)$ . (No credit for classification if the wrong critical point is given. So solve for them carefully!)

Critical point 1:  $(0, 0)$  Classification saddle pointCritical point 2:  $(0, 1)$  Classification saddle pointCritical point 3:  $(1, 0)$  Classification saddle pointCritical point 4:  $(\frac{1}{3}, \frac{1}{3})$  Classification maximum point

6. For the function above, find the absolute max and min on the region bounded by
- $y = -x$
- ,
- $y = 1$
- and
- $x = 0$
- .

Absolute max  $f(0, 0) = f(0, 1) = 0$  Absolute min  $f(-1, 1) = -1$ **Bonus Problems:**

1. Set up an integral to compute the volume of the solid in the first octant bounded by the cylinder
- $z = 16 - x^2$
- and the plane
- $y = 5$
- .

Integral set-up:  $\int_0^5 \int_0^4 16 - x^2 dx dy$  or  $\int_0^4 \int_0^5 16 - x^2 dy dx$  Volume:  $\frac{640}{3}$ 

2. Evaluate the integral. Hint: it may be helpful to reverse the order of integration.

$$\int_0^1 \int_x^1 e^{x/y} dy dx = \underline{\underline{\frac{e-1}{2}}}$$