Do all your work and submit answers with your work, on the separate paper provided. Organize your work for efficient grading and feedback. Leave a margin, especially in the top left, where the staple goes!

1. (10 pts) Find and graph the domain of .
2. Find the first partials  and  for...
   1. (10 pts) 
   2. (10 pts) 
3. Find  for the equation  in 2 ways:  
   1. (5 pts) Use implicit differentiation, holding *y* constant and treating *z* as an implicit function of *x*.
   2. (5 pts) Form a function  and find  for the level surface .
4. Let .
   1. (10 pts) Find an equation of the tangent plane to *f* at the point .
   2. (10 pts) Use your previous answer to approximate .
   3. (5 pts) Find the actual value of .
   4. (5 pts) Find  for the change in *z* from  to 
   5. (5 pts) Find the differential approximation . You may calculate this, directly, or just use previous work and a subtraction.
   6. (5 pts) What is the gradient of *f* at ?
   7. (5 pts) Find the directional derivative for *f* ,  in the direction of  at the point 
5. Find the shortest distance between the plane  and the point  in three ways:  
   1. (5 pts) Use 1st- and/or 2nd- derivative test.
   2. (5 pts) Use earlier skills from Chapter 12.
   3. (5 pts) Use Lagrange Multipliers.

Bonus: Answer up to 3 of the following for up to 15 bonus points.

1. (5 pts) (Line segment) Write the equation of the line segment between  and .
2. (5 pts) Consider the object . Show its traces in the planes  for different choices of *k* and project those into the planes, respectively.
3. (5 pts) Give a verbal description of the statement . What is it? What does it mean? What’s our shortcut for calculating it, in terms of ?