INSTRUCTIONS: Do your work on the ANSWER SHEETS which I am providing. You need not re-write the problem. Just do the work and box your answer. Circle any significant sub-results along the way. Do no more than three (3) problems per page. Label each problem. Draw a horizontal line between problems. Don’t crowd your work. Write on one side (the front side) only. Keep the top and left margins that I have drawn. (Do not write ANYTHING except the page number & total pages in the “circle” provided). When you are finished, put your pages in order with this test paper on top, come up to my desk and sign-out. I’ll do the stapling.

If you don’t get an acceptable answer but do show your work, I’ll give as much partial credit as I can, determined by your work. Full credit will be given only for an acceptable answer AND acceptable work. Extra Credit may be given.

Today you have 5 problems. Each problem counts 10 points. Today’s problems are taken from Sects 14.2-14.5.

#6. By considering different paths of approach, show that the following limit does not exist (DNE) \( \lim_{(x,y) \to (0,0)} \frac{x^2 + y^2}{y^2} \).

#7. Given: \( f(x, y) = \sqrt{x^2 + y^2} \). Required: Find \( \frac{\partial f}{\partial x} \) and \( \frac{\partial f}{\partial y} \).

#8. Suppose \( w = xy + yz + xz \) with \( x = u + v \), \( y = u - v \) and \( z = uv \). (a) Calculate \( \frac{\partial w}{\partial u} \) using the chain rule, giving your answer in terms of \( u \) and \( v \) (make your \( u \)'s and \( v \)'s clear and distinct), then (b) evaluate \( \frac{\partial w}{\partial u} \) at the point \( (u, v) = \left( \frac{1}{2}, 3 \right) \). − Note: 3 extra bonus points for drawing the correct “Tree Diagram” for this problem.

#9. Find the gradient of \( f(x, y) = \frac{x^2 - y^2}{2} \) at the point \( P(\sqrt{2}, 1) \).

#10. (a) Use the Formula for Implicit Differentiation from Sect. 14.4 (Theorem 8) to find \( \frac{dy}{dx} \), if \( y \) is implicitly defined as a function of \( x \) by the equation \( x^3 - 2y^2 + xy = 0 \). Then, (b) evaluate \( \frac{dy}{dx} \) at \( P(1,1) \).

#11. (Bonus) Find the derivative of the function \( f(x, y, z) = xy + yz + xz \) at the point \( P_0(1, -1, 2) \) in the direction of \( \vec{A} = 3\vec{i} + 6\vec{j} - 2\vec{k} \).