

**Math 2415**  
**Paper Homework #7**

1. **14.6, Gradient and Directional Derivative:** Let  $f(x, y) = \frac{1}{\sqrt{x^2+y^2}}$ .
- (a) Calculate the gradient of  $f$  at  $(1, -1)$ .
  - (b) Find the directional derivative of  $f$  at  $(1, -1)$  in the direction of  $-\mathbf{i} + 3\mathbf{j}$ .
  - (c) Find the direction in which  $f$  increases most rapidly at the point  $(1, -1)$ .
  - (d) In what directions is the rate of change of  $f$  equal to zero at the point  $(1, -1)$ ?
  - (e) Sketch the curve  $f(x, y) = \frac{1}{\sqrt{2}}$  together with  $\nabla f$  and the tangent line at the point  $(1, -1)$ .  
Use  $\nabla f(1, -1)$  to find an equation for this tangent line.
2. **14.7A, Local Max/Min:** Find all local maxima, local minima, and saddle points of the function  $f(x, y) = 2xy - 5x^2 - 2y^2 + 4x + 4y - 4$ .