

Name \_\_\_\_\_ Date \_\_\_\_\_

Instructions: Please show all of your work as partial credit will be given where appropriate, **and** there may be no credit given for problems where there is no work shown. All answers should be completely simplified, unless otherwise stated.

1. (15 points) Find the limit of  $\lim_{(x,y) \rightarrow (0,0)} \frac{xy}{\sqrt{x^2+y^2}}$  or state and explain why it does not exist.

Answer : \_\_\_\_\_

2. (10 points) Find the equation of the tangent plane of  $f(x, y) = x^2y + 3xy^2$  at the point at  $\mathbf{p} = (2, -2)$  ?

Answer: \_\_\_\_\_

3. (15 points) Find  $\nabla f$  given  $f(x,y)=x^2-3xy+y^2$ . Use this to find the directional derivative of  $f$  at the point  $(-1,2)$  in the direction of the vector  $2\mathbf{i}-\mathbf{j}$ .

$\nabla f$  : \_\_\_\_\_

Directional Derivative : \_\_\_\_\_