

## Quiz 4

1. (a) Find the directional derivative of  $f(x,y,z) = xy^2 \tan^{-1} z$  at  $(2,1,1)$  in the direction of  $\underline{v} = \langle 1,1,1 \rangle$ .

(b) Find the maximum rate of change of  $f$  at this point, and the direction in which it occurs.

2. ~~Find the~~ If  $f(x,y,z) = xyz$ , find the gradient vector  $\nabla f(3,2,1)$ , and use it to find the tangent line to the level curve  $f(x,y,z) = 6$  at  $(3,2,1)$ . Sketch the level curve, tangent line, and gradient vector.

3. Find the linear approximation of the function  $f(x,y) = 1 - xy \cos(\pi y)$  at  $(1,1)$ , and use it to approximate  $f(1.02, 0.97)$ .

4. (a) Let  $N(p,q,r) = \frac{p+q}{p+r}$ , where  $p = u+vw$ ,  $q = v+4w$ ,  $r = w+uv$ . Find  $\frac{\partial N}{\partial u}$ ,  $\frac{\partial N}{\partial v}$ ,  $\frac{\partial N}{\partial w}$  when  $u=2, v=3, w=4$ .

(b) If  $yz + x \ln(y) = z^2$ ,  $[z = z(x,y)]$ , then find  $\frac{\partial z}{\partial x}$  and  $\frac{\partial z}{\partial y}$  at  $x=1, y=e$ .