Directions: Please show all work for maximum credit. This quiz is worth 14 points. Good luck!

1. Given $f(x,y) = y^4 \cos(3x)$. Determine the following.

(1 point) a. $f_x = -3y^4 \sin(3x)$

(1 point) b. $f_y = 4y^3 \cos(3x)$

(1 point) c. $f_{xx} = -9y^4 \cos(3x)$

(1 point) d. $f_{xy} = -12y^3 \sin(3x)$

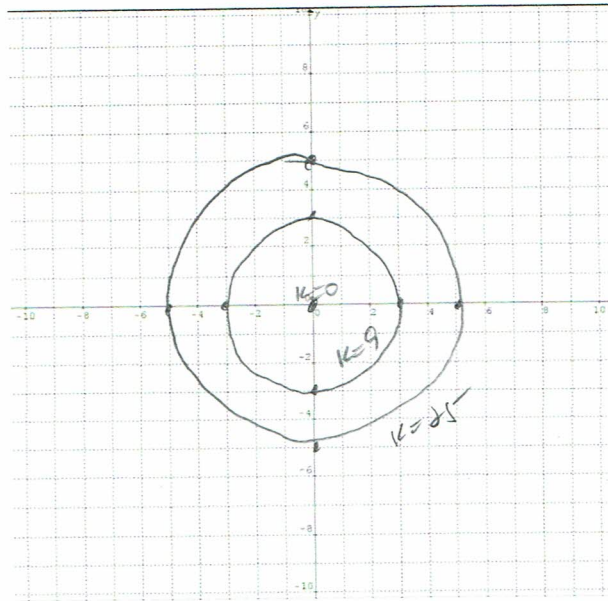*(1 point)* e. $f_{yy} = 12y^2 \cos(3x)$

(3 points) 2. Find the following limit: $\displaystyle \lim_{\substack{(x,y)\to(1,1)\\ x\neq 1}} \frac{xy-y-2x+2}{x-1}$

$$= \lim_{\substack{(x,y)\to(1,1)\\ x\neq 1}} \frac{y(x-1)-2(x-1)}{x-1}$$

$$= \lim_{\substack{(x,y)\to(1,1)\\ x\neq 1}} \frac{(x-1)(y-2)}{x-1}$$

$$= \lim_{\substack{(x,y)\to(1,1)\\ x\neq 1}} (y-2) = 1-2 = -1$$

(3 points) 3. Given the following function: $f(x,y) = x^2 + y^2$. Sketch the function's level curves when $k = 0$, $k = 9$, and $k = 25$.

$k = 0$:
$$x^2 + y^2 = 0$$

$k = 9$
$$x^2 + y^2 = 9$$

$k = 25$
$$x^2 + y^2 = 25$$

(3 points) 4. Find the equation of the tangent plane at the point $P_0(1, -2, 1)$ on the surface $z = 3x^2 - y^2 + 2x$.

$f_x = 6x + 2$ $\qquad$ $f_y = -2y$

$f_x(1, -2) = 8$ $\qquad$ $f_y(1, -2) = 4$

$$z - 1 = 8(x - 1) + 4(y + 2)$$

$$z - 1 = 8x - 8 + 4y + 8$$

$$z - 1 = 8x + 4y$$

$$z = 8x + 4y + 1$$