1. Consider the function

$$f(x, y) = e^{\sin(x)\cos(xy)}$$

Our goal in this problem is to find the equation of the tangent plane to this surface at the origin $(0, 0)$.

(a) (*4 points*) Find the partial derivatives $f_x(0, 0)$ and $f_y(0, 0)$.

$$f_x = e^{\sin(x)\cos(xy)} \cdot \left[\sin(x) \cdot -\sin(xy) \cdot y + \cos(x)\cos(xy)\right]$$

$$f_y = e^{\sin(x)\cos(xy)} \left[\sin(x) \cdot -\sin(xy) \cdot x + 0 \cdot \cos(xy)\right]$$

$$f_x(0,0) = e^0 \cdot [0 + 1] = 1 \qquad \left\{\begin{matrix}\sin 0 = 0 \\ \cos 0 = 1\end{matrix}\right\}$$

$$f_y(0,0) = e^0 \cdot [0 + 0] = 0$$

(b) (*3 points*) Show that the equation of the tangent plane to our given function $f(x, y)$ at the origin is $z = 1 + x$.

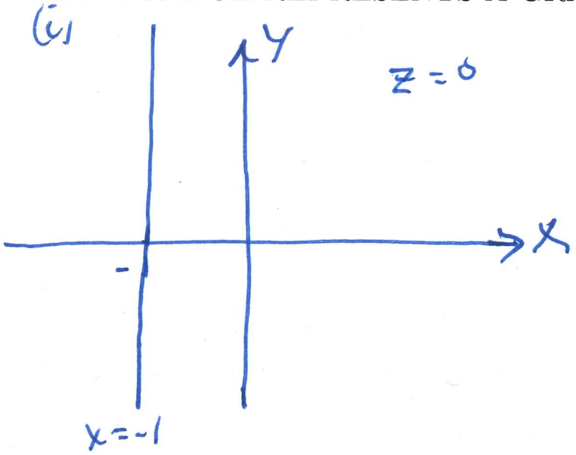
$$z = f(0,0) + f_x(0,0)(x-0) + f_y(0,0)(y-0)$$

$$= 1 + 1 \cdot x + 0 \cdot y$$

$$z = 1 + x \qquad f(0,0) = e^{0 \cdot 1} = e^0 = 1$$

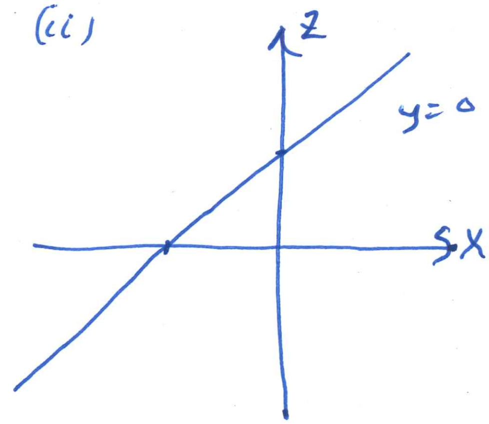
(c) (*3 points*) Sketch 2-dimensional graphs of what the tangent plane to $f(x, y)$ at $(0, 0)$ looks like in the (i) xy-plane with $z = 0$ (ii) xz-plane with $y = 0$ and (iii) yz-plane with $x = 0$. CLEARLY INDICATE WHICH OF THESE GRAPHS REPRESENT A GRAPH OF A CROSS-SECTION AND WHICH REPRESENTS A GRAPH OF A LEVEL SET.

(i)

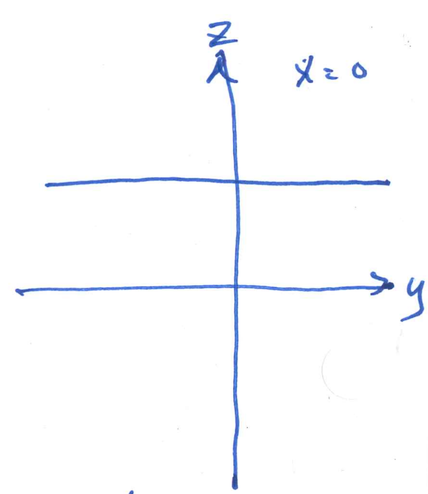


LEVEL SET OF z = 0

(ii)



y = 0 CROSS-SECTION



x = 0 CROSS-SECTION