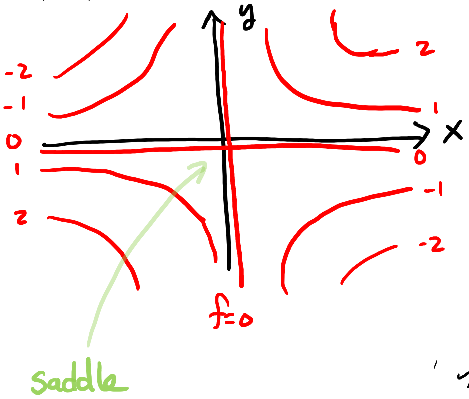
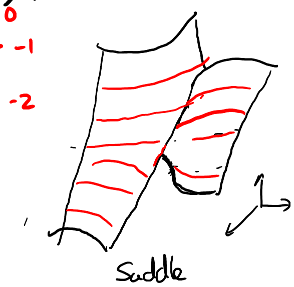
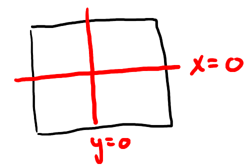
0.1. **Drawing Contour Plots.** Draw a contour plot with steps at $z = 0, z = -1$ and $z = -1$ of the function $f(x, y) = xy$. What is the general shape of the graph of $f(x, y)$?

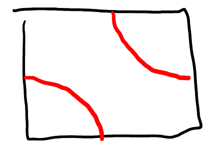




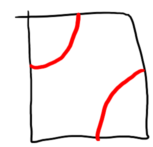
$xy = 0 \Rightarrow x = 0$ or $y = 0$



$xy = 1 \Rightarrow y = \frac{1}{x}$

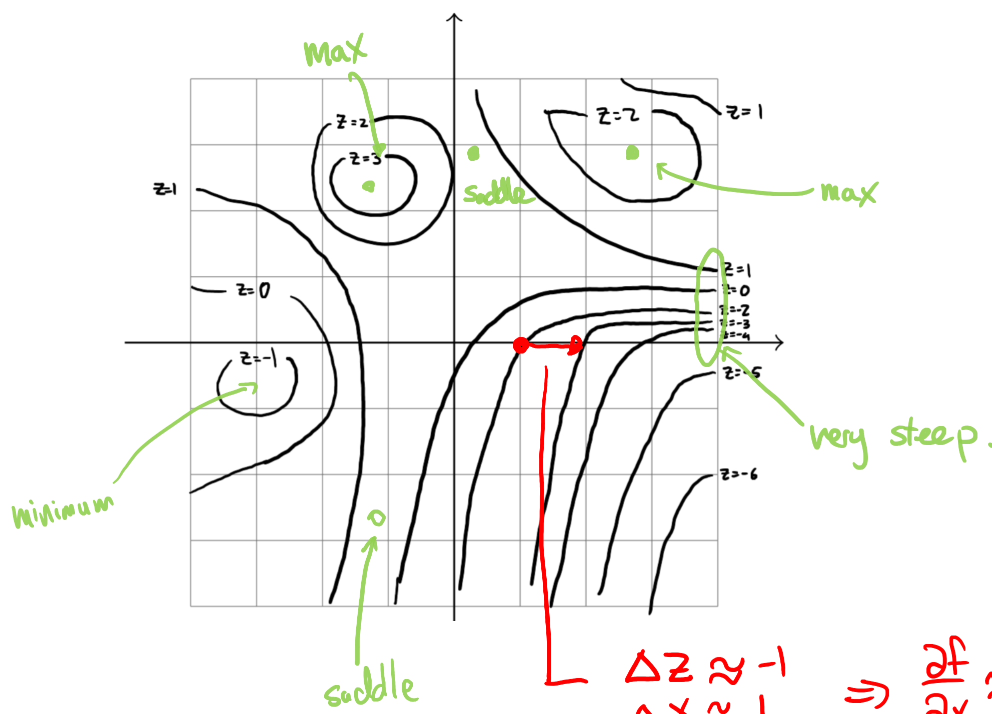


$xy = -1 \Rightarrow y = -\frac{1}{x}$



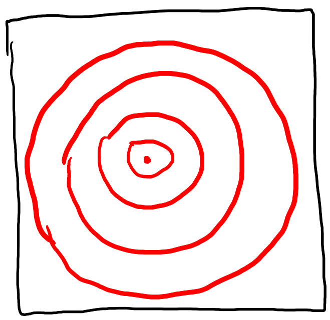
0.2. **Interpreting Contour Plots.** Determine the following information from the drawn contour plot:

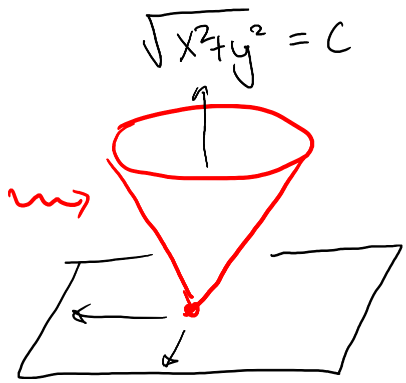
- Mark the locations of minimum, maximum and saddle points for the drawn contour plot.
- Where on this contour plot is the function going to be the "steepest"?
- Approximate the partial derivative $\frac{\partial f}{\partial x}$ at the point $(1, 0)$.



$$\Delta z \approx -1 \quad \Delta x \approx 1 \Rightarrow \frac{\partial f}{\partial x} \approx -1.$$

0.3. **Review: Planes.** Describe the graph of the function $f(x,y)=\sqrt{x^2+y^2}$. Draw a picture of the graph. Using your geometric intuition, guess what the tangent plane to the graph looks like at the point $\langle 1,0,1\rangle$. After you have used your drawing to guess what the tangent plane is, use partial derivatives to check your solution.





Level sets are circles of increasing radis

Guess: Plane through $\langle 1,0,1\rangle$ is $\parallel$ to the y axis & contains origin,

$x - z = 0$?

0.4. **Continuity.** Consider the function $f(x,y)=\frac{x+y}{\sqrt{x^2+y^2}}$. What does this function looks like when restricted to the plane $x+y=0$ and the plane $x-y=0$? Why does this show that f fails to be continuous as the origin?