1. Let $\vec{F} : U \subseteq \mathbb{R}^2 \to \mathbb{R}^2$ be defined by $\vec{F}(x, y) = (\sqrt{x^2 - y}, x + y + 3)$ (where we’ve agreed to drop the “vector hats” except over the name of the function $\vec{F}$).

1A. Sketch the domain of $\vec{F}$.

1B. Note that $\vec{F}$ is a vector field. Draw this much of the field, starting at the following three vectors/points: $(1, -3), (-1, 0),$ and the origin. Put your sketch next to your answer to 1A, above.

2. In the space below, and on the same set of axes, sketch the level curves of $f(x, y) = xy,$ for $C = -2$ and $C = 1$. Label which curve is which.

3. Suppose the level curves for $C = L - \epsilon, C = L, \text{ and } C = L + \epsilon$ for some function $z = f(x, y)$ are as in the following figure.

3A. As $(x, y)$ approaches $(a, b),$ the limit of $f(x, y)$ appears to be $L$. Estimate to a tenth of a centimeter the biggest possible $\delta$ for which $0 < ||(x, y) - (a, b)|| < \delta$ implies $|f(x) - L| < \epsilon$. DRAW that collection of $(x, y)$’s on the graph.

Your value for $\delta$ is?

3B. Explain why $\displaystyle \lim_{(x, y) \to (p, q)} f(x, y)$ cannot exist.