1. Match the vector field with its plot in the above figure. Talk with your group and relate characteristics of the plots to the functions.
   (a) \( \mathbf{F}(x, y) = \langle x, y \rangle \)
   (b) \( \mathbf{F}(x, y) = \langle y, y - x \rangle \)
   (c) \( \mathbf{F}(x, y) = \langle \cos x, \cos y \rangle \)
   (d) \( \mathbf{F}(x, y) = \langle x, x - 2 \rangle \)

2. Which of the above vector fields can you conclude are \textit{not} conservative? For the others, can you find a potential function?

3. Show that if \( \mathbf{F}(x, y, z) \) is a vector field with smooth component functions then the divergence of the curl of \( \mathbf{F} \) is 0, i.e. \( \nabla \cdot (\nabla \times \mathbf{F}) = 0 \). Give an explanation for why this is not surprising in light of what you know about \( \cdot \) and \( \times \) from 32a.

4. Try to determine whether or not the vector field \( \mathbf{F}(x, y, z) = \langle y^2, 2xy + e^{3z}, 3ye^{3z} \rangle \) is conservative. If you think it is conservative, find a potential function.

5. Consider the vector field \( \mathbf{F}(x, y) = \langle -\frac{y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \rangle \).
   (a) Compute \( \oint_{C} \mathbf{F} \cdot d\mathbf{r} \) where \( C \) is the circle of radius \( r \) centered at the origin, oriented counterclockwise. This computation shows that \( \mathbf{F} \) is \textit{not} conservative. (We’ll talk about this more in class on Wednesday)
   (b) Show that the curl of \( \mathbf{F} \) is 0. Is this surprising in light of numbers 2 and 4 on this worksheet and that fact that \( \mathbf{F} \) is not conservative (and what we’ve talked about in class, if you are doing this worksheet later in the week)? Give a resolution to the conundrum. \textbf{Hint:} What are the domains of all these vector fields?