Complete these exercises:

A. Section 16.1 Exercises 11-14, 15-18, 23.

B. In class we discussed the vector field $\vec{F} = \langle 1 + \log(xy), x/y \rangle$ for $x > 0$ and $y > 0$. Either find a potential function for $\vec{F}$, or show that none exists. [Hint: $(x \log x - x)' = \log x$.]

For the remaining problem(s), let X be the set of points in the plane other than the origin:

$$X = \{(x, y) : x \neq 0 \text{ or } y \neq 0\}.$$

Also let

$$\vec{F} = \left\langle \frac{-y}{x^2 + y^2}, \frac{x}{x^2 + y^2} \right\rangle.$$

Notice that $\vec{F}$ is defined on all of X.

C1. Show that $\frac{d}{dy}F_1 = \frac{d}{dx}F_2$ everywhere on X.

C2. Find a potential function for $\vec{F}$ on the part of X where $x > 0$. [Hint: Consider something like $\arctan(y/x)$ or $\arctan(-x/y)$.]

C3. Find a potential function for $\vec{F}$ on the part of X where $y > 0$.

C4. Find a potential function for $\vec{F}$ on the part of X where $x < 0$.

C5. Find a potential function for $\vec{F}$ on the part of X where $y < 0$.

C6. Explain thoroughly why there is no one potential function for $\vec{F}$ on all of X. [Hint: Figure out what the value of the function must be at the four points $(x, y) = (\pm 1, \pm 1)$.]