1. a. Define a "gradient field", and a "potential function".  
   b. Explain why every gradient field is path-independent.  
   c. Explain what the curl has to do with gradient fields?

2. a. Use the table to estimate \( \int_{C_1} \vec{F} \cdot d\vec{R} \) for the rectilinear path \( C_1 \) from \((2, 0)\), via \((0, 0)\) to \((0, 2)\).  
   b. Use the table to estimate \( \int_{C_1} \vec{F} \cdot d\vec{R} \) for the rectilinear path \( C_1 \) from \((2, 0)\), via \((2, 2)\) to \((0, 2)\).  
   c. Based on the results from a. and b. does \( \vec{F}(x, y) \) appear to be a gradient field? Explain.

3. a. Describe a physical application/interpretation for at least one of the pictured vector fields.  
   b. Which of these fields appear to be gradient fields? Explain why, or why not.  
   c. Find a possible formula for each pictured vector field.  
   d. Find a possible formula for a potential function for at least one of the vector fields.

4. Calculate the line integral \( \int_C \vec{F} \cdot d\vec{R} \) where \( \vec{F}(x, y) = -y\vec{i} + x\vec{j} \) and \( C \) consists of the edges of the triangle with corners \((2, 0)\), \((0, 2)\) and \((0, 0)\) traversed counterclockwise.

5. Consider the vector field \( \vec{H}(x, y) = \frac{-y\vec{i} + x\vec{j}}{x^2 + y^2} \).  
   a. Calculate the line integral \( \int_C \vec{H} \cdot d\vec{R} \) where \( C \) is the circle with center \((0, 0)\) and radius \( a = 1 \).  
   b. Calculate the scalar curl \( \frac{\partial}{\partial x} H_2(x, y) - \frac{\partial}{\partial y} H_1(x, y) \).  
   c. Use Green's theorem to calculate \( \int_{C_1} \vec{H} \cdot d\vec{R} \) where \( C_1 \) is the triangle with corners \((7, 0)\), \((3, 3)\) and \((0, 5)\) oriented counterclockwise.  
   d. Explain why Green's theorem does not directly apply to the triangle with corners \((7, 0)\), \((-3, -3)\), and \((0, 5)\). BONUS: Explain how one can still use Green's theorem to utilize the result of part b. to get a quick result for this line integral.