## Assignment 3 PHGN361

## Homework due Jan. 31

- 1. Chapter 1 problems 47, 55.
- 2. Chapter 2 problems 33, 35, 39, 43, 51
- 3. Chapter 3 problems 2, 3, 4.
- 4. Using Mathematica (Load the graphics package using the command *Needs*["*Graphics*'*PlotField*'"]), obtain the following information.
  - (a) Plot the vector field  $x Exp[-(x^2 + y^2)]\hat{i} + 0\hat{j}$  over the interval  $\{x, -2, 2\}$  and  $\{y, -2, 2\}$ .
  - (b) Calculate the divergence of this vector field.
  - (c) Obtain a contour plot of this divergence with 20 contours and  $PlotPoints \rightarrow 50$  over the interval
  - $\{x, -2, 2\}$  and  $\{y, -2, 2\}$ . Interpret parts (a), (b), and (c) in terms of Gauss's law  $(\vec{\nabla} \cdot \vec{E} = \rho/\epsilon)$ .

(d) Consider the two vector fields  $\vec{E}_1 = \{y, -x\}/\sqrt{x^2 + y^2}$  and  $\vec{E}_2 = \{x, y\}/\sqrt{x^2 + y^2}$ . Plot these vector fields over the interval  $\{x, -2, 2\}$  and  $\{y, -2, 2\}$ .

(e) Calculate the curl and divergence of both  $\vec{E}_1$  and  $\vec{E}_2$ .

(f) Consider the vector field  $E_1 = x\hat{i} + y\hat{j}$  and the path defined by  $\vec{r} = \sin(2s)\hat{i} + \cos(s)\hat{j}$ , where s goes from 0 to  $\pi/2$ . Plot the vector field and the path. Find  $\int \vec{E_1} \cdot d\vec{l}$  for this path. Do the integral numerically.