## 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 ${ }^{\bullet}$ "]), obtain the following information.
(a) Plot the vector field $x \operatorname{Exp}\left[-\left(x^{2}+y^{2}\right)\right] \hat{i}+0 \hat{j}$ 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 $\vec{r}=\sin (2 s) \hat{i}+\cos (s) \hat{j}$, 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.
