Physics 106: Electricity and Magnetism I
Spring Semester, 2010

PROBLEM SET 3: Due Friday, Feb. 26

Problem 1: Compute the gradient of the following functions:
(a) $f_1(x, y, z) = x^3y^{-2} + z^2$,
(b) $f_2(x, y, z) = x^2y^3$
(c) $f_3(x, y, z) = \cos(x + yz)\tan(z)$,
(d) $f_4(x, y, z) = (x^2 - 4)^2\cos(y)$.

f_2 and f_4 are functions of x and y only, therefore we can use the plotting scheme demonstrated in class. For these two functions, make a 3D plot and a contour plot of the function itself, and a vector-field plot of the gradient. Choose plotting ranges so you can see the "interesting' regions near the origin.

The Mathematica code you need for the plots is available in the Mathematica Examples section of the P106 website. Here it is again:

```
Needs["VectorFieldPlots‘"] (* that's a left-hand single quote!*)
f[x_,y_] := Sin[x] Sin[y] (* insert your function here *)
xl = -3 (*these specify plot range*)
xu = 3
yl = -3
yu = 3
gx = D[f[x,y],x] (* This sets gx equal to the derivative of f(x,y) w.r.t x *)
gy = D[f[x,y],y]
Plot3D[f[x,y],{x,xl,xu},{y,yl,yu}]
ContourPlot[f[x,y],{x,xl,xu},{y,yl,yu},
Contours->20]
VectorFieldPlot[ {gx,gy},{x,xl,xu},{y,yl,yu}]
```

Problem 2: Purcell 2.1. Remember the minus-sign in the relations between E and ϕ. Use Mathematica to make 3D and contour plots of $\phi(x, y)$, and a vector-field plot of $\mathbf{E}(x, y)$. You will have to make a trivial modification of the code given above.

Problem 3: Purcell 2.2.

Problem 4: Purcell 2.4. Plots are useful!

Problem 5: Purcell 2.5.

Problem 6: Purcell 2.10.