Physics 342, Homework 1

1: 1-9

2: 1-10

3: 1-13 (this is either really easy or really hard, maybe try crossing vector A with vector B)

4: 1-25 The unit vectors in the spherical coordinate system are given by

$\hat{e}_\phi = -\sin\phi\hat{i} + \cos\phi\hat{j}$
$\hat{e}_\theta = \cos\theta\cos\phi\hat{i} + \cos\theta\sin\phi\hat{j} - \sin\theta\hat{k}$
$\hat{e}_r = \sin\theta\cos\phi\hat{i} + \sin\theta\sin\phi\hat{j} + \cos\theta\hat{k}$

Following the procedure used in class for plane cylindrical coordinates do this problem assuming your initial vector is $r\hat{e}_r$. Hint $\hat{e}_\phi$ depends on $\hat{e}_r$ and $\hat{e}_\theta$ in a way that is not as straightforward to see as the time derivatives of the other unit vectors. See what you can do with factors of $-\dot{\phi}$ with trig functions to make this work.

5: 1-31 - don't forget that $r = \sqrt{x^2 + y^2 + z^2}$ and $\frac{\partial f}{\partial x} = \frac{\partial f}{\partial r}\frac{\partial r}{\partial x}$ Also, you really only need to take the first partial derivative with respect to x or the 2nd derivative with respect to x to figure this out since all taking the derivatives with respect to y and z changes is to make x go to y or z. This can be long or relatively short if you don't overdo the work.

6: Check the divergence theorem explicitly using the vector function $\vec{A}(x, y, z) = x^2\hat{i} + y^2\hat{j} + z^2\hat{k}$ on a cube sides L and with one corner at the origin with the cube in the upper positive x,y,z octant

7:Verify Stoke's theorem explicitly using the vector function $\vec{F}(x, y, z) = 2z^2\hat{i} + 3y^2\hat{j}$ on a square with sides of length one placed at the origin and residing in the x z plane. Take the first leg of the integral from the origin up the z axis then work your way around counterclockwise.