

**Class Problems and Homework**  
Physics 403: Mathematical Methods  
January 30, 2006

Problems: Instructor, group and homework.

1. Questions from Class 1?
2. Compute the divergence of the following vector field in  $(r, \theta, \phi)$  coordinates.

$$\vec{v} = (r \cos \theta)\hat{r} + (r \sin \theta)\hat{\theta} + (r \sin \theta \cos \phi)\hat{\phi}$$

3. Compute the gradient and Laplacian of the function

$$T = r(\cos \theta + \sin \theta \cos \phi).$$

4. Check your answer for the Laplacian by converting  $T$  to cartesian coordinates and computing the Laplacian of  $T$  in cartesian coordinates.
5. Compute the divergence and curl of the following vector field in polar coordinates.

$$\vec{v} = \rho(2 + \sin^2 \phi)\hat{\rho} + \rho \sin \phi \cos \phi \hat{\phi} + 3z^2 \hat{z}$$

**SHORT EXAM 1 ON FRIDAY!**