

Class 2 Partial Solutions
Physics 403: Mathematical Methods
January 30, 2006

1.

$$\nabla \cdot \vec{v} = 5 \cos \theta - \sin \phi$$

2.

$$\nabla T = (\cos \theta + \sin \theta \cos \phi) \hat{r} + (-\sin \theta + \cos \theta \cos \phi) \hat{\theta} - \sin \phi \hat{\phi}$$

$$\begin{aligned} \nabla^2 T &= \frac{2}{r}(\cos \theta + \sin \theta \cos \phi) \\ &\quad + \frac{1}{r \sin \theta}(-2 \sin \theta \cos \theta - \sin^2 \theta \cos \phi + \cos^2 \theta \cos \phi) + \frac{1}{r \sin \theta}(-\cos \phi) \\ &= 0 \end{aligned}$$

3.

$$T = z + x \Rightarrow \nabla^2 T = 0$$

4.

$$\nabla \cdot \vec{v} = 5 + \sin^2 \phi + 6z$$

$$\nabla \times \vec{v} = \vec{0}$$