Math 5310 - Fall 2009

Due Wednesday, 9 Nov

Collected problems

1. Parker 3.3, 3.7. Hint: in 3.3, the request for an approximation to first order in a suggests finding the first few terms of a Maclaurin expansion of ϕ in the variable a.

2. Laplace's equation is
$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} + \frac{\partial^2 \phi}{\partial z^2} = 0.$$
   (a) Show that Laplace's equation is linear.
   (b) Show that Laplace's equation can be written with vector operations as
$$\text{div}(\text{ grad}\, \phi) = \nabla \cdot (\nabla \phi) = 0.$$
   If you don't recall the definitions of gradient and divergence, refer to your calculus book.

3. A linear equation has the form $L[u] = f$ where L is a linear operator. Which of the following differential equations are linear?
   (a) $u_{xx} - uu_x = 0$
   (b) $u_{xx} - xu_x = 0$
   (c) $u_{xx} + \sinh u = 0$
   (d) $u_{xx} + \sinh x = 0$