Name _____

MATH 302 Partial Differential Equations Fall 2009 Exam #3

Instructions: Do your own work. You may consult your class notes and the course text. You may also consult your texts from prerequisite courses (calculus, linear algebra, and differential equations) for reference on background mathematics. Do not consult other sources. Do not discuss generalities or specifics of the exam with anyone except me.

Turn in a complete and concise write up of your work. Show enough detail so that a peer could follow your work (both computations and reasoning). All plots should be carefully drawn either by hand or printed from technology.

The exam is due in class on Tuesday, September 22.

If you want to include animations from *Mathematica*, send me an e-mail with your *Mathematica* notebook as an attachment. Name the file you send `Math302Exam2_XX.nb` where XX are your initials and use "Math 302 Exam 2" as the subject line of the e-mail.

Consider the fundamental conservation law in one dimension with flow due to both advection and diffusion (so $\phi = cu - ku_x$) and a source term of zero. Take the spatial domain to be $0 \leq x \leq L$ with boundary conditions $u(0,t) = u_1$ and $u(L,t) = u_2$. Assume that all of the parameters (c, k, u_1, and u_2) are constants.

Set up and solve the steady-state problem for this model. Describe the solution(s) with plots and/or a physical description. As part of understanding and interpreting the solution, you might consider special cases such as $u_1 = u_2$ or $c = 0$.