## AMSC/CMSC 661 Quiz 9 , Spring 2010

Show all work. You may leave arithmetic expressions in any form that a calculator could evaluate. By putting your name on this paper, you agree to abide by the university's code of academic integrity in completing the quiz. Use no calculators, cellphones, or any other electronic devices, and don't communicate with other students. You may use the Larsson&Thomèe textbook, anything taken from the course website, and your own notes.

Name \_\_\_\_

1. (10) Suppose we want to solve the differential equation

$$u_t + (1+x)u_x + 5u = t\cos(x)$$

for  $t > 0, x \in (0, 1)$ , with given initial and boundary conditions. Let  $u_j^n$  be our approximation to u(jh, nk), where k is the timestep and h = 1/m is the spatial step. Consider the Wendroff Box Scheme finite difference method

$$\frac{u_j^{n+1} + u_{j+1}^{n+1} - u_j^n - u_{j+1}^n}{2k} + (1+x_j) \frac{u_{j+1}^{n+1} + u_{j+1}^n - u_j^{n+1} - u_j^n}{2h} + 5 \frac{u_j^{n+1} + u_{j+1}^{n+1} + u_j^n + u_{j+1}^n}{4} = t_n \cos(x_j).$$

Given values  $u_j^n, \ j=0,\ldots,m,$  explain how you would compute  $u_j^{n+1}, \ j=0,\ldots,m$  .

2. Consider the problem

$$\begin{aligned} u_t + (1+t) u_x &= 0, \quad x \in [0,\infty), \ t \in (0,\infty), \\ u &= x^2, \quad \{x \in [0,\infty), \ t = 0\} \cup \{x = 0, \ t > 0\}. \end{aligned}$$

2a. (5) Write the differential equation that defines the characteristics for this problem.

2b. (5) Write the solution to the problem.