DEPARTMENT OF MATHEMATICS  
UNIVERSITY OF KANSAS  
MATH 647 - Spring 2016 - Sample Midterm

Your Name: ________________________________

On this exam, you may use a calculator and a page of notes.

It is not sufficient to just write down the answers. You must explain how you arrived at your answers and how you know they are correct.

1 (100) ________  
2 (100) ________  
3 (100) ________  
4 (100) ________  
Total (400) ________
(1) Consider the linear transport equation
\[ u_t + (1 + x^2)u_x = 0 \]
Find and sketch the characteristic curves, write a formula for the general solutions and find the solution to the initial value problem \( u(x, 0) = 1 - e^{-x^2} \)

(2) Use D’Alembert’s formula to solve the one dimensional wave equation
\[ u_{tt} = 4u_{xx}, \]
subject to initial conditions
\[ u(x, 0) = e^{-x^2}, \quad \frac{\partial u}{\partial t}(x, 0) = \sin x \]

(3) Solve problem 4.2.9 from the book by P. Olver.

(4) Solve the non-homogeneous boundary value problem for the one dimensional heat equation on a bar with unit length and \( c = 1 \), for the following data:
\[ u(0, t) = 100, \quad u(1, t) = 50, \quad u(x, 0) = x. \]