King Fahd University of Petroleum and Minerals
Department of Mathematics and Statistics
Math 470 Exam I
Semester I, 2009- (091)
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(1) Classify the partial differential equations: (pg 37)

(a) $u_{xx} - 8u_{xy} + 2u_{yy} + xu_x - yu_y = 0$

(b) $3u_{xx} + 2u_{xy} - u_{yy} + yu_x - u_y = 0$

(c) $3u_{xx} - 8u_{xy} + 2u_{yy} + (x+y)u_y = 0$

(d) $2u_{xx} - 2u_{xy} - 3u_{yy} + y^2 u_x - u = 0$

(2) Classify the equation as linear, quasi-linear and non-linear ; then find the order of the PDE

	linear	**quasi linear**	**non linear**	**order**
$(x-y)u_x^2 + 2u_y = 4y$ (7(d)/pg4)				
$u_x + u_y^2 - u_{xx} = 4$ (7(f)/pg4)				
$\Delta^2 u + u_x \Delta u_y - u_y \Delta u_x = 0,$ where $\Delta = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}$				
$\Delta u + uu_x + uu_y + P_x = f,$				
$\Delta u + v_x u_x + v_y u_y = g,$ v is a given function				

(3) Determine the canonical form of the elliptic equation (4/pg37)

$$2u_{xx} - 4u_{xy} + 2u_{yy} - y^2 u_x + u_y - xu = 0 .$$

(2(d)/pg29)

(4) Determine the canonical form of the hyperbolic equation

$$3u_{xx} + 6u_{xy} + 2u_{yy} = 0.$$

(5) Use the method of characteristics to find a solution of the PDE (10/pg22)

$$xu_x + u_y = e^u$$

that passes through the curve Γ given by $y = x - 1,\ \ u = 0.$

(11/pg37)

(6) Let a,b, and c be constants and suppose that

$$u_{xx} - u_{yy} + au_x + bu_y + cu = 0$$

Let $v(x,y) = e^{\alpha x + \beta y}u(x,y).$ Determine constants α, β and h so that

$$v_{xx} - v_{yy} = -hv.$$

(7) Discuss the following statement: (is it true or false then justify your answer)
The problem:

$$y^2u_x + x^2uy = y^2$$
$$u(x,y) = -2y \text{ on } y^3 = x^3 - 2$$

has a unique solution.