

## Exercise 1

Classify each of the partial differential equations below as either hyperbolic, parabolic, or elliptic, determine the characteristics, and transform the equations to canonical form:

(a)  $4u_{xx} + 5u_{xy} + u_{yy} + u_x + u_y = 2$

(b)  $2u_{xx} - 3u_{xy} + u_{yy} = y$

(c)  $yu_{xx} + (x + y)u_{xy} + xu_{yy} = 0$

(d)  $u_{xx} + yu_{yy} = 0$

(e)  $yu_{xx} - 2u_{xy} + e^x u_{yy} + x^2 u_x - u = 0$

(f)  $u_{xx} + xu_{yy} = 0$

(g)  $x^2 u_{xx} + 4yu_{xy} + u_{yy} + 2u_x = 0$

(h)  $3yu_{xx} - xu_{yy} = 0$

(i)  $u_{xx} + 2xu_{xy} + a^2 u_{yy} + u = 5$

(j)  $y^2 u_{xx} + x^2 u_{yy} = 0$