

### Quiz 3

No calculator, textbook or note allowed. Write your name and ID number on the front of the quiz. **Show all your work for full credit.**

1. (10 Points) Find the regions in the  $xy$  plane where the equation

$$u_{xx} + 2xu_{xy} + y^2u_{yy} = 0$$

is elliptic, hyperbolic, or parabolic. Sketch them.

Sol:  $D = a_{12}^2 - a_{11} \cdot a_{22}$   
 $= x^2 - y^2$

Elliptic:  $D = x^2 - y^2 < 0$   
 $\Rightarrow |x| < |y|$

Hyperbolic:  $D = x^2 - y^2 > 0$   
 $\Rightarrow |x| > |y|$

Parabolic:  $D = x^2 - y^2 = 0$   
 $\Rightarrow y = \pm x$

