Problem 1:
Consider $u(x, y)$ solving

$$u_y^2 u_{xx} + u u_{xy} + u_x^2 u_{yy} = u^2 + 1$$
$$u(x, 0) = \sin(x), u_y(x, 0) = \cos(x)$$

Problem 2:
Let

$$L[u] = y u_{xx} + (x + y) u_{xy} + x u_{yy} - u_x - u_y$$

Part a:

Part b:

Part c:

Problem 3:
Part a:

Part b: