1. Solve the initial value problem in the domain $x > 0$:

$$xyz_x + x^2 z_y = 2xy - yz, \quad \text{and} \quad z = y \quad \text{on the curve} \quad x = 2y.$$

2. Solve the initial value problem for $t \geq 0$:

$$(2 - z) z_x + z_t = 0, \quad z(x,0) = \begin{cases} 0, & x \leq 0, \\ x, & 0 \leq x \leq 1, \\ 1, & x \geq 1. \end{cases}$$

Sketch the graph of the solution $z(x,t)$ at $t = 0, t = 1/3, t = 2/3$. At what value of $t$ will a shock develop?

3. Use separation of variables to solve the boundary value problem in the unbounded domain:

$$\Delta u(x,y) = 0, \quad x^2 + y^2 > 4,$$

$$u(x,y) = xy, \quad x^2 + y^2 = 4,$$

$$u(x,y) \to 0, \quad (x,y) \to \infty.$$