1. Consider the difference equations:

\[
\frac{u_j^{n+1} - u_j^n}{k} = \nu \left( \frac{u_{j+1}^{n+1} - 2u_j^{n+1} + u_{j-1}^{n+1}}{h^2} + \frac{u_{j+1}^{n} - 2u_j^{n} + u_{j-1}^{n}}{h^2} \right) + \frac{a}{2} \left( \frac{u_{j+1}^{n+1} - u_{j-1}^{n+1}}{2h} + \frac{u_{j+1}^{n} - u_{j-1}^{n}}{2h} \right), \quad 1 \leq j \leq M - 1, \tag{1}
\]

\[
u_0^{n+1} = u_M^{n+1} = 0, \tag{2}
\]

\[
u_j^{0} = u_0(x_j), \quad j = 0, 1, \ldots, M; \tag{3}
\]

where \( \nu \) and \( a \) are constants, and \( k \) is time step, \( h \) is mesh size.

a). Find the accuracy of the method to the equation \( u_t = \nu u_{xx} + a u_x \).

b). Find the stability condition

c). Write down the difference equation in linear system form.

2. Consider

\[
a u_x + \nu u_{xx} = 0, \quad a < x < b, \quad \tag{5}
\]

\[
u(a) = 0, \quad u(b) = 1. \tag{6}
\]

Find the exact solution.