Homework

Someone proposes to use a forward-time, center-space approximation to the 1D constant advection equation

$$u_t + cu_x = 0$$

given by

$$\frac{u_j^{n+1} - u_j^n}{\Delta t} + c\left[\frac{u_{j+1}^n - u_{j-1}^n}{2\Delta x}\right] = 0.$$

1. Is this scheme consistent with the original PDE? (It will suffice to note whether or not the truncation error goes to 0 as Δt and Δx go to zero, without the complicated substitutions for the time derivatives we employed in the upstream scheme demonstration.)

2. Whether or not the scheme is consistent, determine the stability condition for this scheme, using the modified Von Neumann approach discussed in class and in the course notes.