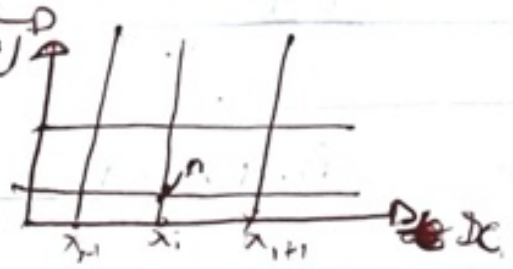
Exercise 9 : MFK 212004

sketch:



Eq. 29 :

$$\frac{\partial^2 U}{\partial x^2} = \frac{U(x+\Delta x) - 2U(x) + U(x-\Delta x)}{\Delta x^2} + O(\Delta x)$$

① Defining discrete time and space axes

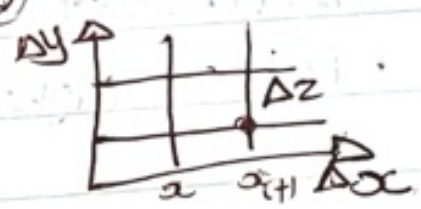
$$t^n = n\Delta t \qquad n = 0, 1, 2, 3 \cdots$$

$$x_i = i\Delta x \qquad i = 0, 1, 2, 3 \cdots$$

② Discretizing eq 29, using the 'above variables'.

$$\frac{\partial^2 U^n}{\partial x_i^2} \approx \frac{U_{i+1}^n - 2U_i^n + U_{i-1}^n}{\Delta x_i^2}$$

③ sketch:



③ 3-D horizontal velocity field $U_{i,k}^n$ (discritized)!

eq 33:

$$\frac{\partial U}{\partial z} = \frac{U(z_i + \Delta z) - U(z_i - \Delta z)}{2\Delta z} + O(\Delta z^2)$$

Discretized!

$$\frac{\partial U^n}{\partial z_{i,k}} \approx \frac{U_{i,j,k+1}^n - U_{i,j,k-1}^n}{2\Delta z} + O(\Delta z^2)$$