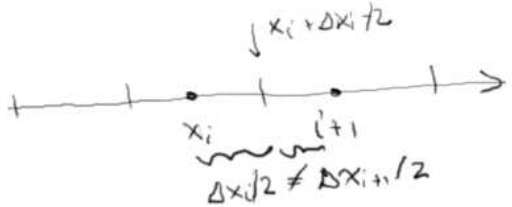
$$\sum_{i=0}^{N-1} \left\{ \underbrace{\frac{V(x_i) c_t \phi}{B_\alpha}}_{B(x_i) \;\downarrow\; B_i} \frac{\partial p(x_i,t)}{\partial t} - \frac{1}{B_\alpha} \left[A(x) \frac{k(x)}{\mu(x)} \frac{\partial p(x)}{\partial x} \right]_{x_i - \Delta x_i/2}^{x_i + \Delta x_i/2} \right\} = 0$$

$$k(x_i + \Delta x_i/2) = k_{i+1/2}$$
$$k(x_i - \Delta x_i/2) = k_{i-1/2}$$
, likewise A, μ

$$\sum_{i=0}^{N-1} \left\{ B_i \frac{\partial p_i}{\partial t} - \frac{1}{B_\alpha} \left[\frac{A_{i+1/2} k_{i+1/2}}{\mu_{i+1/2}} \frac{\partial p_{i+1/2}}{\partial x} - \frac{A_{i-1/2} k_{i-1/2}}{\mu_{i-1/2}} \frac{\partial p_{i-1/2}}{\partial x} \right] \right\} = 0$$



$$\sum_{i=0}^{N-1} \left\{ B_i \frac{\partial p_i}{\partial t} - \frac{1}{B_\alpha} \left[\frac{A_{i+1/2} k_{i+1/2}}{\mu_{i+1/2}} \frac{(p_{i+1} - p_i)}{\Delta x_{i+1}/2 + \Delta x_i/2} - \frac{A_{i-1/2} k_{i-1/2}}{\mu_{i-1/2}} \frac{(p_i - p_{i-1})}{\Delta x_i/2 + \Delta x_{i-1}/2} \right] \right\} = 0$$

$$\Delta x_{i+1/2} = \frac{\Delta x_{i+1} + \Delta x_i}{2}, \quad \Delta x_{i-1/2} = \frac{\Delta x_i + \Delta x_{i-1}}{2}$$

$$\sum_{i=0}^{N-1} \left\{ B_i \frac{\partial p_i}{\partial t} + \left[\underbrace{\frac{A_{i+1/2} k_{i+1/2}}{B_\alpha \mu_{i+1/2} \Delta x_{i+1/2}}}_{T_{i+1/2} = \frac{A_{i+1/2} k_{i+1/2}}{B_\alpha \mu_{i+1/2} \Delta x_{i+1/2}}} (p_i - p_{i+1}) + \underbrace{\frac{A_{i-1/2} k_{i-1/2}}{B_\alpha \mu_{i-1/2} \Delta x_{i-1/2}}}_{T_{i-1/2} = \frac{A_{i-1/2} k_{i-1/2}}{B_\alpha \mu_{i-1/2} \Delta x_{i-1/2}}} (p_i - p_{i-1}) \right] \right\} = 0$$

$$\sum_{i=0}^{N-1} \left\{ B_i \frac{\partial p_i}{\partial t} + \left[T_{i+1/2}\left(P_i - P_{i+1} \right) + T_{i-1/2}\left(P_i - P_{i-1} \right) \right] \right\} = 0$$

$$B_0 \frac{\partial p_0}{\partial t} + B_1 \frac{\partial p_1}{\partial t} + \cdots + B_{N-1} \frac{\partial p_{N-1}}{\partial t} + \left[T_{-1/2}\left(P_0 - P_{-1} \right) + T_{1/2}\left(P_0 - P_1 \right) \right]$$

$$+ \left[T_{1/2}\left(P_1 - P_0 \right) + T_{3/2}\left(P_1 - P_2 \right) \right] + \cdots + \left[T_{N-3/2}\left(P_{N-1} - P_{N-2} \right) + T_{N-1/2}\left(P_{N-1} - P_N \right) \right] = 0$$

$$\underbrace{\begin{bmatrix} B_0 & & & 0 \\ & B_1 & & \\ & & \ddots & \\ 0 & & & B_{N-1} \end{bmatrix}}_{[B]} \left\{ \frac{\partial \vec{P}}{\partial t} \right\} + \begin{bmatrix} T_{-1/2} + T_{1/2} & -T_{1/2} & 0 & \cdots \\ -T_{1/2} & T_{1/2} + T_{3/2} & -T_{3/2} & 0 \cdots \\ 0 & -T_{3/2} & T_{3/2} + T_{5/2} & -T_{5/2} \cdots \\ & & & T_{N-3/2} + T_{N-1/2} \end{bmatrix} \left\{ \vec{P} \right\} = \left\{ \vec{Q} \right\}$$

$$[B]\left\{ \frac{\partial \vec{P}}{\partial t} \right\} + [T]\left\{ \vec{P} \right\} = \left\{ \vec{Q} \right\} \Leftarrow$$