Problem Set No: 3

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1. Diffusion equation:

   The diffusion equation in the one dimensional form is defined as follow

   $$\frac{\partial \mathsf{T}}{\partial t} - \kappa \frac{\partial^2 \mathsf{T}}{\partial x^2} = 0.$$

   Questions:

   (a) Discrete it by using the first order Euler method.

   (b) What is the amplification factor?

   (c) Find the dispersion relation for the difference equation.

   (d) By the comparison of dispersion relation in differential form and difference one specify the space and time accuracy of the scheme.

2. Simulation of temperature diffusion in a medium:
   Consider the results of first question and write a code to simulate the temperature diffusion in a medium with the length $L = 1$ meter. Use the following initial conditions:

   (a) $\mathsf{T}(0,0) = 100$ °K elsewhere $\mathsf{T}(0,x) = 0$.

   (b) $\mathsf{T}(0,0) = 100$ °K and $\mathsf{T}(0,1) = 200$ °K elsewhere $\mathsf{T}(0,x) = 0$.

   (c) $\mathsf{T}(0,x) = 100\ x \qquad \text{and} \qquad x \in [0,1]$