Multiple-Choice Test

Chapter 10.02
Parabolic Partial Differential Equations

1. In a general second order linear partial differential equation with two independent variables

$$A\frac{\partial^2 u}{\partial x^2}+B\frac{\partial^2 u}{\partial x\partial y}+C\frac{\partial^2 u}{\partial y^2}+D=0$$

where A, B, C are functions of x and y, and D is a function of x, y, $\frac{\partial u}{\partial x},\frac{\partial u}{\partial y}$,

then the partial differential equation is parabolic if

(A) $B^2-4AC<0$
(B) $B^2-4AC>0$
(C) $B^2-4AC=0$
(D) $B^2-4AC\neq 0$

2. The region in which the following partial differential equation

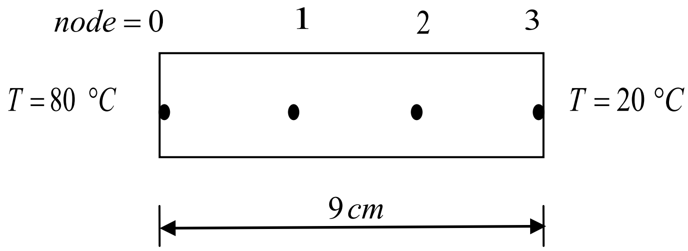
$$x^3\frac{\partial^2 u}{\partial x^2}+27\frac{\partial^2 u}{\partial y^2}+3\frac{\partial^2 u}{\partial x\partial y}+5u=0$$

acts as parabolic equation is

(A) $x>\left(\frac{1}{12}\right)^{1/3}$
(B) $x<\left(\frac{1}{12}\right)^{1/3}$
(C) for all values of x
(D) $x=\left(\frac{1}{12}\right)^{1/3}$

3. The partial differential equation of the temperature in a long thin rod is given by

$$\frac{\partial T}{\partial t}=\alpha\frac{\partial^2 T}{\partial x^2}$$

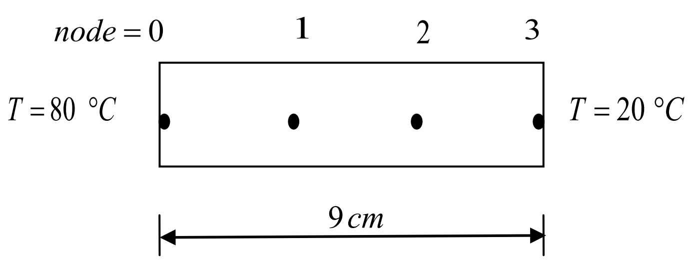


If $\alpha = 0.8\,cm^2/s$, the initial temperature of rod is $40°C$, and the rod is divided into three equal segments, the temperature at node 1 (using $\Delta t = 0.1\,s$) by using an explicit solution at $t = 0.2\sec$ is

(A) $40.7134\,^0C$
(B) $40.6882\,^0C$
(C) $40.7033\,^0C$
(D) $40.6956\,^0C$

4. The partial differential equation of the temperature in a long thin rod is given by

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

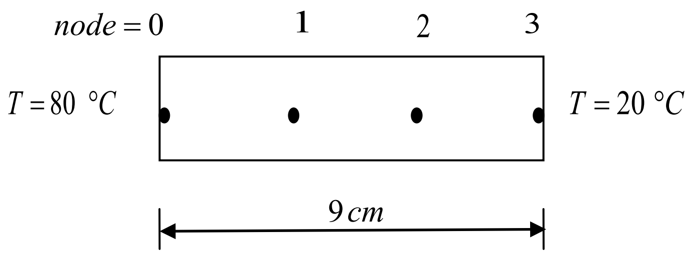


If $\alpha = 0.8\,cm^2/s$, the initial temperature of rod is $40°C$, and the rod is divided into three equal segments, the temperature at node 1 (using $\Delta t = 0.1\,s$) by using an implicit solution for $t = 0.2\sec$ is

(A) $40.7134\,^0C$
(B) $40.6882\,^0C$
(C) $40.7033\,^0C$
(D) $40.6956\,^0C$

5. The partial differential equation of the temperature in a long thin rod is given by

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

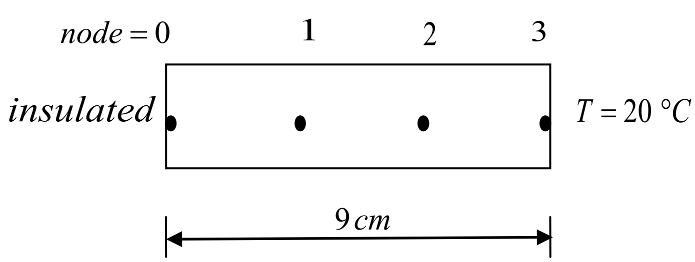


If $\alpha = 0.8\,cm^2/s$, the initial temperature of rod is $40°C$, and the rod is divided into three equal segments, the temperature at node 1 (using $\Delta t = 0.1s$) by using a <u>Crank-Nicolson</u> solution for $t = 0.2\sec$ is

(A) $40.7134\,^0C$
(B) $40.6882\,^0C$
(C) $40.7033\,^0C$
(D) $40.6956\,^0C$

6. The partial differential equation of the temperature in a long thin rod is given by

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$



If $\alpha = 0.8\,cm^2/s$, the initial temperature of rod is $40°C$, and the rod is divided into three equal segments, the temperature at node 1 (using $\Delta t = 0.1s$) by using an <u>explicit</u> solution at $t = 0.2\sec$ is

(For node 0, $k\frac{\partial T}{\partial x} = h(T_a - T_0)$), where $k = 9W/(m°C)$, $h = 20W/m^2$, $T_a = 25°C$, and $T_0 =$ (the temperature of rod at node 0)

(A) $41.6478\,^0C$
(B) $38.4356\,^0C$
(C) $39.9983\,^0C$
(D) $37.5798\,^0C$