

```

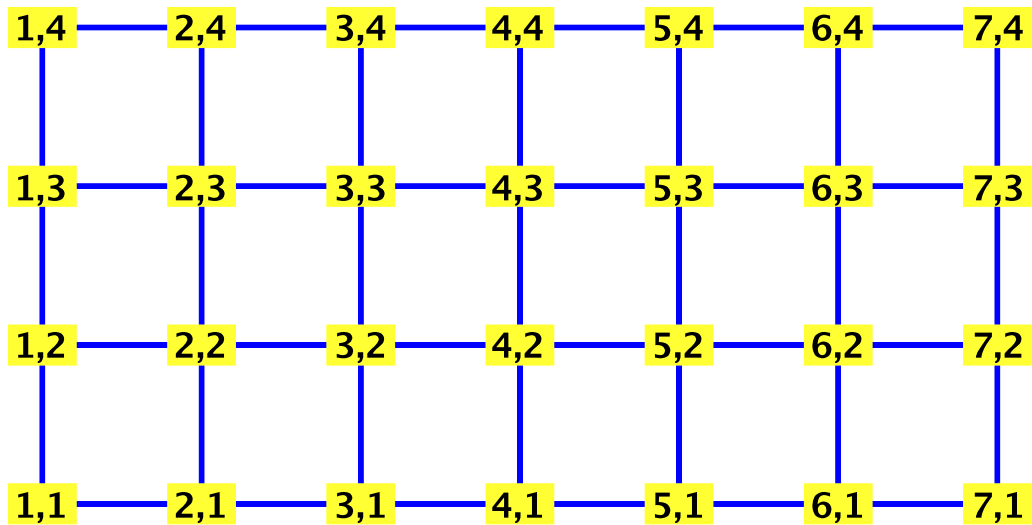
[> restart
[
[> Digits := 5
[
[> Digits:= 5 (1)
[> Ndx := 6;
    Ndy := 3;

    imax := Ndx + 1;
    jmax := Ndy + 1;

    Tb := 0;
    Td := 600;
    Th := 1800;
    Tg := 80;

    Ndx:= 6
    Ndy:= 3
    imax:= 7
    jmax:= 4
    Tb:= 0
    Td:= 600
    Th:= 1800
    Tg:= 80 (2)
[>
[
[> Ndeq := (imax-2)·(jmax-2)
[> Ndeq:= 10 (3)
[> with(GraphTheory) : with(SpecialGraphs) :
[> G := GridGraph( imax, jmax )
[> G:= Graph 1: an undirected unweighted graph with 28 vertices and 45 edge(s) (4)
[>
[> IsBipartite(G) ; DrawGraph(G)
[> true

```



```
> for i from 1 to imax do
  T[i, 1] := Tb
end;
```

$$T_{1,1} := 0$$

$$T_{2,1} := 0$$

$$T_{3,1} := 0$$

$$T_{4,1} := 0$$

$$T_{5,1} := 0$$

$$T_{6,1} := 0$$

$$T_{7,1} := 0$$

(5)

```
> for i from 1 to imax do
  T[i, jmax] := Th
end;
```

$$T_{1,4} := 1800$$

$$T_{2,4} := 1800$$

$$T_{3,4} := 1800$$

$$T_{4,4} := 1800$$

$$T_{5,4} := 1800$$

$$T_{6,4} := 1800$$

$$T_{7,4} := 1800$$

(6)

```
> for j from 1 to jmax do
  T[1, j] := Tg
end;
```

$$T_{1,1} := 80$$

$$T_{1,2} := 80$$

$$T_{1,3} := 80$$

$$T_{1,4} := 80$$

(7)

```
> for j from 1 to jmax do
  T[imax, j] := Td
end;
```

$$T_{7,1} := 600$$

$$T_{7,2} := 600$$

$$T_{7,3} := 600$$

$$T_{7,4} := 600$$

(8)

```
> k := 1;
```

$$k := 1$$

(9)

```
>
```

```
> for j from 2 to jmax - 1 do
  for i from 2 to imax - 1 do
    Eq[k] := -4 T[i, j] + T[i-1, j] + T[i+1, j] + T[i, j-1] + T[i, j+1] = 0;
    var[k] := T[i, j];
```

```
  k := k + 1 ;
```

```
  end do;
```

```
end do;
```

```
>
```

```
> for k from 1 to Ndeq do
  Eq[k];
  var[k];
end do;
```

$$-4 T_{2,2} + 80 + T_{3,2} + T_{2,3} = 0$$

$$T_{2,2}$$

$$\begin{aligned}
& -4 T_{3,2} + T_{2,2} + T_{4,2} + T_{3,3} = 0 \\
& \quad T_{3,2} \\
& -4 T_{4,2} + T_{3,2} + T_{5,2} + T_{4,3} = 0 \\
& \quad T_{4,2} \\
& -4 T_{5,2} + T_{4,2} + T_{6,2} + T_{5,3} = 0 \\
& \quad T_{5,2} \\
& -4 T_{6,2} + T_{5,2} + 600 + T_{6,3} = 0 \\
& \quad T_{6,2} \\
& -4 T_{2,3} + 1880 + T_{3,3} + T_{2,2} = 0 \\
& \quad T_{2,3} \\
& -4 T_{3,3} + T_{2,3} + T_{4,3} + T_{3,2} + 1800 = 0 \\
& \quad T_{3,3} \\
& -4 T_{4,3} + T_{3,3} + T_{5,3} + T_{4,2} + 1800 = 0 \\
& \quad T_{4,3} \\
& -4 T_{5,3} + T_{4,3} + T_{6,3} + T_{5,2} + 1800 = 0 \\
& \quad T_{5,3} \\
& -4 T_{6,3} + T_{5,3} + 2400 + T_{6,2} = 0 \\
& \quad T_{6,3}
\end{aligned} \tag{10}$$

> with(LinearAlgebra) :

> sys := [seq(Eq[k], k = 1..Ndeq)];

$$\begin{aligned}
\text{sys} := & [-4 T_{2,2} + 80 + T_{3,2} + T_{2,3} = 0, -4 T_{3,2} + T_{2,2} + T_{4,2} + T_{3,3} = 0, -4 T_{4,2} \\
& + T_{3,2} + T_{5,2} + T_{4,3} = 0, -4 T_{5,2} + T_{4,2} + T_{6,2} + T_{5,3} = 0, -4 T_{6,2} + T_{5,2} + 600 \\
& + T_{6,3} = 0, -4 T_{2,3} + 1880 + T_{3,3} + T_{2,2} = 0, -4 T_{3,3} + T_{2,3} + T_{4,3} + T_{3,2} \\
& + 1800 = 0, -4 T_{4,3} + T_{3,3} + T_{5,3} + T_{4,2} + 1800 = 0, -4 T_{5,3} + T_{4,3} + T_{6,3} \\
& + T_{5,2} + 1800 = 0, -4 T_{6,3} + T_{5,3} + 2400 + T_{6,2} = 0]
\end{aligned} \tag{11}$$

> var := [seq(var[k], k = 1..Ndeq)];

$$\text{var} := [T_{2,2}, T_{3,2}, T_{4,2}, T_{5,2}, T_{6,2}, T_{2,3}, T_{3,3}, T_{4,3}, T_{5,3}, T_{6,3}] \tag{12}$$

> A, B := GenerateMatrix(sys, var)

(13)

$$A, B := \begin{bmatrix} -4 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & -4 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & -4 & 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & -4 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & -4 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & -4 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & -4 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 1 & -4 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & -4 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & -4 \end{bmatrix}, \begin{bmatrix} -80 \\ 0 \\ 0 \\ 0 \\ -600 \\ -1880 \\ -1800 \\ -1800 \\ -1800 \\ -2400 \end{bmatrix}, \quad (13)$$

>

> $A_{\text{invers}} := \text{MatrixInverse}(A);$

$$A_{\text{invers}} := \begin{bmatrix} -\frac{2339}{7920}, -\frac{25}{264}, -\frac{16}{495}, -\frac{1}{88}, -\frac{29}{7920}, -\frac{343}{3960}, -\frac{9}{176}, -\frac{23}{990}, \\ -\frac{5}{528}, -\frac{13}{3960} \end{bmatrix}, \quad (14)$$

$$\begin{bmatrix} -\frac{25}{264}, -\frac{173}{528}, -\frac{7}{66}, -\frac{19}{528}, -\frac{1}{88}, -\frac{9}{176}, -\frac{29}{264}, -\frac{2}{33}, -\frac{7}{264}, -\frac{5}{528} \end{bmatrix},$$

$$\begin{bmatrix} -\frac{16}{495}, -\frac{7}{66}, -\frac{164}{495}, -\frac{7}{66}, -\frac{16}{495}, -\frac{23}{990}, -\frac{2}{33}, -\frac{56}{495}, -\frac{2}{33}, -\frac{23}{990} \end{bmatrix},$$

$$\begin{bmatrix} -\frac{1}{88}, -\frac{19}{528}, -\frac{7}{66}, -\frac{173}{528}, -\frac{25}{264}, -\frac{5}{528}, -\frac{7}{264}, -\frac{2}{33}, -\frac{29}{264}, -\frac{9}{176} \end{bmatrix},$$

$$\begin{bmatrix} -\frac{29}{7920}, -\frac{1}{88}, -\frac{16}{495}, -\frac{25}{264}, -\frac{2339}{7920}, -\frac{13}{3960}, -\frac{5}{528}, -\frac{23}{990}, -\frac{9}{176}, \\ -\frac{343}{3960} \end{bmatrix},$$

$$\begin{bmatrix} -\frac{343}{3960}, -\frac{9}{176}, -\frac{23}{990}, -\frac{5}{528}, -\frac{13}{3960}, -\frac{2339}{7920}, -\frac{25}{264}, -\frac{16}{495}, -\frac{1}{88}, \\ -\frac{29}{7920} \end{bmatrix},$$

$$\begin{bmatrix} -\frac{9}{176}, -\frac{29}{264}, -\frac{2}{33}, -\frac{7}{264}, -\frac{5}{528}, -\frac{25}{264}, -\frac{173}{528}, -\frac{7}{66}, -\frac{19}{528}, -\frac{1}{88} \end{bmatrix},$$

$$\begin{bmatrix} -\frac{23}{990}, -\frac{2}{33}, -\frac{56}{495}, -\frac{2}{33}, -\frac{23}{990}, -\frac{16}{495}, -\frac{7}{66}, -\frac{164}{495}, -\frac{7}{66}, -\frac{16}{495} \end{bmatrix},$$

$$\begin{bmatrix} -\frac{5}{528}, -\frac{7}{264}, -\frac{2}{33}, -\frac{29}{264}, -\frac{9}{176}, -\frac{1}{88}, -\frac{19}{528}, -\frac{7}{66}, -\frac{173}{528}, -\frac{25}{264} \\ -\frac{13}{3960}, -\frac{5}{528}, -\frac{23}{990}, -\frac{9}{176}, -\frac{343}{3960}, -\frac{29}{7920}, -\frac{1}{88}, -\frac{16}{495}, -\frac{25}{264}, \\ -\frac{2339}{7920} \end{bmatrix}$$

```
> TT:= MatrixVectorMultiply(Ainvers, B) :
> evalf(TT)
```

$$\begin{bmatrix} 347.45 \\ 487.80 \\ 543.23 \\ 552.80 \\ 542.45 \\ 821.99 \\ 1060.5 \\ 1132.3 \\ 1125.5 \\ 1017.0 \end{bmatrix}$$

(15)

```
> Equate(var, TT) ;
```

$$\left[T_{2,2} = \frac{68795}{198}, T_{3,2} = \frac{32195}{66}, T_{4,2} = \frac{53780}{99}, T_{5,2} = \frac{36485}{66}, T_{6,2} = \frac{107405}{198}, \right. \\ T_{2,3} = \frac{162755}{198}, T_{3,3} = \frac{69995}{66}, T_{4,3} = \frac{112100}{99}, T_{5,3} = \frac{74285}{66}, T_{6,3} \\ \left. = \frac{201365}{198} \right]$$

(16)

```
> R := assign(%);
```

R:=

(17)

```
> with(plots) :
```

```
> listcontplot([seq([seq(T[i, j], i = 2..Ndx)], j = 2..Ndy)])
```

