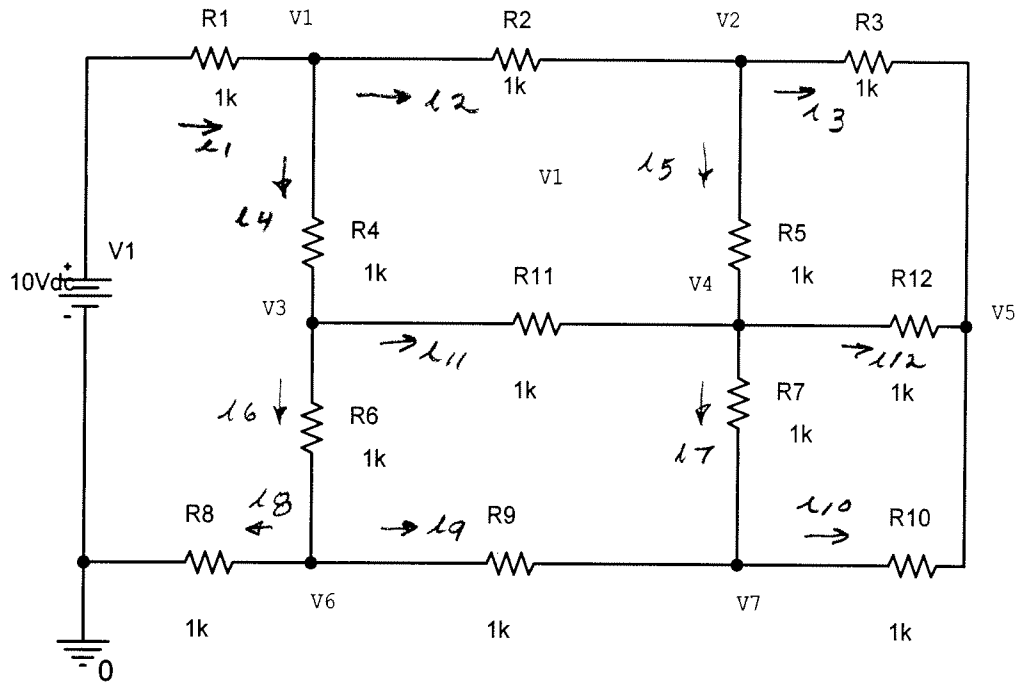

① Σi @ V_1 $\quad i_1 = i_2 + i_4$

② Σi @ V_2 $\quad i_2 = i_3 + i_5$

③ Σi @ V_3 $\quad i_4 = i_6 + i_{11}$

④ Σi @ V_4 $\quad i_5 + i_{11} = i_7 + i_{12}$

⑤ Σi @ V_5 $\quad i_3 + i_{12} + i_{10} = 0$

⑥ Σi @ V_6 $\quad i_6 = i_8 + i_9$

⑦ Σi @ V_7 $\quad i_7 + i_9 = i_{10}$

$$i_1 = \frac{10 - V_1}{R_1} \qquad i_2 = \frac{V_1 - V_2}{R_2} \qquad i_3 = \frac{V_2 - V_5}{R_3}$$

$$i_4 = \frac{V_1 - V_3}{R_4} \qquad i_5 = \frac{V_2 - V_4}{R_5} \qquad i_6 = \frac{V_3 - V_6}{R_6}$$

$$i_7 = \frac{V_4 - V_7}{R_7} \qquad i_8 = \frac{V_6}{R_8} \qquad i_9 = \frac{V_6 - V_7}{R_9}$$

$$i_{10} = \frac{V_7 - V_5}{R_{10}} \qquad i_{11} = \frac{V_3 - V_4}{R_{11}} \qquad i_{12} = \frac{V_4 - V_5}{R_{12}}$$

(1) $$\frac{10 - V_1}{R_1} = \frac{V_1 - V_2}{R_2} + \frac{V_1 - V_3}{R_4}$$

(2) $$\frac{V_1 - V_2}{R_2} = \frac{V_2 - V_5}{R_3} + \frac{V_2 - V_4}{R_5}$$

(3) $$\frac{V_1 - V_3}{R_4} = \frac{V_3 - V_6}{R_6} + \frac{V_3 - V_4}{R_{11}}$$

(4) $$\frac{V_2 - V_4}{R_5} + \frac{V_3 - V_4}{R_{11}} = \frac{V_4 - V_7}{R_7} + \frac{V_4 - V_5}{R_{12}}$$

(5) $$\frac{V_2 - V_5}{R_3} + \frac{V_4 - V_5}{R_{12}} + \frac{V_7 - V_5}{R_{10}} = 0$$

(6) $$\frac{V_3 - V_6}{R_6} = \frac{V_6}{R_8} + \frac{V_6 - V_7}{R_9}$$

(7) $$\frac{V_4 - V_7}{R_7} + \frac{V_6 - V_7}{R_9} = \frac{V_7 - V_5}{R_{10}}$$

If all of the resistors are the same 1kΩ, then we can simplify

① $10 - V_1 = V_1 - V_2 + V_1 - V_3$

✓ $3V_1 - V_2 - V_3 + 0V_4 + 0V_5 + 0V_6 + 0V_7 = 10$

② $V_1 - V_2 = V_2 - V_5 + V_2 - V_4$

✓ $V_1 - 3V_2 + 0V_3 + V_4 + V_5 + 0V_6 + 0V_7 = 0$

③ $V_1 - V_3 = V_3 - V_6 + V_3 - V_4$

✓ $V_1 + 0V_2 - 3V_3 + V_4 + 0V_5 + V_6 + 0V_7 = 0$

④ $V_2 - V_4 + V_3 - V_4 = V_4 - V_7 + V_4 - V_5$

✓ $0V_1 + V_2 + V_3 - 4V_4 + V_5 + 0V_6 + V_7 = 0$

⑤ $V_2 - V_5 + V_4 - V_5 + V_7 - V_5 = 0$

✓ $0V_1 + V_2 + 0V_3 + V_4 - 3V_5 + 0V_6 + V_7 = 0$

⑥ $V_3 - V_6 = V_6 + V_6 - V_7$

✓ $0V_1 + 0V_2 + V_3 + 0V_4 + 0V_5 - 3V_6 + V_7 = 0$

⑦ $V_4 - V_7 + V_6 - V_7 = V_7 - V_5$

✓ $0V_1 + 0V_2 + 0V_3 + V_4 + V_5 + V_6 - 3V_7 = 0$

$$\begin{bmatrix} 3 & -1 & -1 & 0 & 0 & 0 & 0 \\ 1 & -3 & 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & -3 & 1 & 0 & 1 & 0 \\ 0 & 1 & 1 & -4 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & -3 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & -3 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & -3 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \\ V_5 \\ V_6 \\ V_7 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

» A USING MATLAB TO SOLVE, WE GET THE FOLLOWING:

A =

```
     3    -1    -1     0     0     0     0
     1    -3     0     1     1     0     0
     1     0    -3     1     0     1     0
     0     1     1    -4     1     0     1
     0     1     0     1    -3     0     1
     0     0     1     0     0    -3     1
     0     0     0     1     1     1    -3
```

» b

b =

```
    10
     0
     0
     0
     0
     0
     0
```

» x=A\b

x =

```
    6.8750 — V1
    5.6250 — V2
    5.0000 — V3
    5.0000 — V4
    5.0000 — V5
    3.1250 — V6
    4.3750 — V7
```

»

CARL, I SHOULD OF HAD A V8 :-)

OR, WE CAN USE PSPICE TO SIMULATE THE CIRCUIT