

Ηλεκτρικά Κυκλώματα Ι

Διάλεξη 09

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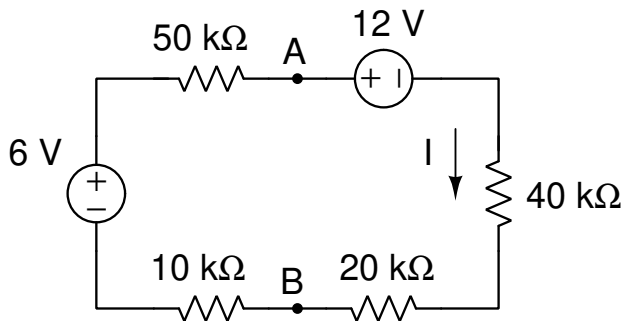
09-11-2022

1 Ασκήσεις

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Άσκηση 1

Να βρεθεί η V_{AB} και το I στο κύκλωμα.



Κανόνας Τάσεων Kirchhoff

$$50I + 12 + 40I + 20I + 10I - 6 = 0 \Rightarrow I = -0.05 \text{ mA}$$

$$V_{AB} = 12 + 60I = 9 \text{ V}$$

$$V_{AB} = -50I + 6 - 10I = 9 \text{ V}$$

```
octave:1> I = (-12+6)/(50+40+20+10)
```

```
I = -0.050000
```

```
octave:2> Vab = 12+60*I
```

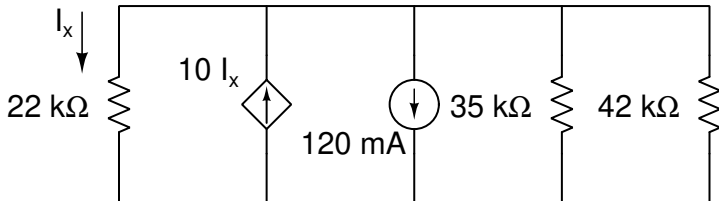
```
Vab = 9
```

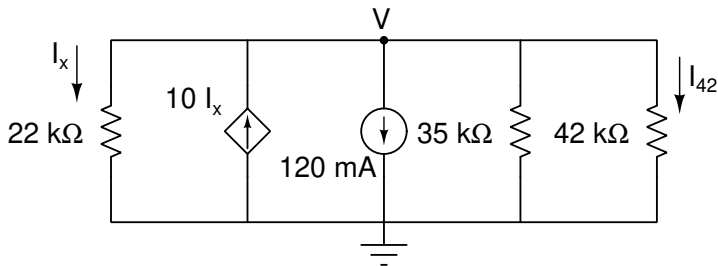
```
octave:3> Vab = -60*I+6
```

```
Vab = 9
```

Άσκηση 2

Να βρεθεί η τάση στα άκρα και το ρεύμα που διαρρέει την $42\text{ k}\Omega$.





Κομβική ανάλυση

$$\frac{V}{22} - 10I_x + 120 + \frac{V}{35} + \frac{V}{42} = 0$$

$$\frac{V}{22} = I_x$$

$$\frac{V}{22} - 10\frac{V}{22} + 120 + \frac{V}{35} + \frac{V}{42} = 0 \Rightarrow V \left(\frac{1}{22} - \frac{10}{22} + \frac{1}{35} + \frac{1}{42} \right) = -120 \Rightarrow$$

$$V = 336.41 \text{ V} \quad \text{και} \quad I_{42} = \frac{V}{42} = 8 \text{ mA}$$

octave:4> V = -120/(1/22-10/22+1/35+1/42)

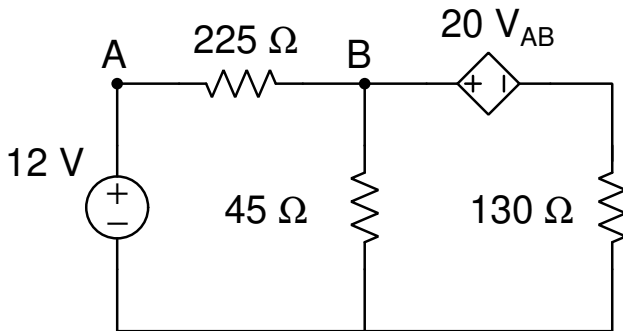
V = 336.41

octave:5> I42 = V/42

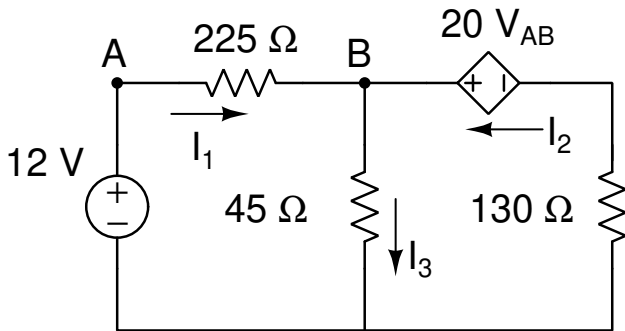
I42 = 8.0097

Άσκηση 3

Να βρεθεί η V_{AB} και το ρεύμα που κυκλοφορεί στην 130Ω .



Κλαδικά ρεύματα



Κανόνες Kirchhoff - κλαδικά ρεύματα

$$\left. \begin{aligned} I_1 + I_2 - I_3 &= 0 \\ 225I_1 + 45I_3 &= 12 \\ 20V_{AB} - 130I_2 - 45I_3 &= 0 \\ V_{AB} &= 225I_1 \end{aligned} \right\} \Rightarrow$$

$$\left. \begin{aligned} I_1 + I_2 - I_3 &= 0 \\ 225I_1 + 45I_3 &= 12 \\ 4500I_1 - 130I_2 - 45I_3 &= 0 \end{aligned} \right\} \Rightarrow$$

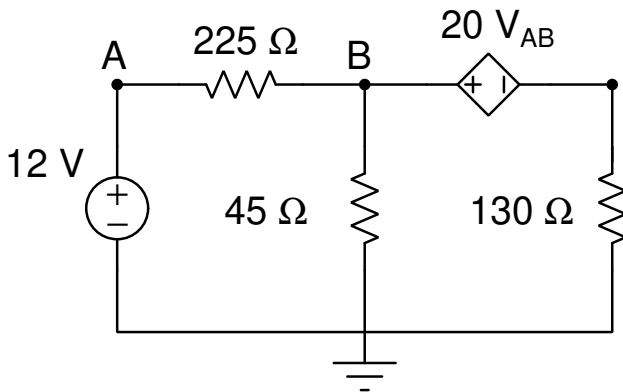
$$I_1 = 0.0085\text{A} \quad I_2 = 0.2158\text{A} \quad I_3 = 0.2243\text{A}$$

Το ρεύμα που κυκλοφορεί στην $130\ \Omega$ είναι $I_2 = 0.2158\text{A}$.

Τάση $V_{AB} = 225I_1 = 1.91\text{V}$.

```
octave:6> 225*20
ans = 4500
octave:11> A=[1 1 -1; 225 0 45; 4500 -130 -45]
A =
    1    1   -1
   225    0   45
 4500 -130 -45
octave:12> b=[0; 12; 0]
b =
    0
   12
    0
octave:13> I=inv(A)*b
I =
 0.0084771
 0.2158038
 0.2242810
octave:14> 225*I(1)
ans = 1.9074
```

Κομβική ανάλυση



Κανόνες Kirchhoff - κομβική ανάλυση

$$\frac{V_B - 12}{225} + \frac{V_B}{45} + \frac{(-20V_{AB} + V_B)}{130} = 0$$

$$V_{AB} = -V_{BA} = -(V_B - 12)$$

$$\frac{V_B - 12}{225} + \frac{V_B}{45} + \frac{20(V_B - 12) + V_B}{130} = 0 \Rightarrow$$

$$V_B \left(\frac{1}{225} + \frac{1}{45} + \frac{21}{130} \right) = \frac{12}{225} + \frac{240}{130} \Rightarrow$$

$$V_B = 10.093 \text{ V} \quad V_{AB} = 1.91 \text{ V} \quad I_{130} = \frac{-20V_{AB} + V_B}{130} = -0.2158 \text{ A}$$

octave:17> Vb=(12/225+240/130)/(1/225+1/45+21/130)

Vb = 10.093

octave:19> Vab=12-Vb

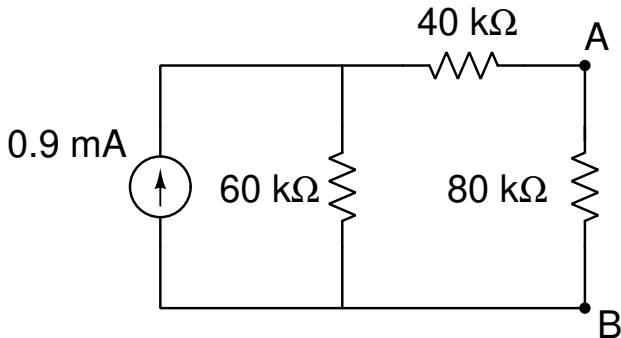
Vab = 1.9074

octave:20> I=(-20*Vab+Vb)/130

I = -0.21580

Άσκηση 4

Να βρεθεί η V_{AB} .



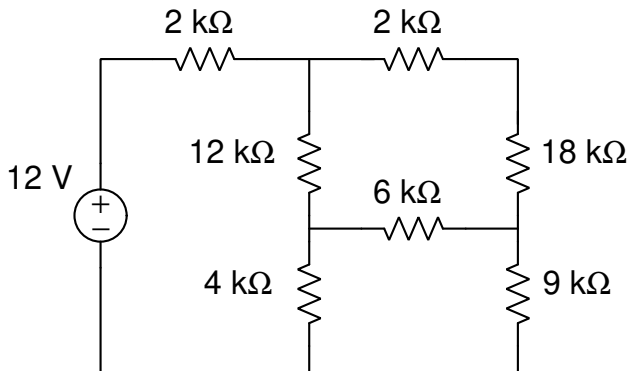
Με διαιρέτη ρεύματος

$$I_{AB} = \frac{60}{80 + 40 + 60} 0.9 = 0.3 \text{ mA}$$

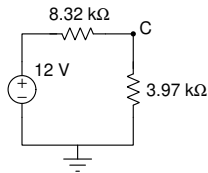
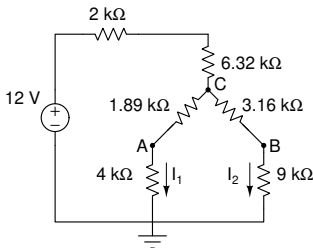
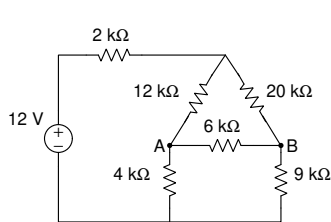
$$V_{AB} = 80I_{AB} = 24 \text{ V}$$

Άσκηση 5

Να βρεθεί η ισχύς που καταναλώνεται στην $6\text{ k}\Omega$.



5b



$$r_1 = \frac{12 \cdot 20}{12 + 20 + 6} = 6.32 \text{ k}\Omega \quad r_2 = \frac{12 \cdot 6}{12 + 20 + 6} = 1.89 \text{ k}\Omega \quad r_3 = \frac{6 \cdot 20}{12 + 20 + 6} = 3.16 \text{ k}\Omega$$

$$r_4 = (1.89 + 4) \parallel (3.16 + 9) = 3.97 \text{ k}\Omega$$

$$V_C = \frac{3.97}{3.97 + 8.32} 12 = 3.89 \text{ V} \quad I_1 = \frac{V_C}{1.89 + 4} = 0.658 \text{ mA} \quad I_2 = \frac{V_C}{3.16 + 9} = 0.319 \text{ mA}$$

$$V_A = 2.6312 \text{ V} \quad V_B = 2.8704 \text{ V} \quad V_{AB} = -0.2392 \text{ V}$$

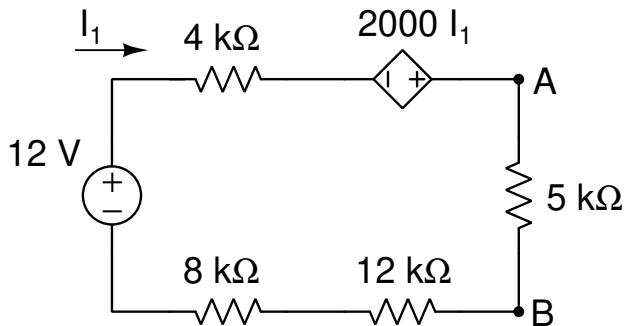
$$P = V_{AB}^2 / 6 = 0.009536 \text{ mW} = 9.536 \text{ }\mu\text{W}$$

```
octave:23> r1=12*20/(12+20+6)
r1 = 6.3158
octave:24> r2=12*6/(12+20+6)
r2 = 1.8947
octave:25> r3=6*20/(12+20+6)
r3 = 3.1579
octave:26> 2+r1
ans = 8.3158
octave:27> r4=r2+4
r4 = 5.8947
octave:28> r5=r3+9
r5 = 12.158
octave:29> r6=r4*r5/(r4+r5)
r6 = 3.9699
```

```
octave:30> Vc=r6*12/(r6+2+r1)
Vc = 3.8776
octave:31> I1=Vc/(r2+4)
I1 = 0.65781
octave:32> I2=Vc/(r3+9)
I2 = 0.31894
octave:34> Va=4*I1
Va = 2.6312
octave:35> Vb=9*I2
Vb = 2.8704
octave:36> Vab=Va-Vb
Vab = -0.23920
octave:37> P=Vab^2/6
P = 0.0095363
```

Άσκηση 6

Να βρεθεί η V_{AB} όπου η παράμετρος 2000 έχει μονάδες Ω .



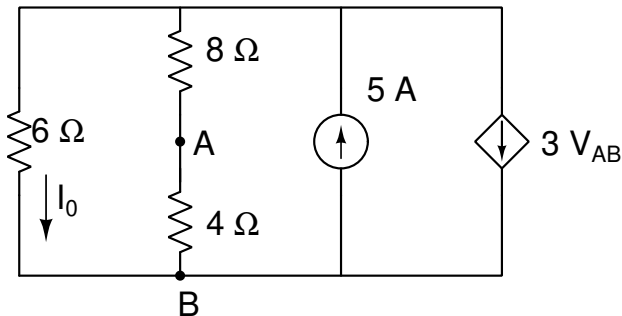
Κανόνας τάσης Kirchhoff

$$I_1(4 + 5 + 12 + 8) - 2I_1 = 12 \Rightarrow I_1 = 0.444 \text{ mA}$$

$$V_{AB} = 5I_1 = 2.22 \text{ V}$$

Άσκηση 7

Να βρεθεί η V_{AB} και το I_0 στο κύκλωμα.



Κομβική ανάλυση με V την τάση του επάνω κόμβου ως προς Β, τον κόμβο αναφοράς.

$$\frac{V}{6} + \frac{V}{12} - 5 + 3V_{AB} = 0$$

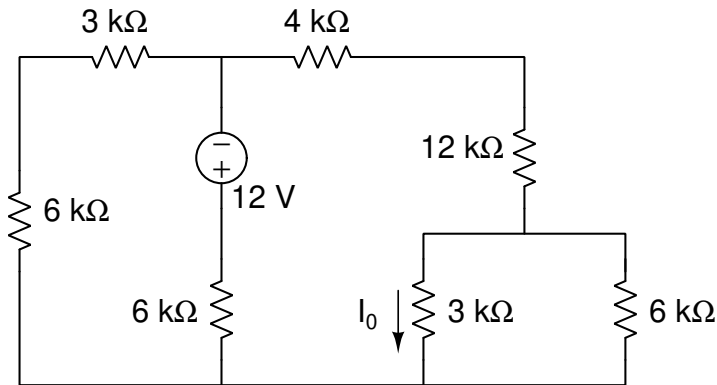
$$V_{AB} = \frac{4}{12} V$$

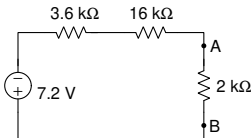
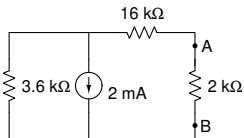
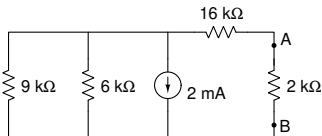
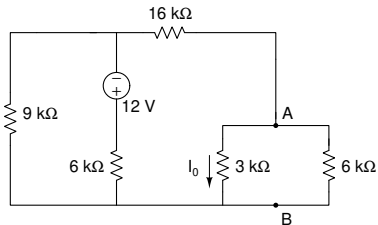
$$V \left(\frac{1}{6} + \frac{1}{12} + 3 \frac{4}{12} \right) = 5$$

$$V = 4 \text{ V} \quad \text{και} \quad V_{AB} = 16/12 = 1.33 \text{ V} \quad \text{και} \quad I_0 = \frac{V}{6} = 0.667 \text{ A}$$

Άσκηση 8

Να βρεθεί το I_0 .





$$V_{BA} = \frac{2}{2 + 16 + 3.6} 7.2 = 0.667 \text{ V}$$

$$I_0 = \frac{V_{AB}}{3} = -0.222 \text{ mA}$$