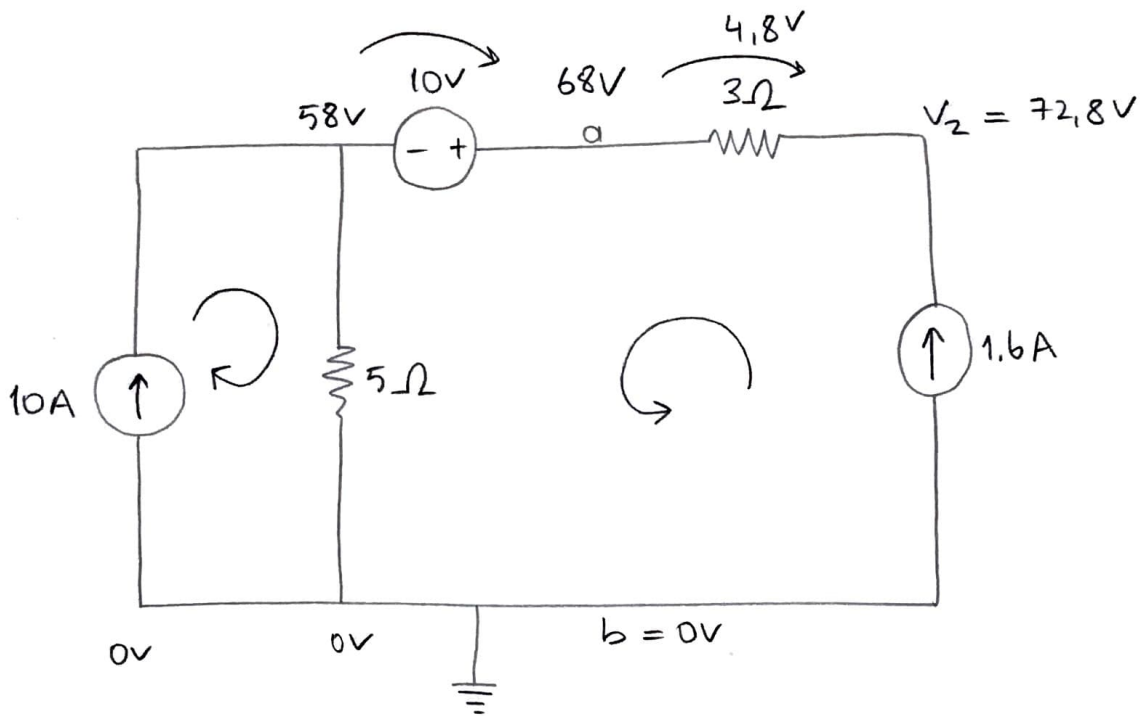


Q₁. Find V_{ab} and V_2 .



- current flow on 5Ω resistor is $10A + 1.6A$.

$$V(5\Omega) = 11.6 \cdot 5 = 58V$$

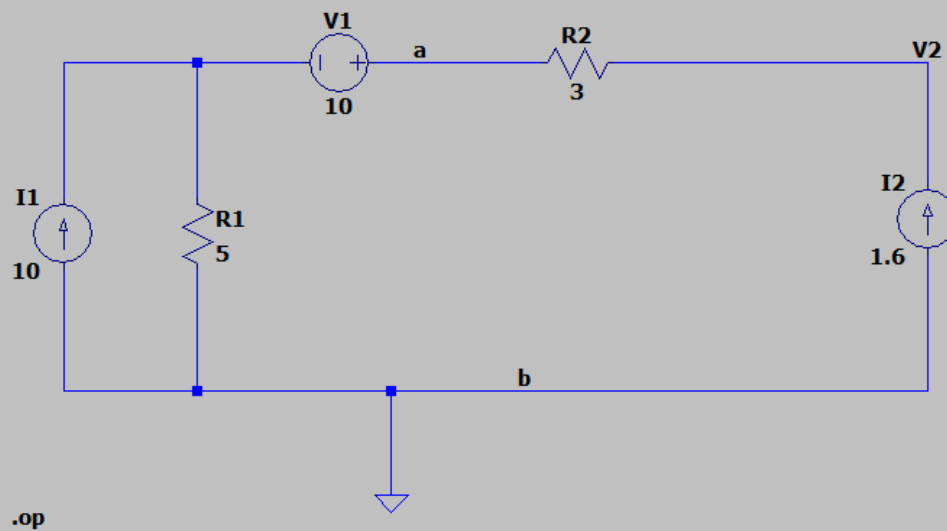
- current flow on 3Ω resistor is $1.6A$.

$$V(3\Omega) = 1.6 \cdot 3 = 4.8V$$

$$* V_2 = 72.8V$$

$$* V_{ab} = V_a - V_b = 68 - 0, \quad V_{ab} = 68V$$

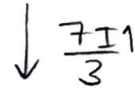
Q1 simulation:



```
* D:\itu cmpe\fall 20-21\ehb211e\homeworks\q1.asc
--- Operating Point ---
V(n001):      58      voltage
V(a):         68      voltage
V(v2):        72.8     voltage
I(I2):        1.6     device_current
I(I1):        10      device_current
I(R2):        1.6     device_current
I(R1):        11.6    device_current
I(V1):        1.6     device_current
```

150180112

150180112



$$V_2 - 4I_1 = 0$$

$$V_2 + 4 \cdot \frac{10}{14} = 0$$

$$V_2 = -2,85V$$

$$V_3 = V_2 + 3I_1$$

$$V_3 = -2,85 - 3 \cdot \frac{10}{14}$$

$$V_3 = -5V$$

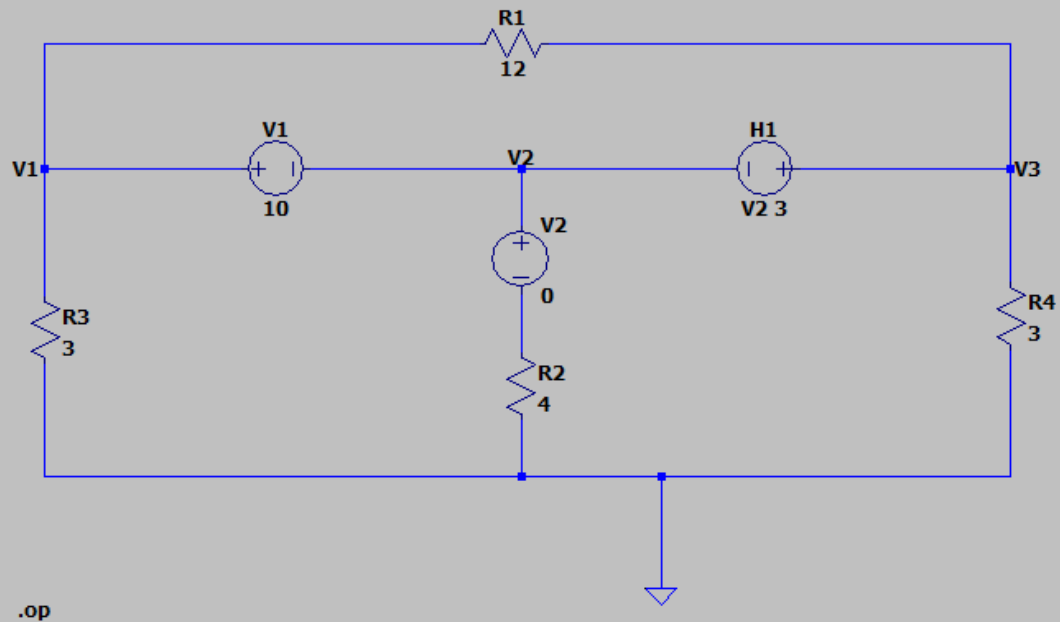
$$V_1 = V_2 + 10$$

$$V_1 = -2,85 + 10$$

$$V_1 = 7,15 \text{ V}$$

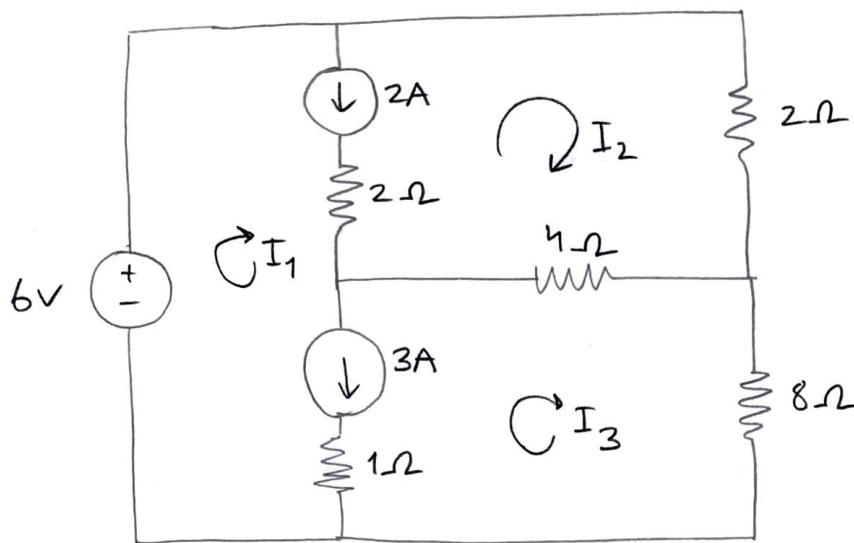
$$V_1 = 7,15 \text{ V}$$

Q2 simulation:



```
* D:\itu cmpe\fall 20-21\ehb211e\homeworks\q2.asc
--- Operating Point ---
V(v3) :      -5      voltage
V(v1) :      7.14286  voltage
V(v2) :      -2.85714 voltage
V(n001) :     -2.85714 voltage
I(H1) :       2.67857  device_current
I(R2) :      -0.714286 device_current
I(R4) :      -1.66667  device_current
I(R3) :       2.38095  device_current
I(R1) :      -1.0119   device_current
I(V2) :      -0.714286 device_current
I(V1) :      -3.39286  device_current
```

Q₃ . find I_1 , I_2 and I_3



* from supermesh ; $-6V + 2I_2 + 8I_3 = 0V$

$$I_2 + 4I_3 = 3A$$

$$\begin{array}{l} * I_1 - I_2 = 2A \\ * I_1 - I_3 = 3A \end{array} \quad \left. \vphantom{\begin{array}{l} * I_1 - I_2 = 2A \\ * I_1 - I_3 = 3A \end{array}} \right\} I_2 = I_3 + 1A$$

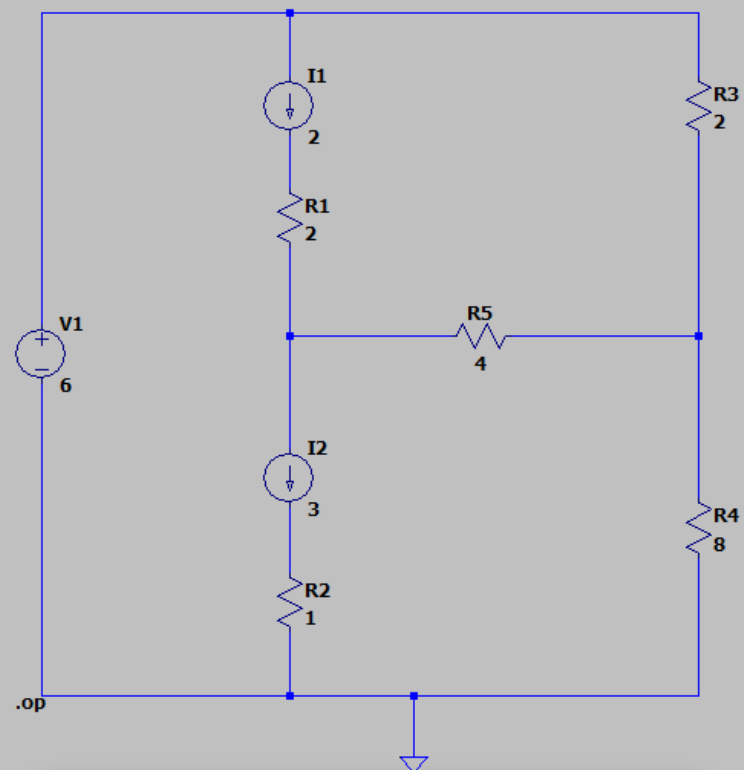
$$(I_3 + 1A) + 4I_3 = 3A$$

$$5I_3 = 2A, \quad I_3 = 0,4A$$

$$I_1 - I_3 = 3A, \quad I_1 - 0,4A = 3A, \quad I_1 = 3,4A$$

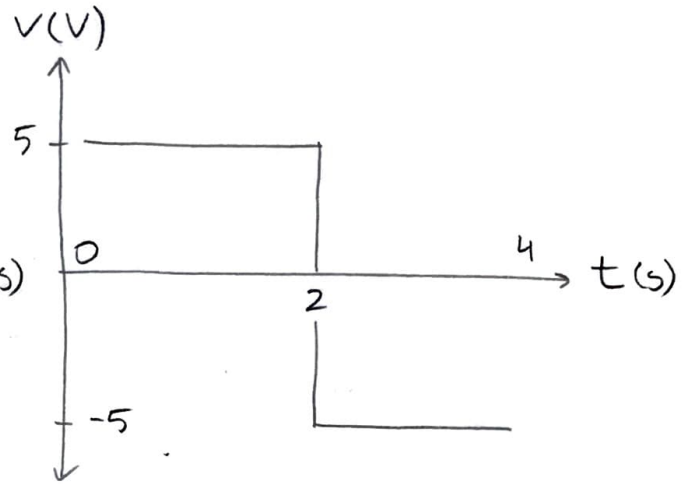
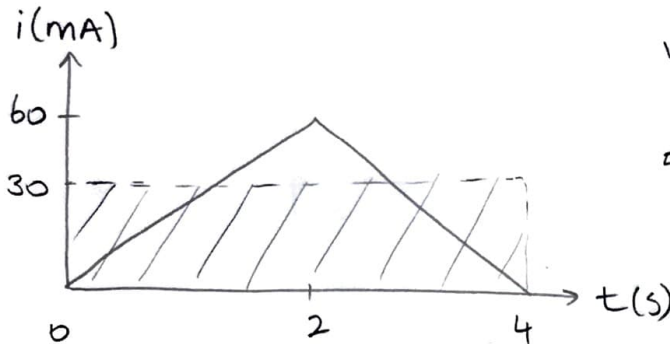
$$I_1 - I_2 = 2A, \quad 3,4A - I_2 = 2A, \quad I_2 = 1,4A$$

Q3 simulation:



```
* D:\itu cmpe\fall 20-21\ehb211e\homeworks\q3.asc
--- Operating Point ---
V(n001):      6          voltage
V(n002):      3.2        voltage
V(n003):     -0.8        voltage
V(n005):      3          voltage
V(n004):      3.2        voltage
I(I2):        3          device_current
I(I1):        2          device_current
I(R5):        1          device_current
I(R4):        0.4        device_current
I(R3):        1.4        device_current
I(R2):        3          device_current
I(R1):        2          device_current
I(V1):       -3.4        device_current
```

Q₄. Find the total energy absorbed an element for the period of $0 < t < 4s$.



$$W = P \cdot t$$

$$P = i \cdot V$$

$$W = i \cdot V \cdot t$$

$$i \cdot t \rightarrow \int_{t_0}^t i dt = \int_0^4 i dt$$

$$\int_0^4 i dt = \underbrace{\int_0^2 i dt}_{60} + \underbrace{\int_2^4 i dt}_{60}$$

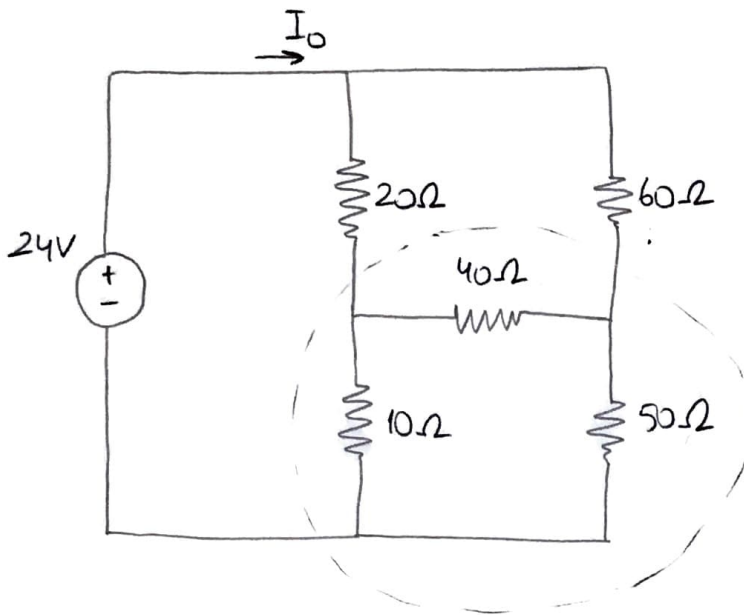
$$W_1 (t=0 \text{ to } t=2s) = 60 \cdot 5 = 300 \text{ W}$$

$$W_2 (t=2s \text{ to } t=4s) = 60 \cdot (-5) = -300 \text{ W}$$

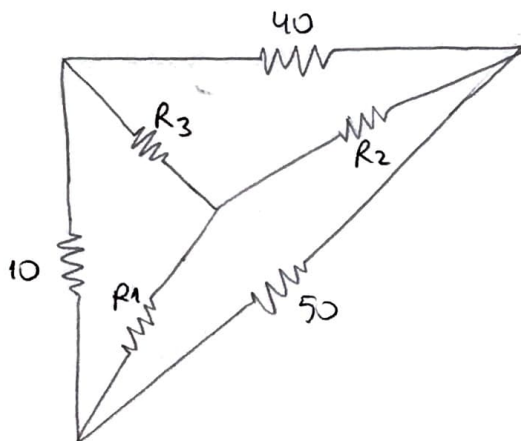
$$W = W_1 + W_2 = 0$$

$$W = 0$$

Q5. Calculate I_0 .



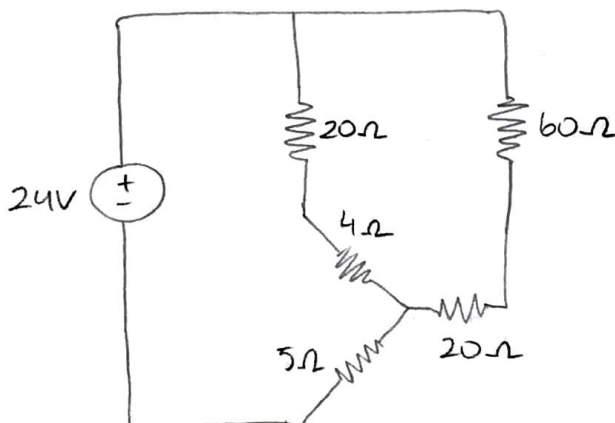
delta - wye conversion



$$R_1 = \frac{10 \cdot 50}{100} = 5 \Omega$$

$$R_2 = \frac{50 \cdot 40}{100} = 20 \Omega$$

$$R_3 = \frac{40 \cdot 10}{100} = 4 \Omega$$



$$20 + 4 = 24 \Omega$$

$$60 + 20 = 80 \Omega$$

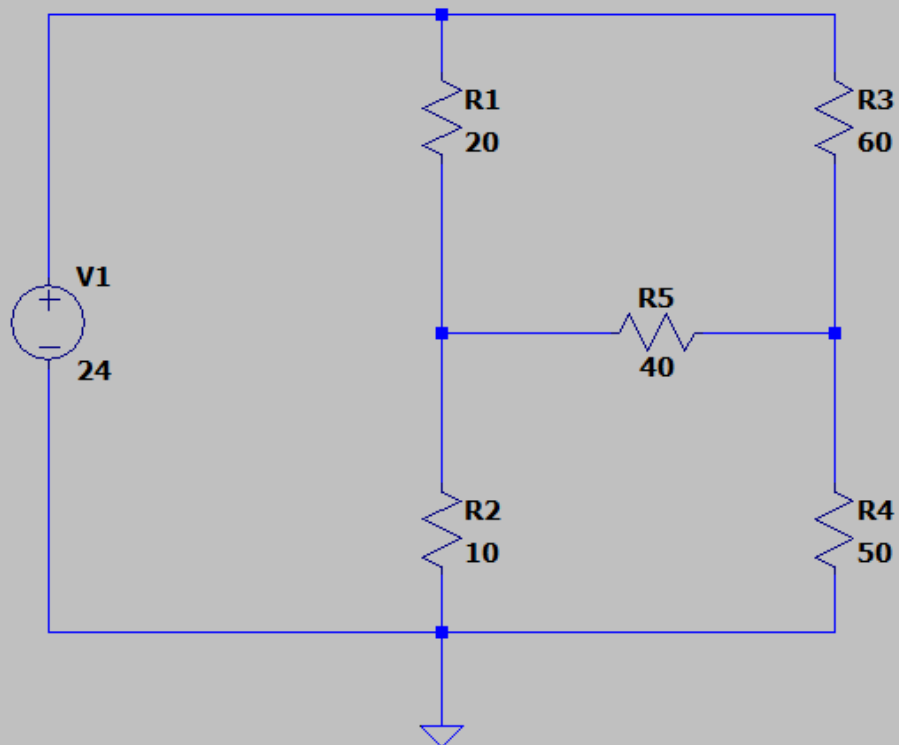
$$\frac{80 \cdot 24}{80 + 24} = \frac{240}{13} \Omega$$

$$\frac{240}{13} + 5 = \frac{305}{13} \Omega (R_{eq})$$

$$V = i \cdot R, \quad 24 = I_0 \cdot \frac{305}{13}$$

$$I_0 = 1.0295$$

Q5. Simulation:



.op

```
* D:\itu cmpe\fall 20-21\ehb211e\homeworks\q5.asc
--- Operating Point ---
V(n001):      24          voltage
V(n002):      8.26229     voltage
V(n003):      9.83607     voltage
I(R3):        0.236066     device_current
I(R5):        0.0393443    device_current
I(R4):        0.196721     device_current
I(R2):        0.82623      device_current
I(R1):        0.786885     device_current
I(V1):        -1.02295     device_current
```