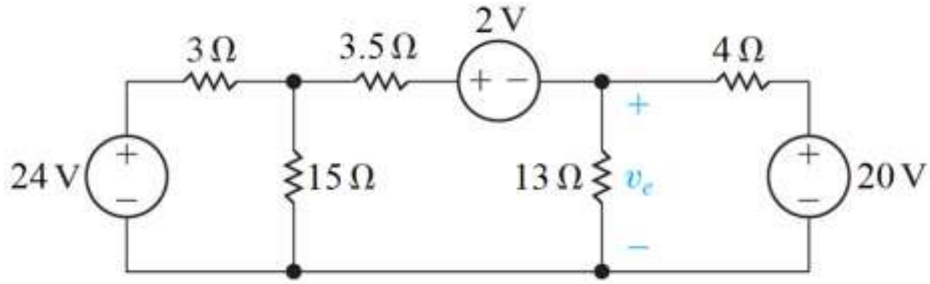
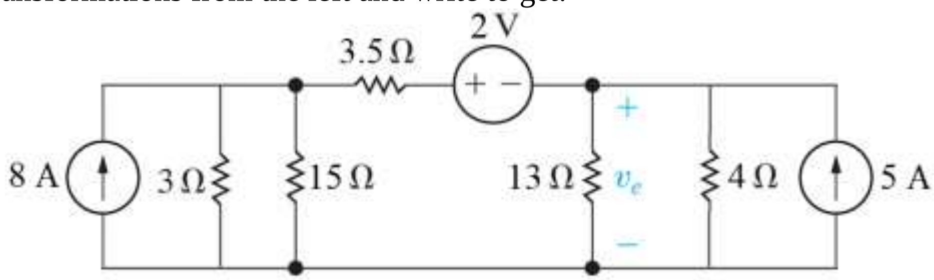
Question 1:

For the circuit below, use a series of source transformations all the way (only **source transformations**) to find the **voltage v_e**.

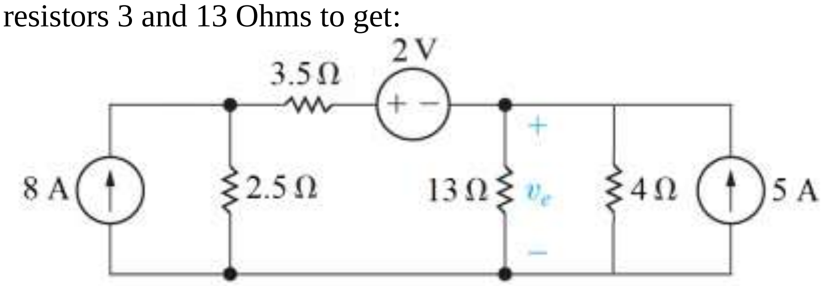


Solution:

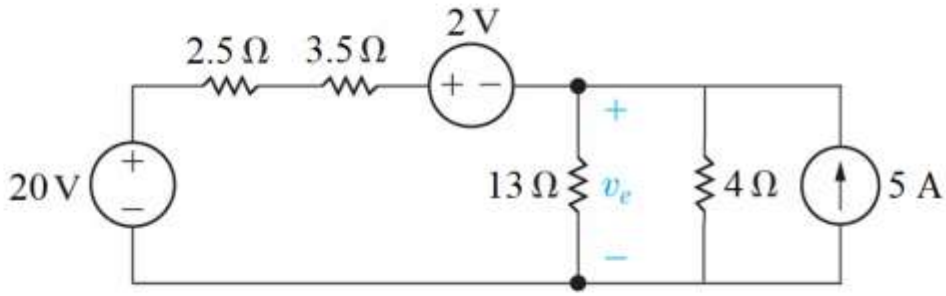
1) [] Two source transformations from the left and write to get:



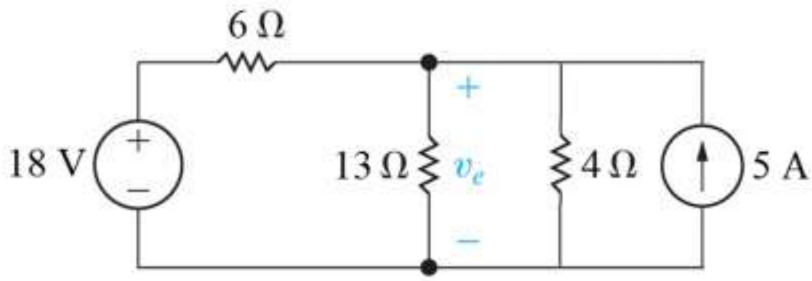
2) []:Combine the two resistors 3 and 13 Ohms to get:



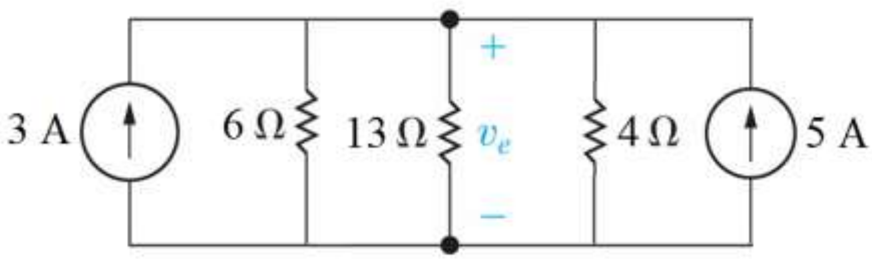
3) [] One source transformation from the left:



4) []:Combine the two voltage sources and two resistors to get:



5) []:One source transformation from the left to get:



6) []:Apply KCL and the upper node and Ohms Law on the three resistors to get:

$$v_e\left(\frac{1}{6}+\frac{1}{13}+\frac{1}{4}\right)-3-5=0$$

$$v_e = 16.21 \text{ V}$$

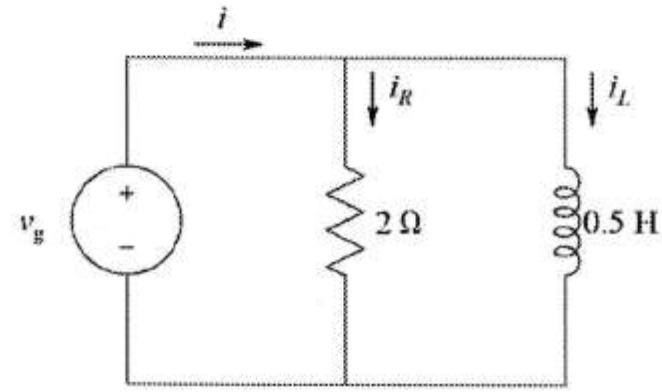
Question 2:

For the circuit shown, the voltage

$$v_g(t) = \begin{cases} -2t+2 \text{ V} & , 0 \le t \le 1 \\ 2t-2 \text{ V} & , 1 \le t \le 2 \end{cases}$$

and $i_L(0) = -1\text{A}$

a) Find the current i(t) for 0 < t < 1 s
b) Find i(1)
c) Find the energy stored in the inductor at t=1 s
d) Find the current i(t) for 1 < t < 2 s



Solution

a)

$$i = i_R + i_L$$

$$i_R = \frac{v_g}{2} = -t+1 \qquad 0<t<1$$

$$i_L = \frac{1}{0.5}\int_0^t v_g dt + i_L(0) \qquad 0<t<1$$

$$= \frac{1}{0.5}\int_0^t (-2t+2)dt - 1 \qquad 0<t<1$$

$$= 2\left[-t^2+2t\right]-1 \qquad 0<t<1$$

$$i = -2t^2+3t \ A \qquad 0<t<1$$

b)

$i(1)=1$ A

c)

$W(1)=1/2Li^2(1)=1/2(0.5)(1)^2=1/4$ J

d)

$$i_R=\frac{v_g}{2}=t-1 \qquad 1<t<2$$

$$i_L=\frac{1}{0.5}\int_1^t v_g\,dt+i_L(1) \qquad 1<t<2$$

$$=\frac{1}{0.5}\int_1^t (2t-2)\,dt+1 \qquad 1<t<2$$

$$=2\left[t^2-2t-1+2\right]+1 \qquad 1<t<2$$

$$i=2t^2-3t+2\,A \qquad 1<t<2$$

Question 3:

For the circuit below, the switch has been Closed for long time before opening **at t = 0**. All currents i(t) are in **mA**, and voltages v(t) in **V**. **Circle the correct answer for the parts a to i**.

a) Find $i_o(0^-)$:

i) −3 ii) −2 iii) −1 iv) 0 **v) 1** vi) 2 vii) 3

b) Find $v_C(0^-)$:

i) −20 ii) −10 iii) −5 iv) 0 v) 5 **vi) 10** vii) 20

c) Find $i_o(0^+)$:

i) −3 ii) −2 iii) −1 iv) 0 **v) 1** vi) 2 vii) 3

d) Find $v_C(0^+)$:

i) −20 ii) −10 iii) −5 iv) 0 v) 5 **vi) 10** vii) 20

e) Find $i_o(\infty)$:

i) −3 ii) −2 iii) −1 **iv) 0** v) 1 vi) 2 vii) 3

f) Find $v_C(\infty)$:

i) −20 ii) −10 iii) −5 **iv) 0** v) 5 vi) 10 vii) 20

g) Find $i_C(0^-)$:

i) −3 ii) −2 iii) −1 **iv) 0** v) 1 vi) 2 vii) 3

h) Find $i_C(0^+)$:

i) −3 ii) −2 **iii) −1** iv) 0 v) 1 vi) 2 vii) 3

i) Find $i_C(\infty)$:

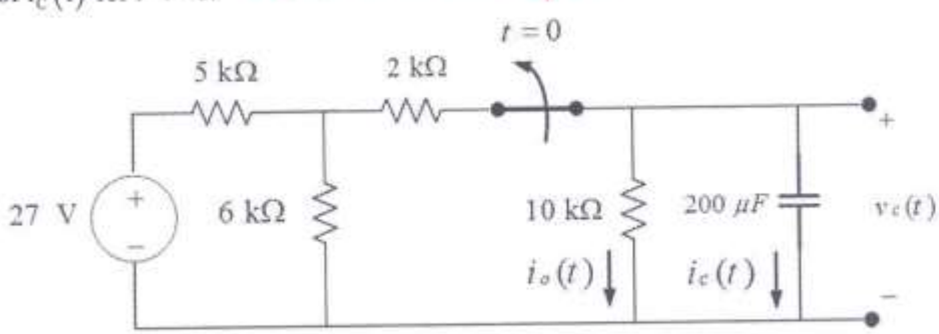
i) −3 ii) −2 iii) −1 **iv) 0** v) 1 vi) 2 vii) 3

j) Write the expression of $v_C(t)$ for $t \geq 0$. $v_c(t) = 10\, e^{-\frac{t}{2}}$ V, $t \geq 0$

$\tau = RC = 10k \times 200\mu F$
$\tau = 2$ s

k) Write the expression of $i_o(t)$ for $t > 0$. $i_o(t) = e^{-\frac{t}{2}}$ mA, $t > 0$

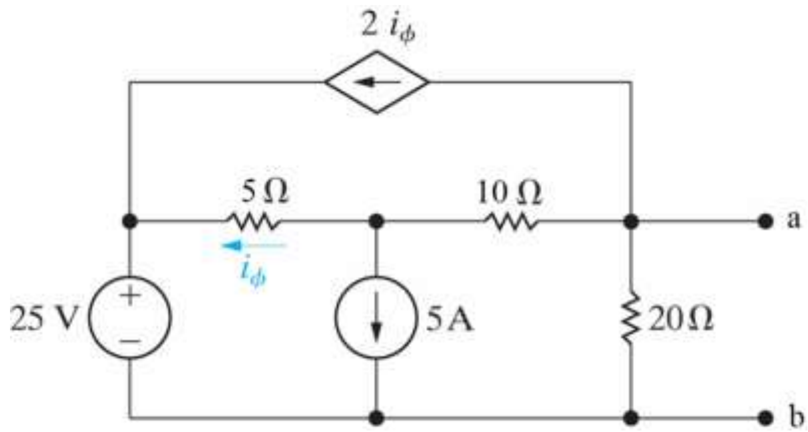
l) Write the expression of $i_C(t)$ for $t > 0$. $i_c(t) = -e^{-\frac{t}{2}}$ mA, $t > 0$



Question 4:

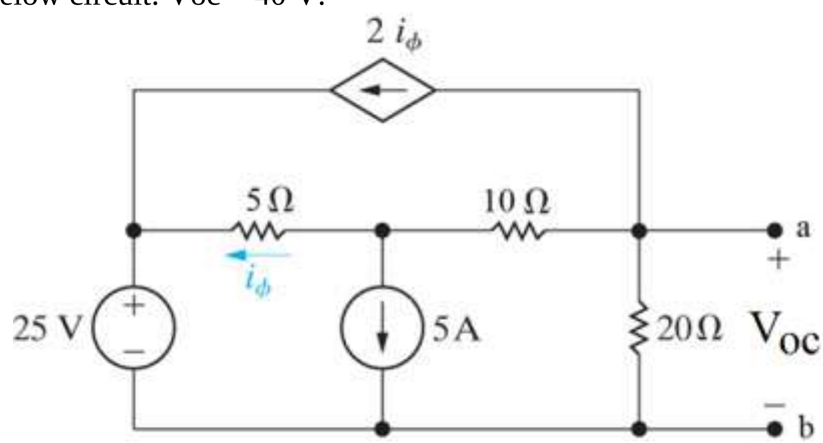
For the circuit below, find the following:

a) The open circuit voltage between ab.
b) The Thevenin resistor R_{th}.



Solution:

a) To find the open circuit voltage:
   - to start with the below circuit. Voc = 40 V.



b) To find the Thevenin resistor:
   - Rth = 4 Ω.