EE1002/CG1108 Tutorial 1

1. Use Kirchoff's current law to determine the unknown currents in the circuit of the Figure 1. Assume that I_0=-2A, I_1=-4A, I_s=8A and V_s=12V.

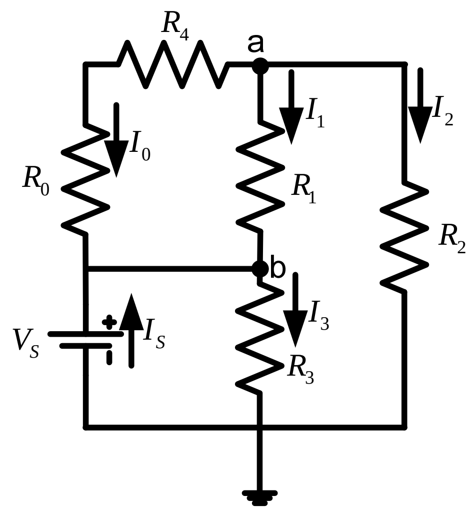

Figure 1

Ans. $I_2 = 6A, I_3 = 2A$

2. Apply KVL to find the voltages v_1 and v_2 in the Figure 2.

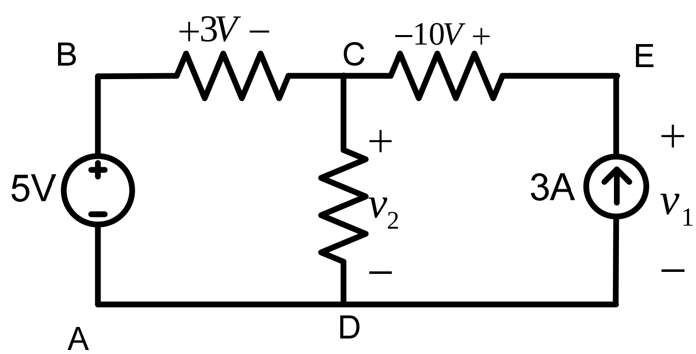

Figure 2

Ans. $v_1 = 12V, v_2 = 2V$

3. For the circuit given in Figure 3,
   i) Determine which components are absorbing power and which are delivering power.
   ii) Is conservation of power satisfied? Explain your answer.

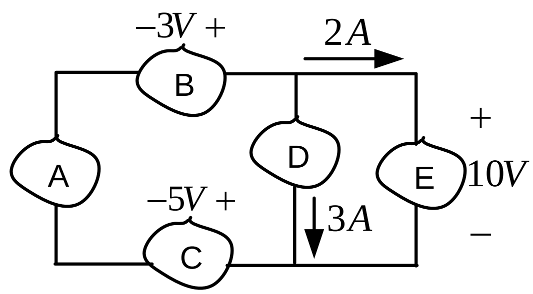

Figure 3

Ans: **Absorbing power: C,D,E; Delivering power: A,B**

4. In the circuit given in Figure 4, the power absorbed by the 15-Ohm resistor is 15W. Find R.

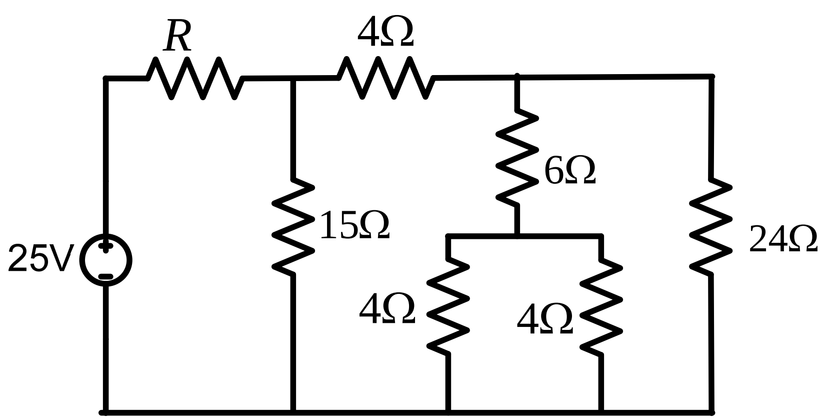

Figure 4

Ans. $R = 4\Omega$

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5. For the circuit shown in Figure 4, find:
   i) The currents i_1 and i_2.
      Ans. $i_1 = -1.8A, i_2 = -1.2A$
   ii) The power delivered by the *3A* current source and by the *12V* voltage source.
      Ans. $279W, 6.17W$
   iii) The total power dissipated by the circuit.
      Ans. 285.17W

   Given R1=25 ohm, R2= 10 ohm, R3=5 ohm, R4=7 ohm .

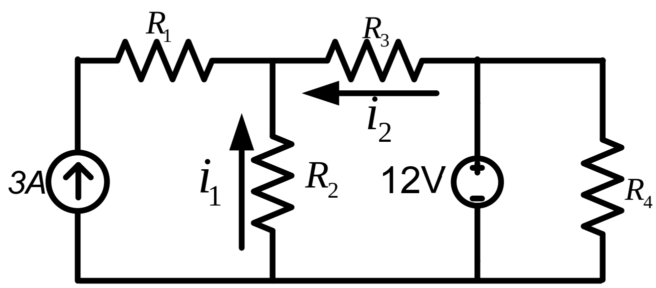

Figure 5

6. Given the circuit of Figure 6:
   i) Determine the power delivered by the dependent current source.
      Ans. 108W
   ii) Determine the power delivered by the voltage source.
      Ans. 0W

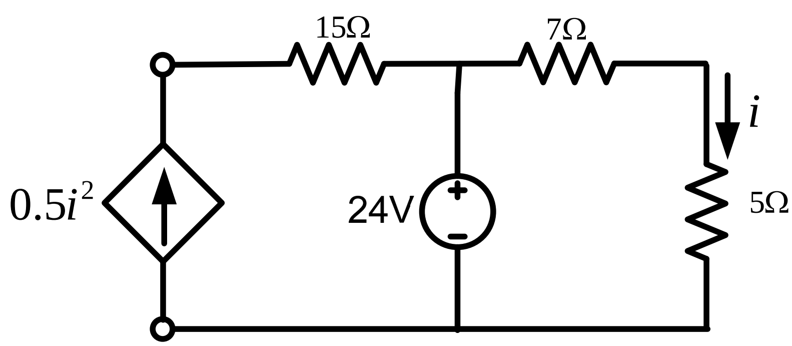

Figure 6

7. Consider NiMH hobbyist batteries shown in the circuit of Figure 7:

   i) If V_1=12.0V, R_1=0.15 ohm, R_L=2.55 ohm, find the load current I_L and the power dissipated by the load.

   Ans. $I_L = 4.44A, P_L = 50.4W$

   ii) If we connect a second battery in parallel with battery 1 that has voltage V2=12V and R2=0.28 ohm, will the load current I_L increase or decrease? By how much?

   Use mesh current analysis method.

   Ans. *Increases by 0.09A*

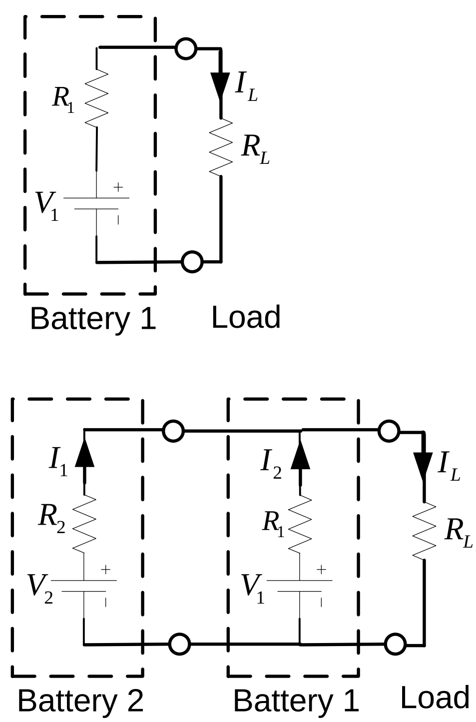

Figure 7

8. Using node voltage analysis in the circuit of Figure 8, find the current *i* through the voltage source.

   Ans. *i=8.03A*

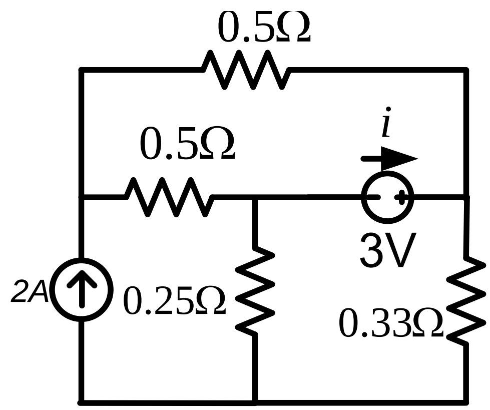

Figure 8

9. Using KCL, perform node analysis in the circuit shown in Figure 9 and determine voltage across R4. Note that one source is a controlled voltage source

   Vs=5V, Av=70, R1=2.2kohm, 2=1.8kohm, R3=6.8kohm, R4=220ohm.

   Ans. *8.757mV*

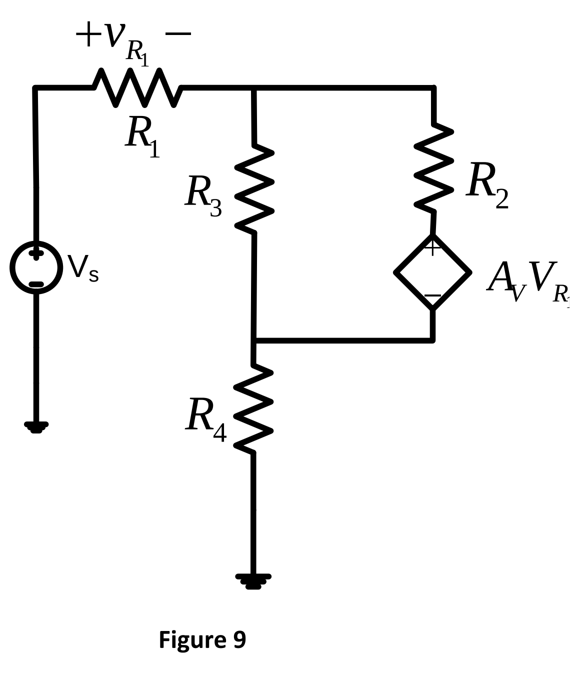

Figure 9

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10. Determine, using superposition, the voltage v across R in the circuit of Figure 10.

$$I_B = 3A, R_B = 1\Omega, V_G = 15V, R_G = 1\Omega, R = 2\Omega$$

Ans. *v=7.2V*

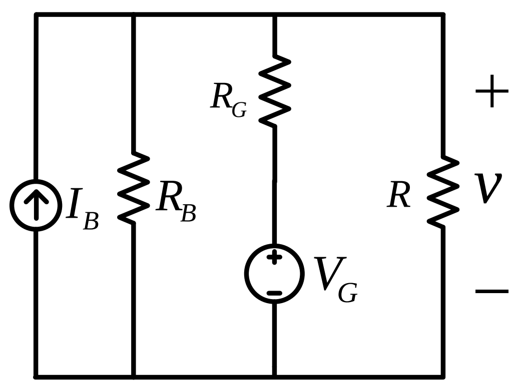

Figure 10

11. Find the Thevenin equivalent circuit that the load (R_L) sees for the circuit of Figure 11.

Ans. *V_{th}=4.499V, R_{th}=504 ohm*

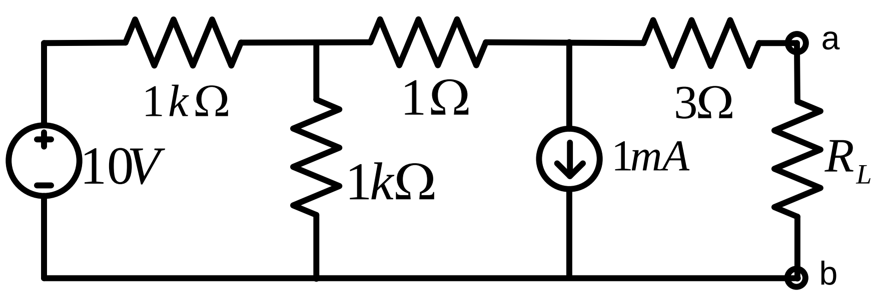

Figure 11

12. For the circuit given in Figure 12:

   i) Obtain the Thevenin's equivalent for the circuit which contains a dependent voltage source.
      Ans. Vth=30V, Rth=10 ohm

   ii) What should be the optimum value of a load resistor RL to be connected between a and b so that the power delivered to it by the network is maximum?
      Ans. RL=10 ohm

   iii) What is the maximum power?
      Ans. 22.5W

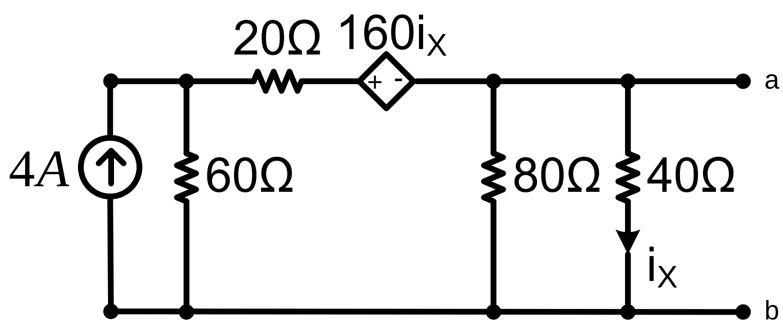

Figure 12

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13. In the circuit of Figure 13, assume that the capacitor is initially uncharged. If the switch is closed at t=0,
    i) Determine the current flow through the resistors and the capacitor when t=0+.
    Ans. $i_1 = 5A, i_2 = 0A, i_3 = 5A$

    ii) What will be the current flow under steady state condition?
    Ans. $i_1 = i_2 = 2.5A, i_3 = 0A$

    iii) Determine the voltage across the capacitor under steady state condition.
    Ans. *50V*

    iv) Find an expression for the capacitor voltage as a function of time t>0.
    Ans. $50(1-e^{-\frac{1}{20\times10^{-6}}})$

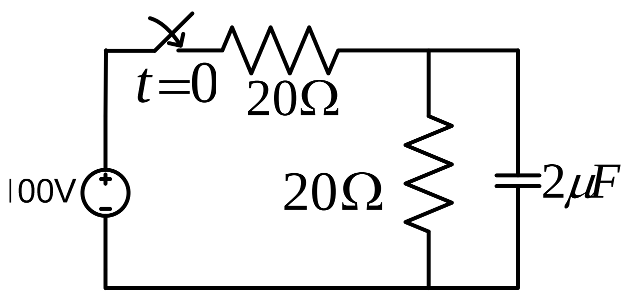

Figure 13

14. For the circuit shown in Figure 14, assume that switch S1 was closed and switch S2 was opened for a long time. Then, at time t=0, switch S1 is opened and switch S2 is closed.

    i) Find the capacitor voltage $v_c(t)$ at t=0+.
    Ans. *20V*

    ii) Find the time constant τ for t>=0.
    Ans. $56\mu S$

    iii) Find an expression for $v_c(t)$, and sketch the function.
    Ans. $12+8e^{-\frac{t}{56\times10^{-6}}}$

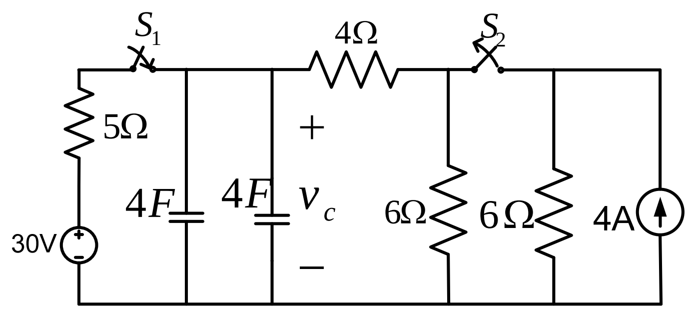

Figure 14

15. For the circuit given in Figure 15, switch S2 was closed for a long time before t=0. At t=0, the switch S1 is closed and S2 is opened.

    i) Find the inductor current i(t) at t=0+.

       Ans. *2A*

    ii) Find the time constant τ for t>=0.

       Ans. $1\mu S$

    iii) Find an expression for i(t).

       Ans. $0.5+1.5e^{-\frac{t}{1\times10^{-6}}}$

    iv) Find i(t) for each of the following values, the time constant, twice the time constant, five times the time constant and ten times the time constant. Sketch the function.

       Ans. $i(\tau)=1.05A, i(2\tau)=0.70A, i(3\tau)=0.55A, i(5\tau)=0.51$

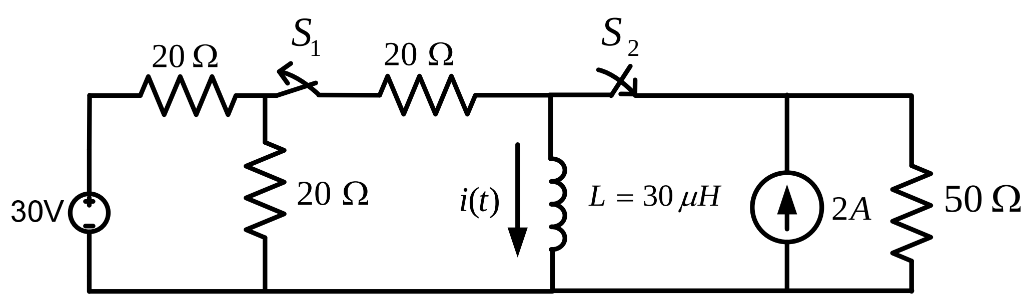

Figure 15

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16. For the circuit in Figure 16,
    i) Find the expression for $v_R(t)$.
    ii) If the sinusoidal has a frequency of 10 kHz, and the inductor is 1 mH, what is the value of R for phase difference between $v_s(t)$ and $v_R(t)$ to be 45 deg?

       Ans. *62.832 ohm*

    iii) Draw the phasor diagram showing the $v_s(t)$ and $v_R(t)$ for part (ii).

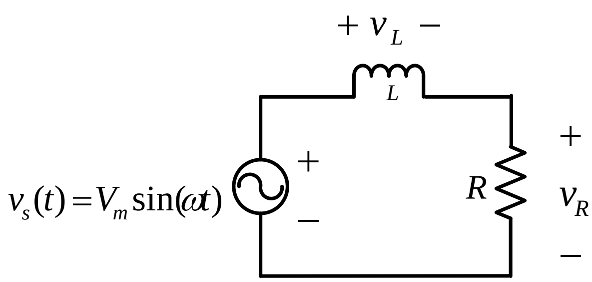

Figure 16

17. Determine the current *i(t)* in the circuit shown in Figure 17.

$$v_s(t) = 636\cos\left(3000t + \pi/12\right)$$
$$R_1 = 2.3k\Omega, R_2 = 1.1k\Omega$$
$$L = 190mH, C = 55nF$$

Ans. $i(t) = 0.2814\cos(3000t + 22.56^0)A$

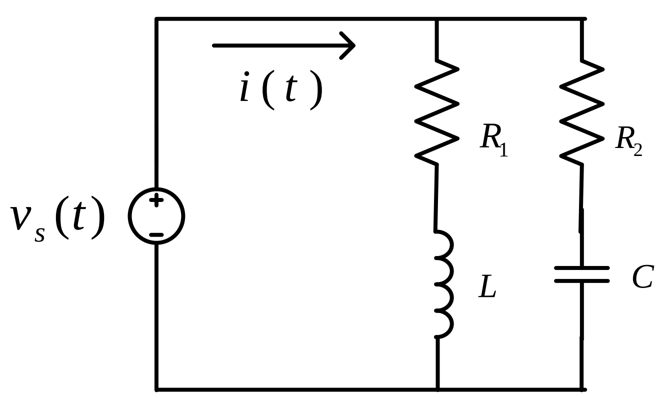

Figure 17

18. Find the Thevenin equivalent of the circuit as seen from terminals a-b for the circuit shown in Figure 18.

Ans. $V_{th} = 5\sqrt{2}\angle 15^{0}, Z_{th} = 8 - j8$

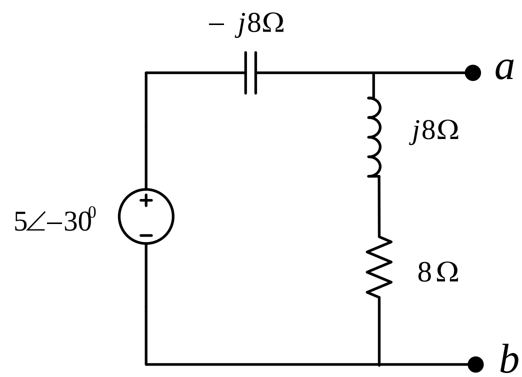

Figure 18