ELL 101: INTRODUCTION TO ELECTRICAL ENGINEERING

Tutorial Problem Set 1

1. Determine the ratio of powers dissipated in two resistors, each having the same length and each made of copper wire of circular cross-section, but one having a diameter twice that of the other, and each being connected across the same voltage.

2. Calculate the charge flowing through the circuit in 250ms when the current flowing through the circuit is given by
   i. $i = 10(1 - e^{-2t})$
   ii. $i = 8t^2 - 4t$
   iii. $i = cos2\pi t - sin4\pi t + 1$

3. The current flowing through a tungsten-filament light-bulb is determined to follow $i(t) = 114\sin(100\pi t)$ A. (a) Over the interval defined by $t = 0$ s and $t = 2$ s, how many times does the current equal zero amperes? (b) How much charge is transported through the light bulb in the first second?

4. An inductance of 3.0 mH has a voltage that is described as follows: for 0 < t < 2 ms, V =15.0 V and for 2 < t < 4 ms, V=-30.0 V. Obtain the corresponding current and sketch V_L and i for the given intervals.

5. A coil consists of 2000 turns of copper wire having a cross-sectional area of 0.8 mm^2. The mean length per turn is 80 cm and the resistivity of copper is 0.02 $\mu\Omega$-m. Find the resistance of the coil and power absorbed by the coil when connected across 110 V D.C. supply.

6. A 25.0 Ω resistance has a voltage v = 150.0 sin 377t V. Find the total power P and the average power P_{avg} over one cycle.

7. A certain circuit element has a current $i = 2.5\ sin\ \omega t$ ma, where ω is the angular frequency in rad/s, and a voltage difference $v = 45\ sin\ \omega t$ V between its terminals. Find the average power P_{avg} and the energy W_T transferred in one period of the sine function.

8. A certain circuit element has the current and voltage: $i = 100e^{-2500t}$A and voltage $v = 100(1 - e^{-2500t})$ V. Find the total energy transferred during $t \geq 0$.

9. A series circuit with R = 2Ω, L = 2 mH, and C = 500 µF has a current which increases linearly from zero to 10 A in the interval $0 \leq t \leq 1$ ms, remains at 10 A for $1 \text{ ms} \leq t \leq 2$ ms, and decreases linearly from 10 A at t = 2 ms to zero at t = 3 ms. Sketch V_R, V_L, and V_C.

10. What is the value of the unknown resistor R in the figure 1, if the voltage drop across the 500 Ω resistor is 2.5 V? All resistances are in ohm.

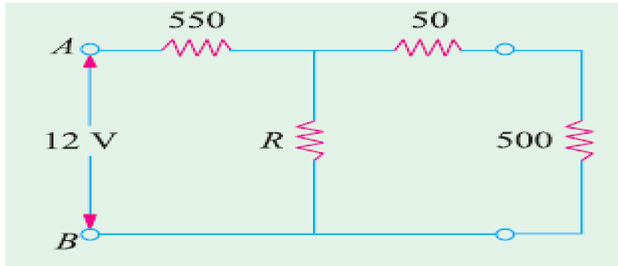

Fig. 1

11. Refer to the circuit represented in the figure 2, while noting that the same current flows through each element. The voltage-controlled dependent source provides a current which is 5 times as large as the voltage V_x. (a) For $V_R = 10$ V and $V_x = 2$ V, determine the power absorbed by each element. (b) Is element **A** likely a passive or active source?

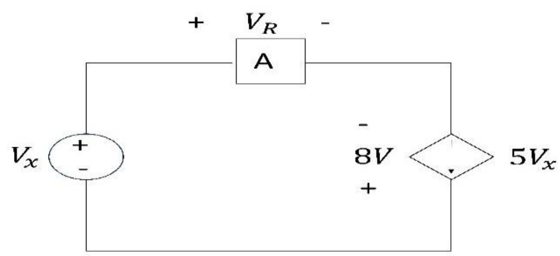

Fig. 2

12. Obtain the voltage v in the branch shown below for a) $i_2 = 2$ A b) $i_2 = -2$ A c) $i_2 = 0$ A

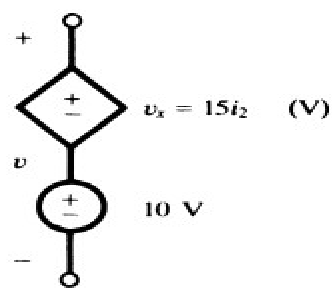

Fig. 3

13. In the given figure 3 find i_b and v_g so that the given connections are valid. If the connections are valid, find the power generated by current source.

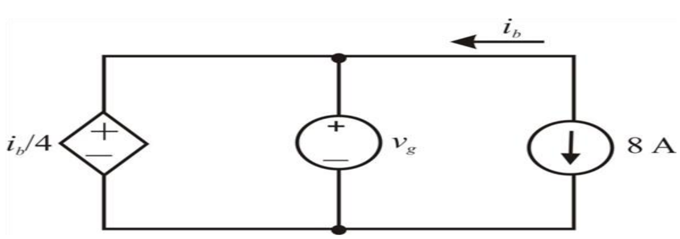

Fig. 4

14. Find the value of unknown current in the given circuits using source transformation technique

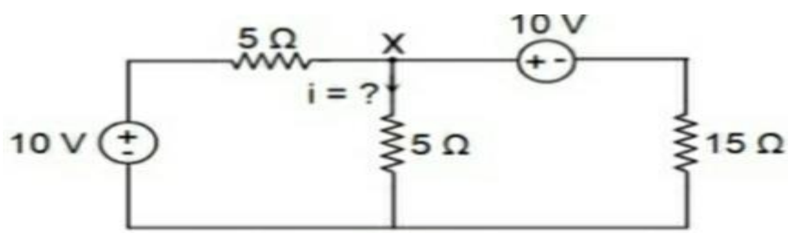

Fig. 5

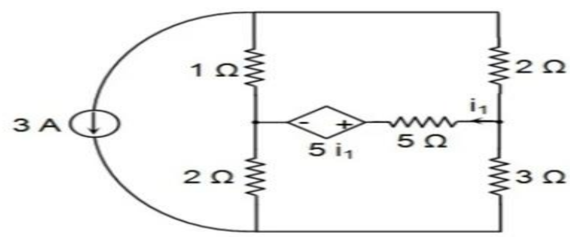

Fig. 6

15. The voltmeter shown in Fig. 7(a) measures the voltage across the current source. Fig. 7(b) shows the circuit after removing the voltmeter and labelling the voltage measured by the voltmeter as v_m. Also, the other element voltages and currents are labelled in Fig. 7(b).

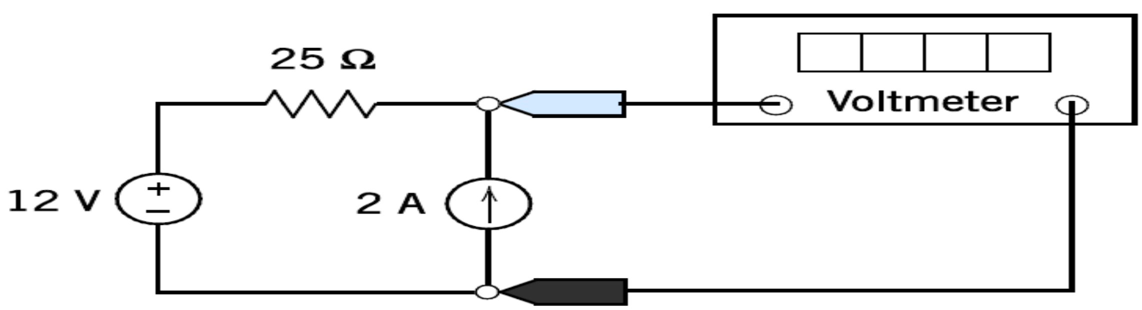

Fig. 7(a)

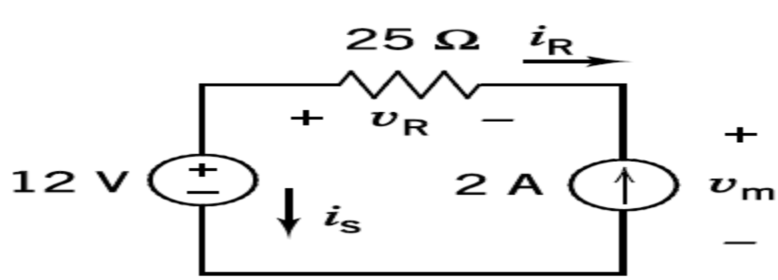

Fig. 7 (b)

Given that $v_R + v_m = 12$ and $-i_R = i_s = 2A$ and $v_R = 25i_R$

Determine the power supplied by each element, i.e. the voltage source, current source and resistor.

16. Find the voltage across 10 Ω resistor in figure 8, if the control current i_x is a) 2 A b) -1 A

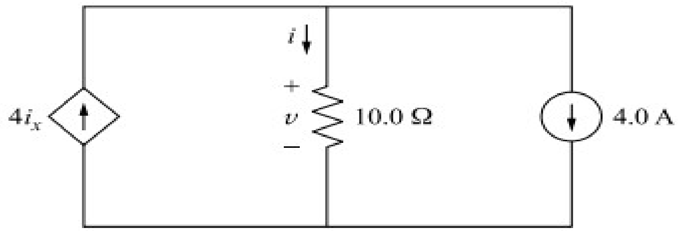

Fig. 8

17. Determine the voltages V_1 and V_2 in the network shown in Fig.9 using the concept of voltage division.

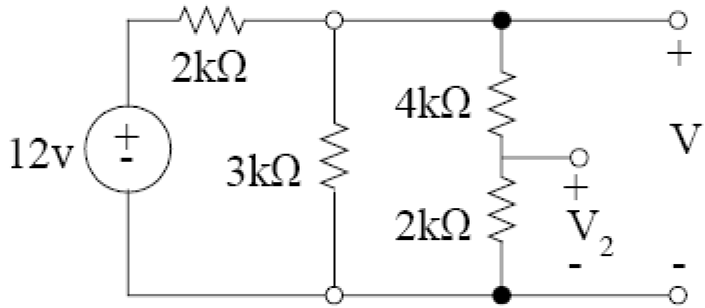

Fig. 9

18. Find the currents I_0 and I_1 in the circuit shown in Fig.10 using the concept of current division.

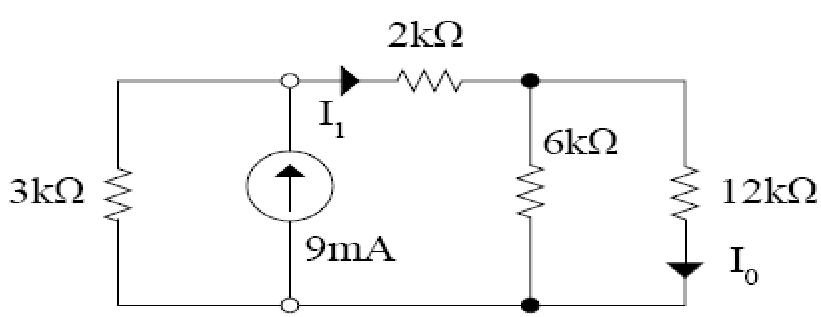

Fig.10

19. Find the equivalent resistance across A and B in the circuit shown in figure 11

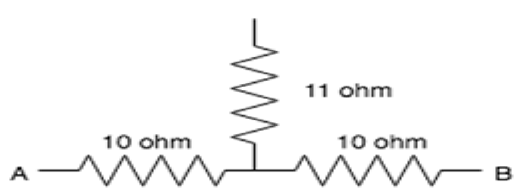

Fig. 11

20. Find the equivalent resistance across X and Y in the circuit shown in figure 12

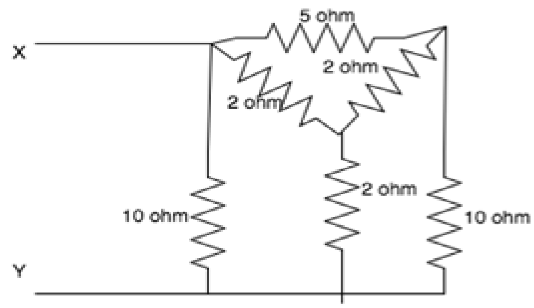

Fig. 12