Chapter 2

Principles of Electricity, Network Theorems and AC principles

One mark questions (Knowledge):

1. Define electric charge.
2. Define electric current.
3. Define potential difference.
4. What are linear devices?
5. Define electric power.
6. Define kWh.
7. What is the commercial or Board Of Trade (BOT) unit of electrical energy?
8. What is the direction of conventional current?
9. What is a node?
10. What is a closed loop?
11. What is an open loop?
12. What is a mesh?
13. Give an expression for instantaneous value of AC voltage.
14. Define RMS value of AC.
15. What is a square wave?

One mark questions (Understanding):

1. How do you relate voltage and current in case of conductors?
2. How many electrons pass through a conductor in one second if the current through the Conductor is one ampere?
3. Can Ohm's law be applicable when the temperature of a conductor continuously changes?
4. How do you arrange cells to get desired current rating?
5. How do you connect cells to obtain desired voltage rating?
6. Give an example for electro-chemical cell.
7. What do you mean by current source?
8. When will a load receives maximum power from a source?
9. Who invented modern alternating current electrical supply system?
10. RMS value has to be considered in case of AC. Why?
11. How much is the AC voltage supplied to all household electrical devices in India?
12. Mention any one type of battery used in mobile phones.

One mark questions (Application):

1. What will be the current flowing through an open circuit?
2. What will be the voltage across short circuit?
3. Write any one application of network theorem.
4. Mention one advantage of superposition theorem.
5. Mention an application of maximum power transfer theorem.
6. The output impedance of an amplifier is 8 Ω. What should be the input impedance of the loud speaker to hear the quality sound?

Two marks questions (Knowledge):

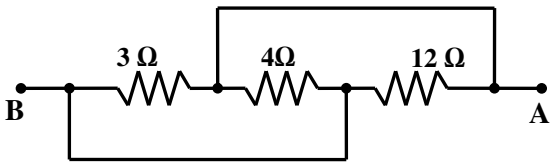
1. What is meant by a linear network? Give an example for linear device.
2. What is meant by a nonlinear network? Give an example for nonlinear device.
3. What will be the resistance in open circuit and short circuit?
4. State superposition theorem.
5. State Thevinin's theorem.
6. State KVL and KCL.
7. What are primary DC-sources? Give an example.
8. What are secondary DC-sources? Give an example.
9. Define 'branch' and 'loop' in an electrical circuit?
10. Define peak value and RMS value.
11. Define time period and frequency of AC?
12. Mention the unit of AC voltage and frequency.

Two marks questions (Understanding):

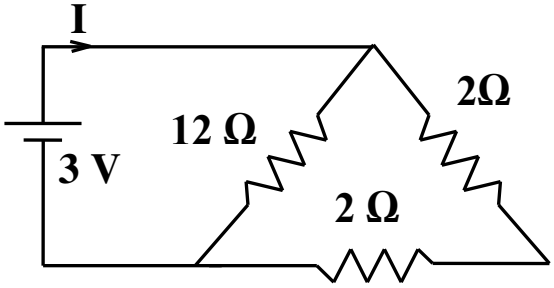
1. Give an example for primary and secondary batteries.
2. Give an example for AC and DC sources.
3. Distinguish between open and short circuit
4. Write the difference between voltage source and current source.
5. Compare ideal and practical voltage source.
6. What is the difference between conventional current and electron current?
7. Draw the V-I characteristics of a practical voltage source.
8. Why is DC not used for powering all houses?

Two marks questions (Application):

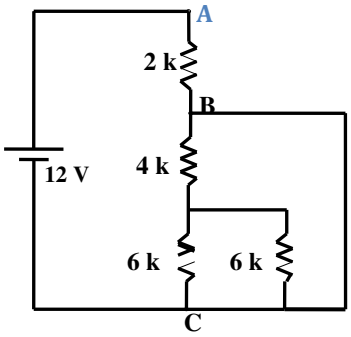
1. A bulb of a car head light is connected to a 12 V battery maintains 3 A of current. What is the power rating of the bulb? [Ans: 36 w]
2. Find the resistance between A and B. [Ans: 1.5 Ω]



3. The specifications of an iron box are labelled as 230 AC, 350 W. Calculate the resistance of the iron box. [Ans: 151 Ω]
4. Find the current 'I' in the circuit. Find the following:



5. For the circuit shown below determine
   a) Total resistance [R_T = 2 kΩ]
   b) Total current flowing in the circuit [I = 6 mA]



6. A 12 V battery allows 2 A of current through a resistor. What is the current in the same resistor if a 6 V battery is connected? [Ans: 1 A]
7. Calculate the current I flowing into the node N in the given circuit. [Ans: -2 mA]
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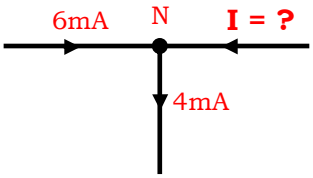


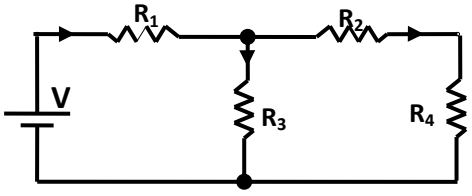
8. The angular frequency of a waveform is 100 π radian/sec.
   Find its a) frequency and b) time period. [Ans: 50 Hz, 20 mS]
9. The equation of an alternating voltage is given by v = 325sin (314t). Find the frequency and the RMS value of the voltage. [Ans: 50 Hz, 229.8 V]

Three marks questions (Knowledge):

1. Mention the properties of charges.
2. Mention any three limitations of Ohm's law.
3. What are primary and secondary batteries give an example for each.
4. Define the terms mesh, branch and loop in an electrical network.
5. Define the following terms in an ac signal
   a) Frequency b) Time period c) Peak Value
6. Briefly explain open circuit and short circuit with relevant circuit.

Three marks questions (Understanding):

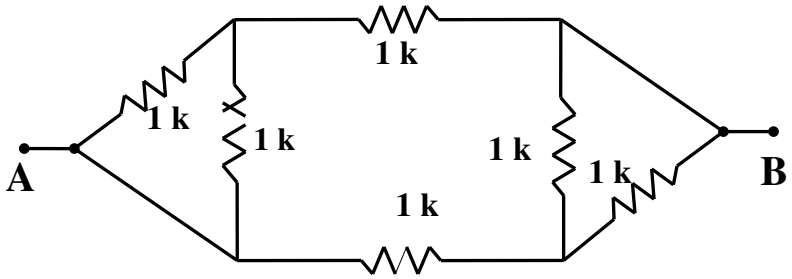
1. Give comparison between AC and DC.
2. Write any three differences between the Dry cell and Wet cell.
3. How to convert voltage source into current source, explain.
4. How to convert current source into voltage source, explain.
5. Find the number of branches, nodes and loops in the following circuit



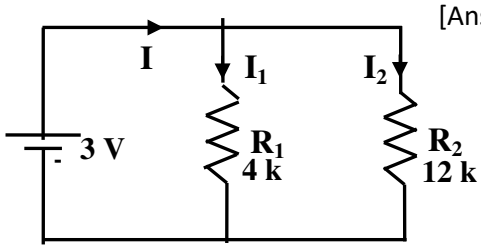
6. Explain voltage divider rule.
7. Explain current divider rule.
8. Draw any three non sinusoidal waveforms.

Three marks questions (Application):

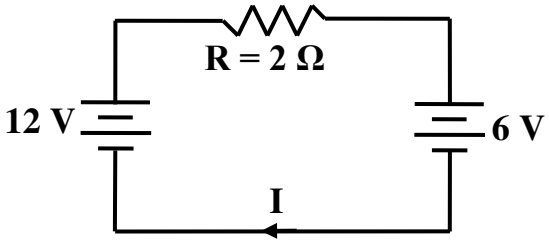
1. A battery is connected across a conductor. If it transfers 30 C of charge/S and the amount of work done by the battery is 90 joules/S, what is the battery voltage? [Ans: 3 V]
2. How do you create 3 V, 2 V and 1 V from a 3 V source?
3. An UPS supplies 2 A of current to a bulb of 20 V for 20 minutes. Calculate the amount of charge supplied by the UPS. [Ans: 2400 C]
4. Find the total resistance between A and B. [Ans: 0.75 kΩ]



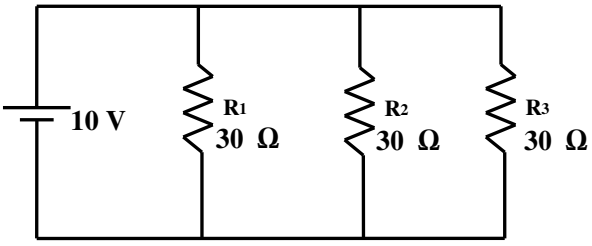
5. Find the total current flowing in the circuit also find the branch current?
[Ans: I = 1 mA, I_1 = 0.75 mA, and I_2 = 0.25 mA]



6. Find the current flowing through and voltage across R using super position theorem.
[Ans: V = 6 V, I = 3 A]



7. Find the total current and total resistance in the circuit given below.
[Ans: I = 1 A, R_t= 10 Ω]

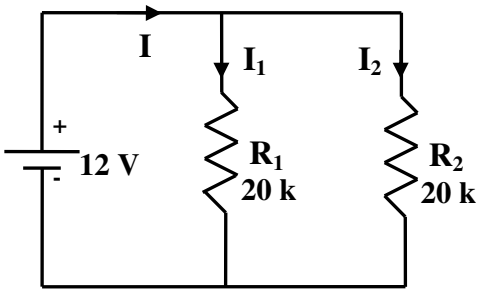


8. A 220 Ω resistor is connected to 220 V sinusoidal 50 Hz supply. Find the peak, rms and average values of the current and the power dissipated.

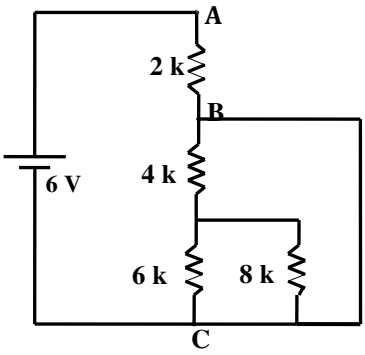
[Ans: V_P = 311 V, V_{rms} = 220 V, V_{avg} = 197.9 V]

9. Find the total current flowing in the circuit. Also find the branch current?

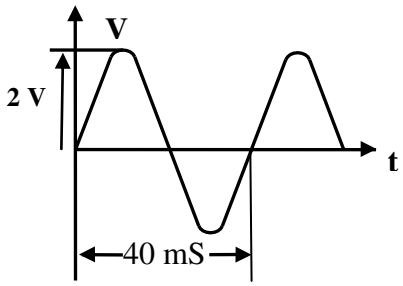
[Ans: I = 1.2 mA, $I_1 = I_2$ = 0.6 mA]



10. Find the following in the given circuit.
    (a) Voltage at A
    (b) Potential at B
    (c) Total current flowing in the circuit [Ans: V_A = 6V, V_B = 0 V, I = 3 mA]



11. A sinusoidal voltage varies from zero to a maximum value of 200 V. How much is its value at the instances of a) 30^0 b) 45^0 c) 90^0 [Ans: (a) 100 V (b) 141 V (c) 200 V]
12. Find V_m, $V_{p\text{-}p,}$ and frequency of the given waveform. [V_m =2 V, $V_{p\text{-}p}$ = 4 V, f = 25 HZ]

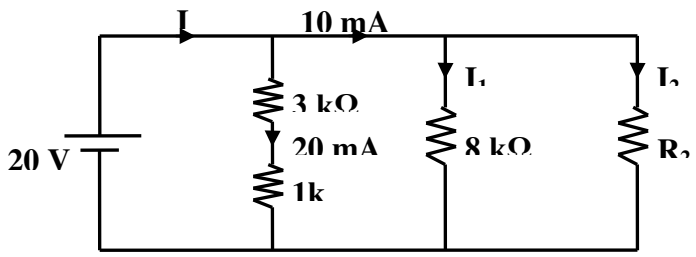


13. A 100 W electric bulb connected across a 230 V, 50 Hz power line. What is the rms and peak value of the current flowing through it? [Ans: Vp = 230 V, I_{rms} = 0.434 A , I_p= 0.613 A]

Five marks questions (Application):

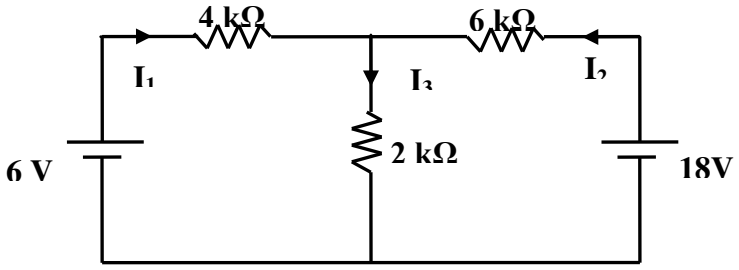
1. In the figure, determine the unknown branch currents and unknown resistance of resistors.

[Ans: R_2 = 2.66 kΩ, I_2 = 7.5 mA, I_2 = 2.5 mA I = 30 mA]



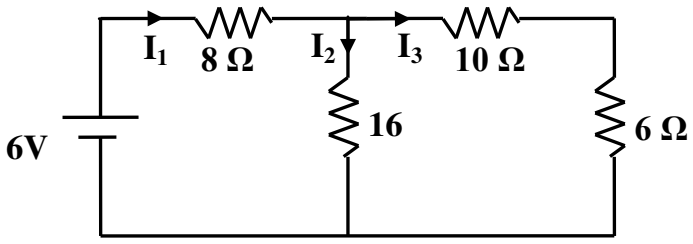
2. Determine the branch currents in the given figure.

[Ans : I_1 = -2.63 A , I_2 = 2.18 A , I_3 = -0.45 A]

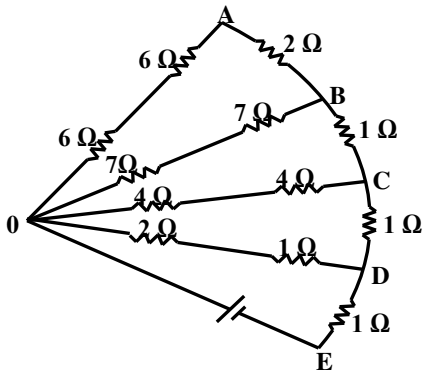


3. Determine the branch currents and voltage drops across each resistor.

[Ans : I_1 = 3/8 A , I_2 = 3/4 A , I_2 = 3/4 A]



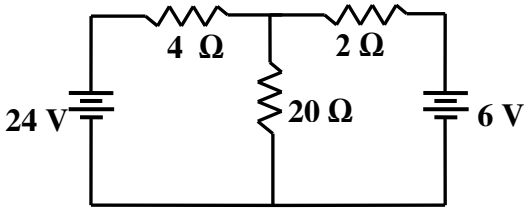
4. Find the total resistance between the terminals O and E in the figure shown below.



[Ans: R_t = 2.87 Ω]

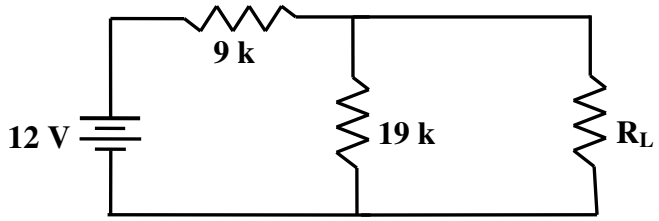
5. Using superposition theorem, find the current through the 20 Ω resistance of the circuit.

[Ans: 0.705 A]

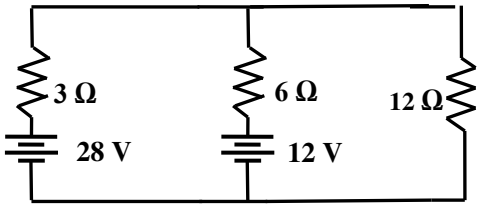


6. What should be the value of load R_L to abstract maximum power from 12 V batteries? Determine the power transferred to R_L.

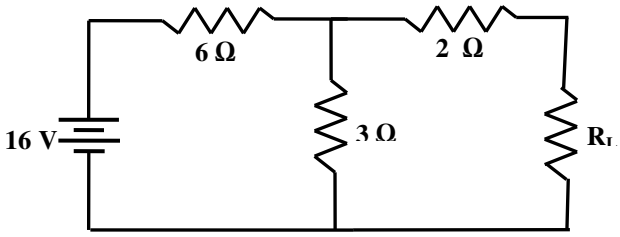
[Ans: $R_{th} = R_L = 6.1\ k\Omega$, $V_{th} = 8.14$ V, $P_{max} = 2.71$ mW]



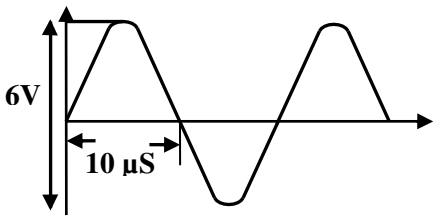
7. Use superposition Theorem to find the current through 12 Ω resistor. [Ans: 1.62 A]



8. According to Maximum Power transfer theorem, what should be the value of load resistance R_L to abstract maximum power from the 16 V battery as shown in figure below? What is the value of maximum power? [Ans: $R_{TH} = 4\ \Omega$, $P_{max} = 1.77$ W]



9. Calculate V_m, $V_{p\text{-}p}$, V_{rms}, time period and frequency of the given waveform.



[Ans: Vp = 3 V, $V_{p\text{-}p} = 6$ V, $V_{rms} = 2.1$ V, $V_{AVG} = 1.91$V, T = 20 µS , f = 50 kHz]

Five marks questions (Knowledge):

1. State and explain KCL and KVL.
2. State and explain Thevenin's theorem with an example.
3. State and explain superposition theorem.
4. Define the following terms with respect to an ac signal
   a) Cycle b) RMS value c) Peak to peak value d) Average value e) Instantaneous voltage.

Five marks questions (Understanding):

1. Distinguish between DC and AC current.
2. Derive an expression for the effective resistance of two resistors connected in series.
3. Derive an expression for the effective resistance of two resistors connected in parallel.
4. State and explain maximum power transfer theorem with an example

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