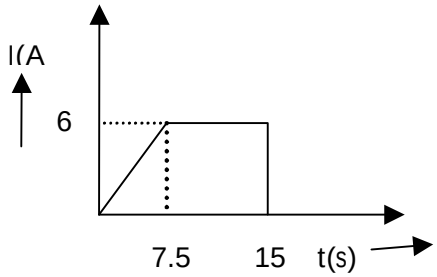
Current Electricity

1. In a hydrogen atom, an electron moves in an orbit of radius 4.8 x 10^{-11}m with a speed of 2.5 x 10^{6} m/s. Find the equivalent current.

2. Plot of current I versus time interval is given below. Find the charge that flows through the wire during this time period

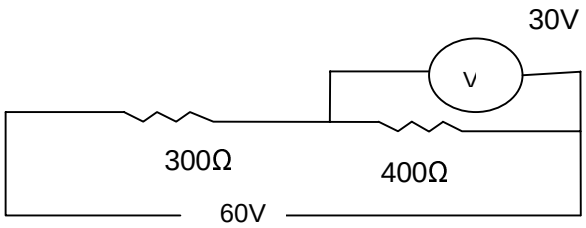


3. Amount of charge passing through the cross section of a wire is $q(t)=at^2+bt+c$.Write the dimensional formula for a, b and c. If the values of a, b and c in SI unit are 6, 4, 2 respectively. Find the value of current at t=6 seconds.
4. Current through a wire depends on time as $I=I_0+\alpha t$ where I_0 =15A and

   α=6 A/s. Find the charge that flows across a section of wire in 12 seconds.

5. One metre long metallic wire is broken into two equal parts P and Q. The part 'P' is uniformly extended into another wire R. Length of R is twice the length of P and the resistance of R is equal to that of Q. Find the ratio of the resistances of P and R and also the ratio of lengths of P and Q.
6. The area of cross section , length and density of a piece of a metal of atomic weight 60 are 10^{-6} m^2, 1.0 m and 5 x 103 kg/m^3 respectively . Find the number of free electrons per unit volume of every atom that contributes one free electron. Also find the drift velocity of electron in the metal when a current of 16A passes through it. Avogadro no.=6x10^{23} per gram per mole.
7. An n-type Silicon sample of width 4x 10^{-3} m thickness 25x10^{-4}m and length 6 X 10^{-2} m carries a current of 4.8mA.When the voltage is applied across the length of the sample what is the current density? If the free electron density is 10^{22} /m^3 then find how much time does it take for the electrons to travel the full length of the sample?
8. The temperature coefficient of a resistance wire is 0.00125 C^{-1}. At 300K its resistance is 1Ω. At what temperature the resistance of the wire will be 2Ω?

9. The length and radii of 3 wires of same metal are in the ratios 2:3:4 and 3:4:5 respectively. They are joined in parallel and included in a circuit having 5A current. Find the current in each case.
10. In the circuit diagram the voltmeter reads 30V when connected across 400Ω resistance . Calculate reading in the same voltmeter when it is connected across 300Ω resistance?

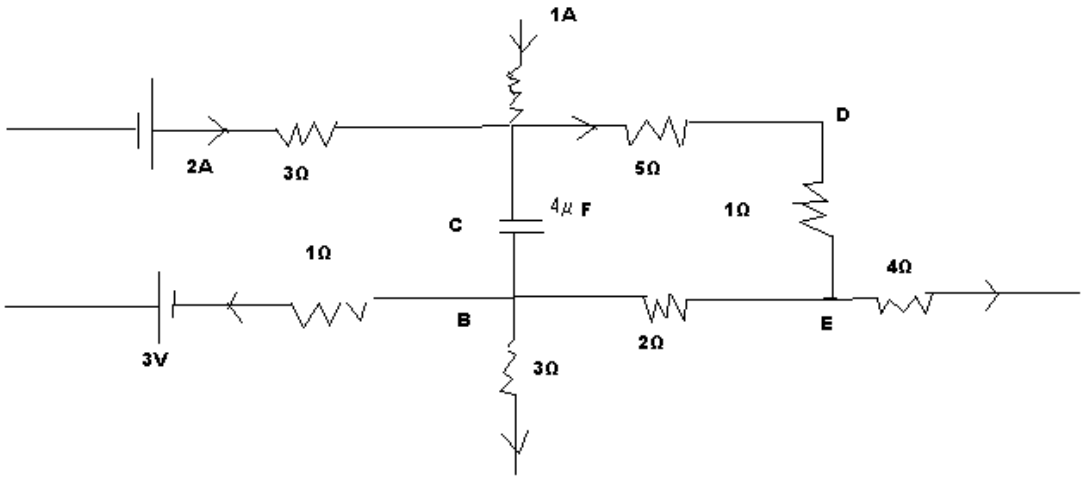


11. A galvanometer together with an unknown resistance in series is connected across 2 identical cells each of emf 1.5V. When the cells are connected in series the galvanometer records a current of 1A and when the cells are connected in parallel the current is 0.6 A .What is the internal resistance of each cell?

12. An electric bulb rated for 500 Watt at 100 V is used in circuit having a 200 V supply. Calculate the resistance R that must be put in series with the bulb s that the bulb delivers 500 watt.
13. A heater is designed to operate with a power of 1000 watt in a 100 V line. It is connected in combination with a resistance of 10Ω and a resistance R, to a 100 V mains in series. What should be the value of 'R' so that the heater operates with a power of 62.5 watt
14. An electric kettle has 2 heating coils. When one of the coils is switched on , the kettle begins to boil in'6' min and when the other coil is switched on , the boiling begins in 8 min. In what time will the boiling begin if both the coils are switched on simultaneously : a)in series b)in parallel
15. One kilowatt electric heater is to be used with 220 V d.c supply. a)What is the current in the heater? b) What is its resistance? c) What is the power dissipated in the heater d) how much heat in calories is produced per second? e) How many grams of water at 100^0C will be converted per minute into steam at 100^0C with the heater? Radiation losses are negligible. Latent heat of steam = 540 cal /g.
16. The walls of a closed cubical box of edge 50 cm are made of a material of thickness 1mm and thermal conductivity $4x10^{-4}$ cal per sec per cm. per ^{o}C. The interior of the box maintained at 100 ^{0}C above the outside

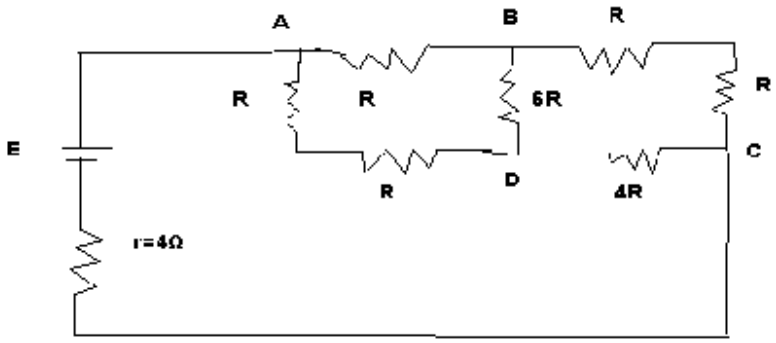
temperature by a heater placed inside the box and connected across a 40V d.c source .Calculate the resistance of the heater.

17. A part of the circuit in a steady state along with the currents following in the branches, the values of the resistance etc is shown in the fig. Calculate the energy stored in the capacitor.



19.A potentiometer wire of length 100 cm has a resistance of 100Ω. It is connected in series with a resistance and a battery of emf 2V and of negligible internal resistance. A source of emf 10mV is balanced against a length of 40cm of the potentiometer. What is the value of the external resistance?

20.A battery of internal resistance r=4Ω is connected to the network of resistance as shown in figure. What must be the value of R , so that maximum power is delivered to the network? What is the maximum power?



21. A battery of emf 2V and internal resistance 0.1 Ω is being charged by a current of 5A. What will be the direction of current inside the battery? What is the potential difference between the terminals of the battery?

22. Two wires A and B of the same material and having same length have their cross sectional area in the ratio1:4. What would be the ratio of heat produced in these wires when same voltage is applied across each?

23. Two wires of the same material having lengths in the ratio 1:2 and diameters in the ratio 2:3 are connected in series with an accumulator. Compute the ratio of p.d across the two wires.

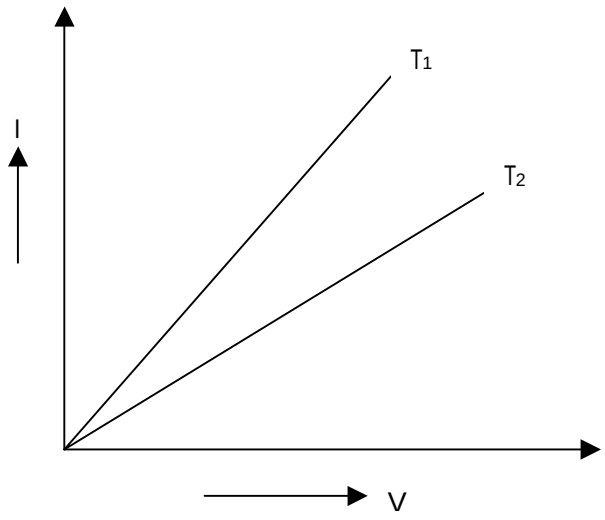
24. If the current supplied to a variable resistor is constant, draw a graph between voltage and resistance.

25. Observations on a given device yielded the following current – voltage data.

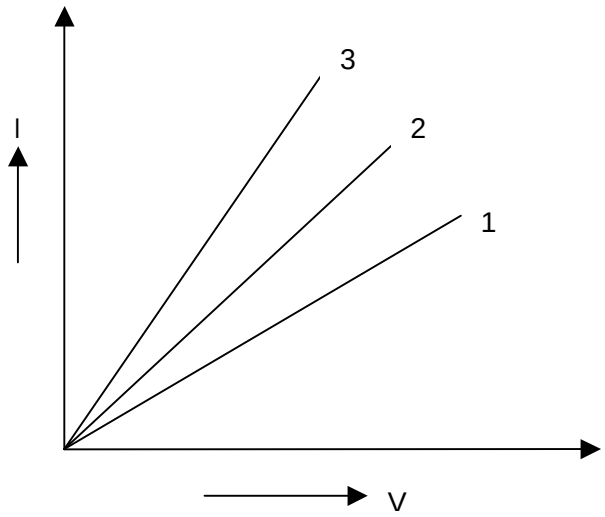
Current (A)	Voltage
1	19.7
2	39.4
3	59.1
4	78.8
5	98.5

Draw V-I graph using this data. What conclusion can you draw from the graph with regard to ohmic or non-ohmic nature of device?

26. Current voltage graphs for a given metallic wire at different temperatures T_1 and T_2 are shown in figure. Which of the temperatures T_1 and T_2 is greater?



27. V-I graphs for two resistors and their series combination are as shown in figure. Which one of these graphs represents the series combination of the other two? Give reasons for your answer.



28. Two metallic wires of the same material and same length but of different cross sectional areas are joined together.

1) in series

2) in parallel to a source of emf.

In which of the two wires will the drift velocity of electron be more in each of the two cases and why?

29. The resistivity of a material of a conductor of uniform cross section varies along its length as $e = \varepsilon (1+\alpha x)$. Deduce the expression for the resistance of the conductor, if its length is “L” and area of cross section is “A”.

30. A uniform wire of resistance “R” is shaped into a regular “n” sided polygon, where “n” is even. Find the equivalent resistance between

1) opposite corners of the polygon

2) adjacent corners of the polygon.

31. Under what condition is the heat produced in an electric circuit

1) directly proportional

2) inversely proportional to the resistance of the circuit?

32. A 4Ω non insulated wire is bent 180° in the middle and the two halves are twisted together. What will be its new resistance?

33. What is the safest voltage you can safely put across a 98 Ω, 0.5 watt resistor?

34. A student has two wires of iron and copper of equal length and diameter. He first joins the two wires in series and passes electric current through the combination which increases gradually. After that he joins the two wires in parallel and repeats the process of passing current. Which wire will glow first in each case and why?

35. A series combination of a 2K Ω resistor and 1K Ω resistor is connected across a battery of emf 6V and negligible internal resistance. The potential drop across the 2 Ω resistor is measured by

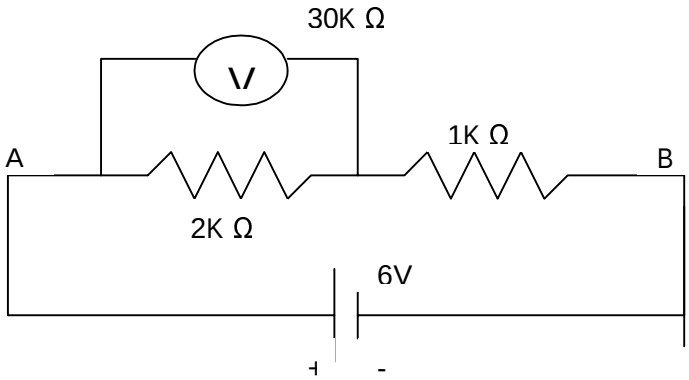
1. a 30K Ω voltmeter

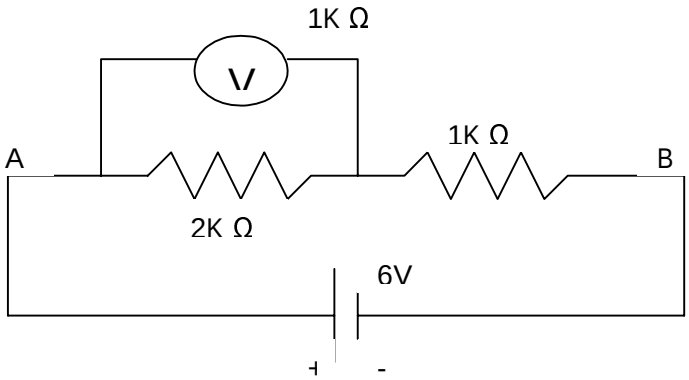
2. a 1K Ω voltmeter

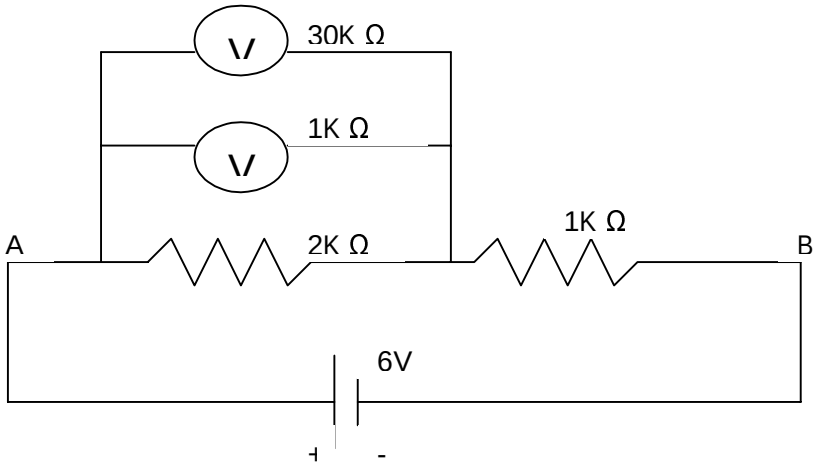
3. both these voltmeters connected across it.

If the voltmeter readings in the three cases are V_1, V_2 and V_3 respectively,arrange these readings in descending order.

How will the three readings be compared with one another if the potential drop were measured across the series combination of the 2 K Ω and 1K Ω resistor? i.e. across A and B?


30K Ω
V
1K Ω
A
B
2K Ω
6V
+
-


1K Ω
V
1K Ω
A
B
2K Ω
6V
+
-


V
30K Ω
1K Ω
V
1K Ω
A
2K Ω
B
6V
+
-