RAVI TEST PAPERS & NOTES, WHATSAPP 8056206308

3 Current Electricity previously asked

12th Standard

Physics

Multiple Choice Question 20 x 1 = 20

1) A steady current of 8 mA flows through a wire.The number of electrons passing through a cross-section of the wire in 10 s is

(a) 4.0×10^{16} (b) 5.0×10^{17} (c) 1.6×10^{16} (d) 1.0×10^{17}

2) The current in a device varies with time t as I=6t, whereI is in mÁ and t is in s. The amount of charge that passes through thedevice during t=0s to t= 3s is

(a) 10 mC (b) 18 mC (c) 27 mC (d) 54 mC

3) Pieces of copper and silicon are initially at room temperature. Both are heated to temperature T. The conduction of

(a) both increases (b) both decreases (c) copper increases and silicon decreases

(d) copper decreases and silicon increases

4) A conductor of 10Ω is connected across a 6V ideal source. The power supplied by the source to the conductor is

(a) 1.8W (b) 2.4W (c) 3.6W (d) 7.2W

5) A cell of emf E is connected across an external resistance R. When current I is drawn from the cell, the potential difference across the electrodes of the cell drops to V. The internal resistance r of the cell is

(a) $\left(\frac{E-V}{E}\right) R$ (b) $\left(\frac{E-V}{R}\right)$ (c) $\frac{(E-V)R}{I}$ (d) $\left(\frac{E-V}{V}\right) R$

6) The current density due to drift of electrons in a conductor is given by (symbols have their usual meanings)

(a) $neAv_d$ (b) $\frac{nAv_d}{e}$ (c) $\frac{nv_d}{eA}$ (d) nev_d

7) A current of 0.8 A flows in a conductor of 40Ω for 1 min. The heat produced in the conductor will be

(a) 1445 J (b) 1536 J (c) 1569 J (d) 1640 J

8) The electric power consumed by a 220 V-100 W bulb, when operated at 110 V is

(a) 25 W (b) 30 W (c) 35 W (d) 45 W

9) If an ammeter is to be used in place of a voltmeter, then we must connect with the ammeter a

(a) low resistance in parallel (b) low resistance in series (c) high resistance in parallel

(d) high resistance in series

10) Kirchhoff's first rule, EI = 0 and second rule, ΣIA = ΣE (where the symbols have their usual meanings) are respectively, based on

(a) conservation of momentum and conservation of charge (b) conservation of energy and conservation of charge

(c) conservation of charge and conservation of momentum (d) conservation of charge and conservation of energy

11) Which of the following has negative temperature coefficient of resistivity?

(a) Metal (b) Metal and semiconductor (c) Semiconductor (d) Metal and alloy

12) If the potential difference V applied across a conductor is increased to 2V with its temperature kept constant, then the drift velocity of the free electrons in a conductor will

(a) remain the same (b) become half of its previous value (c) be double of its initial value (d) become zero

13) A constant voltage is applied between the two ends of a uniform metallic wire, heat His developed in it. If another wire of the same material, double the radius and twice the length as compared to original wire is used, then the heat developed in it will be

(a) H/2 (b) H (c) 2H (d) 4H

14) In a DC circuit, the direction of current inside the battery and outside the battery, respectively are

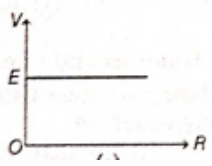
(a) positive to negative terminal and negative to positive terminal

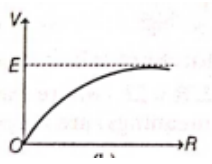
(b) positive to negative terminal and positive to negative terminal

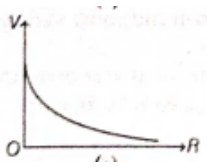
(c) negative to positive terminal and positive to negative terminal

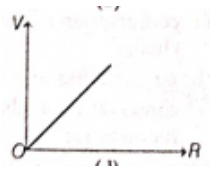
(d) negative to positive terminal and negative to positive terminal

15) A cell of emf (E) and internal resistance is connected across a variable external resistance R. The graph of terminal potential difference V as a function of R is

(a) 

(b) 

(c) 

(d) 

16) In a DCcircuit,the direction of current inside the battery and outside the battery, respectively are

(a) positive to negative terminal and negative to positive terminal

(b) positive to negative terminal and positive to negative terminal

(c) negative to positive terminal and positive to negative terminal

(d) negative to positive terminal and negative to positive terminal

17) A car battery is charged by a 12 V supply and energy stored in it is 720 x 10^5 J. The charge passed through the battery is

(a) 6.0×10^4 C (b) 5.8×10^3 J (c) 8.64×10^6 J (d) 1.6×10^5 C

18) If n,e, τ and m have their usual meanings, then the resistance of a wire of length and cross-sectional area A is given by

(a) $\frac{ne^2A}{2m\tau l}$ (b) $\frac{ml}{ne^2\tau A}$ (c) $\frac{m\tau A}{ne^2l}$ (d) $\frac{ne^2\tau A}{2ml}$

19) Two sources of equal emf are connected in series. This combination is in turn connected to an external resistance R. The internal resistance of two sources are r_1 and r_2 ($r_2 > r_1$). If the potential difference across the source of internal resistance r_2 is zero, then R equals to

(a) $\frac{r_1+r_2}{r_2-r_1}$ (b) $r_2 - r_1$ (c) $\frac{r_1r_2}{r_2-r_1}$ (d) $\frac{r_1+r_2}{r_1r_2}$

20) The equivalent resistance between A and B of the network shown in figure is

(a) 3RΩ (b) (3/2)RΩ (c) 2RΩ (d) (2/3)RΩ

Assertion and reason 1 x 1 = 1

21) Assertion (A) : Higher the range, lower is the resistance of an ammeter.
Reason (R) : To increase the range of an ammeter, additional shunt is added in series to it

(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) Assertion is true but Reason is false.

(d) Assertion is false but Reason is true.

2 Marks 96 x 2 = 192

22) If the temperature of a good conductor increases, how does the relaxing time of electrons in the conductor change?

23) Two different wires X and Y of the same diameter but different materials are joined in series across a battery. If the number density of electrons in X is twice that in Y, find the ratio of drift velocity of electrons in the two wires.

24) A 4 Ω non-insulated resistance wire is bent in the middle by 180° and both the halves are twisted with each other. What will be its new resistance?

25) Two wires of equal length one of copper and other of manganin have the same resistance. Which wire is thicker?

26) What is the resistance of carbon resistor on which the colour of rings in sequence is black, brown, black and gold.

27) A (i) series (ii) parallel combination of two given resistors is connected one by one across a cell. In which case will the terminal potential difference across the cell have a higher value?

28) Write any two factors on which internal resistance of a cell depends.

29) The car battery is 12 volts. 8 simple cells connected in series can give 12 volt. But such cells are not used in starting a car; why?

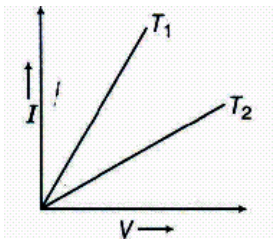
30) A parallel combination of two cells of EMFs ϵ_1 and ϵ_2, and internal resistances r_1 and r_2 is used to supply current to a load of resistance R. Write the expression for the current through the load in terms of ϵ_1, ϵ_2, r_1 and r_2.

31) Why is the meter bridge method considered unsuitable for the measurement of very low resistances?

32) Two resistors of $2\,\Omega$ and $4\,\Omega$ are connected in parallel to a constant d.c. voltage. In which case more heat is produced?

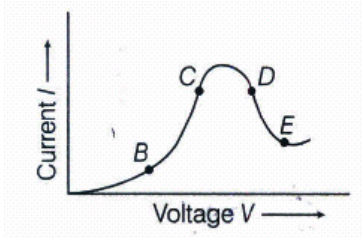
33) A heating element is marked 210 V, 630 W. What is the value of the current drawn by the element when connected to a 210 V dc source?

34) I-V graph for a metallic wire at two different temperature T_1 and T_2 is as shown in the figure below.



Which of the two temperatures is lower and why?

35) Graphing showing the variation of current versus voltage for material Gaas is shown in the figure. Identify the region of



(i) negative resistance.
(ii) where Ohm's law is obeyed.

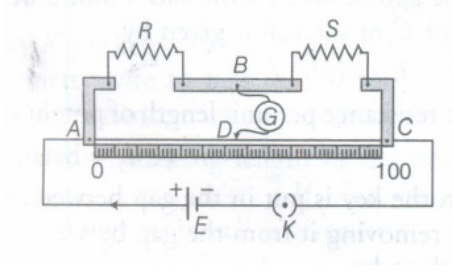
36) When electrons drift in a metals from lower to higher potential, does it mean that all the free electrons of the metal are moving in the same direction?

37) In a meter bridge, two unknown resistances R and S, when connected between the two gaps, give a null point at 40 cm from one end. What is the ratio of R and S?

38) A resistance R is connected across a cell of emf E and internal resistance r.
Now, a potentiometer measure the potential difference between the terminals of the cells as V. Write the expression for r in terms of E, V and R

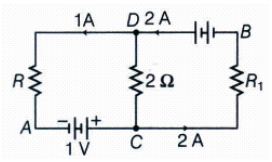
39) (i) You are required to select a carbon resistor of resistance $47K\Omega \pm 10\%$ from a large collection. What should be the sequence of colour bands used to code it?
(ii) Write two characteristics of manganin which make it suitable for making standard resistances.

40) In a meter bridge, the null point is found at a distance of 33.7 cm from A. If a resistance of 12Ω is connected in parallel with S, the null point occurs at 51.9 cm. Determine the values of R and S.

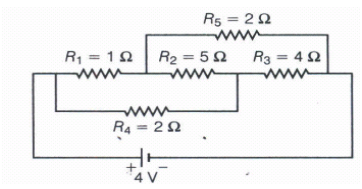


41) A cell of emf E and internal resistance r is connected across a variabl resistor R. Plot a graph showing variation terminal voltage V of the cell versus the current I. Using the plot, show how emf of the cell and its internal resistance can be determined.

42) In the given circuit, assuming point A to be at zero potential, use Kirchhoff,s rules to determine the potential at point B.



43) Calculate the current drawn from the battery in the given network.



44) Write the expression for the drift velocity of charge carriers in a conductor of length / across which a potential difference V is applied.

45) How does one explain increase in resistivity of a metal with increase in temperature?

46) Why is the terminal voltage of a cell less than its emf?

47) Two wires of equal length, one of copper and the other of manganin have the same resistance. Which wire is thicker?

48) Two conducting wires X and Y of same diameter but different materials are joined in series across a battery. If the number density of electrons in X is twice that in Y, find the ratio of drift velocity of electrons in the two wires.

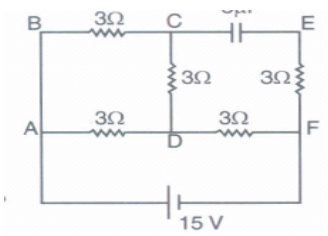
49) Draw a plot showing the variation of resistivity of a (i) conductor and (ii) semiconductor, with the increase in temperature. How does one explain this behaviour in terms of number density of charge carriers and the relaxation time?

50) Distinguish between emf (ε) and terminal voltage (V) of a cell having internal resistance 'r'. Draw a plot showing the variation of terminal voltage (V) vs the current (I) drawn from the cell. Using this plot, how does one determine the internal resistance of the cell?

51) A cell of emf 'E' and internal resistance 'r' is connected across a variable resistor 'R'. Plot a graph showing variation of terminal voltage 'V' of the cell versus the current 'I'. Using the plot, show how the emf of the cell and its internal resistance can be determined.
Draw the plots of the terminal voltage V versus (i) R and (ii) the current I

52) Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area $1.0 \times 10^{-7}\ m^2$ carrying a current of 1.5 A. Assume the density of conduction electrons to be $9 \times 10^{28}\ m^{-3}$.

53) In the circuit shown in the figure, find the total resistance of the circuit an d the current in the arm CD.

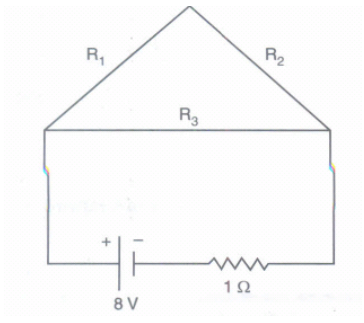


54) A battery of emf E and internal resistance, r, when connected an external resistance of 12 n produces a current of 0.5 A. When connected across a resistance of 25Ω, it produces a current of 0.25 A. Determine (i) the emf and (ii) the internal resistance of the cell.

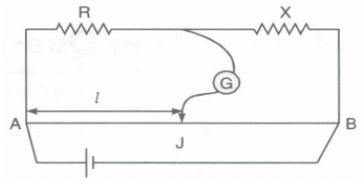
55) Two heating elements of resistance R_1 and R_2 when operated at a constant supply of voltage, V, consume powers P_1 and P_2 respectively. Deduce the expressions for the power of their combination when they are, in turn, connected in
(i) series and
(ii) parallel across the same voltage supply.

56) State Kirchhoff's rules. Explain briefly how these rules are justified.

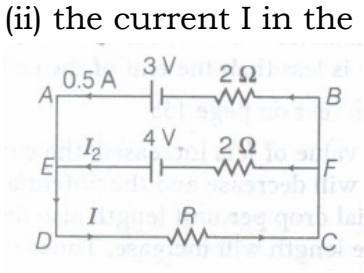
57) A uniform wire of resistance 12 Ωis cut into three pieces so that the ratio of the resistances R_1: R_2: R_3 = 1 : 2 : 3 and the three pieces are connected to form a angle across which a cell of emf 8 V and internal resistance 1Ω is connected as shown. Calculate the current through each part of the circuit.



58) In the metre bridge experiment, balance point was observed at J with AJ = l.
(i) The values of R and X were doubled and then interchanged. What would be the new position of the balance point?
(ii) If the galvanometer and battery are interchanged at the balance position, how will the balance point get affected?

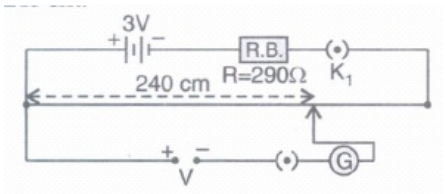


59) Using Kirchhoff's rules in the given circuit, determine
(i) the voltage drop across the unknown resistor R and
(ii) the current I in the arm EF.

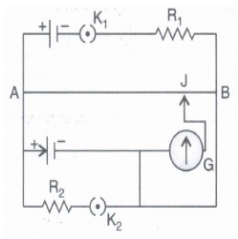


60) State the underlying principle of a potentiometer.

61) Calculate the value of the unknown potential V for the given potentiometer circuit. The total length (400 cm) of the potentiometer wire has a resistance of 10 Ω and the balance point is obtained at a length of 240 cm



62) For the circuit shown here, would the balancing length increase, decrease or remain the same, if
(i) R_1 is decreased;
(ii) R_2 is increased;
without any other change, (in each case) in the rest of the circuit. Justify your answers in each case.

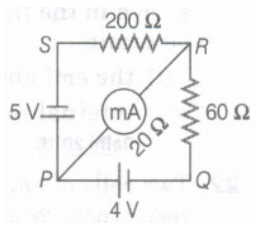


63) Why is adsorption always exothermic?

64) (i) State the law which helps to determine the limiting molar conductivity of the weak electrolyte.
(ii) Calculate limiting molar conductivity of $CaSO_4$

65) Show variation of resistivity of copper as a function of temperature in a graph.

66) The network PQRS, shown in the circuit diagram, has the batteries of 4 V and 5 V and negligible internal resistance. A milliammeter of 20 Ω resistance is connected between P and R. Calculate the reading in the Millimetre.



67) A metal rod of square cross-sectional area A having length l has current I flowing through it when a potential difference of V volt is applied across its ends (figure I). Now the rod is cut parallel to its length into two identical pieces and joined as shown in figure II. What potential difference must be maintained across the length of 2l so that the current in the rod is still I?

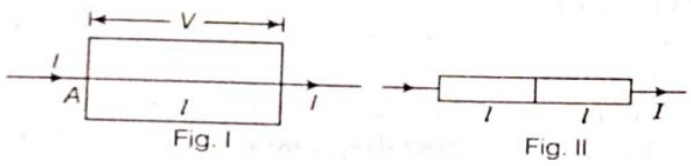


Fig. I Fig. II

68) Derive an expression for the current density of a conductor in terms of the drift speed of electrons.

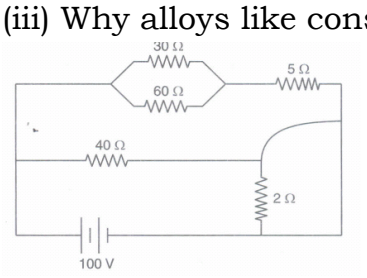
69) Define mobility of a charge carrier. Write the relation expressing mobility in terms of relaxation time. Give its SI unit.

70) Plot a graph showing temperature dependence of resistivity for a typical semiconductor. How is this behaviour explained?

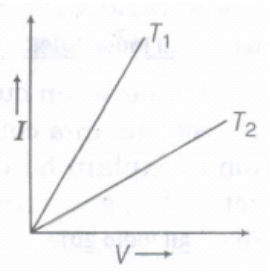
71) Derive an expression for drift velocity of free electrons in a conductor in terms of relaxation time.

72) Derive an expression for drift velocity of free electrons.
How does drift velocity of electrons in a metallic conductor vary with increase in temperature? Explain

73) (i) Define the term of drift velocity.
(ii) On the basis of electron drift, derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time. On what factors does resistivity of a conductor depend?
(iii) Why alloys like constantan and manganin are used for making standard resistors?



74) I-V graph for a metallic wire at two different temperatures T_1 and T_2 is as shown in the figure below. Which of the two temperature is lower and why?



75) Graph showing the variation of current versus voltage for a material GaAs is shown in the figure. Identify the region

(i) of negative resistance.
(ii) where Ohm's law is obeyed.

76) Plot a graph showing variation of current versus voltage for the material GaAs.

77) Define the term electrical conductivity of a metallic wire. Write its SI unit.

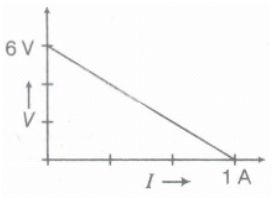
78) Write a relation between current and drift velocity of electrons in a conductor. Use this relation to explain how the resistance of a conductor changes with the rise in temperature?

79) Two materials Si and Cu, are cooled from 300 K to 60 K. What will be the effect on their resistivity?

80) Define resistivity of a conductor. Write its SI unit.

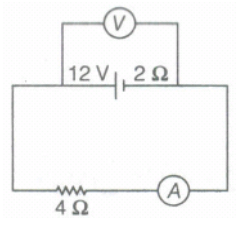
81) The three coloured bands, on a carbon resistor are red, green and yellow, respectively. Write the value of its resistance.

82) The plot of the variation of potential difference across a combination,n of three identical cells in series versus current is shown below. What is the emf and internal resistance of each cell?



83) A cell of emf E and internal resistance r draws a current I. Write the relation between terminal voltage V in terms of E, I and r.

84) A battery of emf 12 V and internal resistance 2Ω is connected to a 4Ω resistor as shown in the figure.



(i) Show that a voltmeter when placed across the cell and across the resistor, in turn, gives the same reading.
(ii) To record the voltage and the current in the circuit, why is voltmeter placed in parallel and ammeter in series in the circuit?

85) Two cells of emfs 1.5 V and 2.0 V having internal resistances 0.2Ω and 0.3Ω respectively are connected in parallel. Calculate the emf and internal resistance of the equivalent cell.

86) A cell of emf E and internal resistance r is connected across a variable resistor R. Plot a graph showing the variation of terminal potential V with resistance R. Predict from the graph, the condition under which V becomes equal to E.

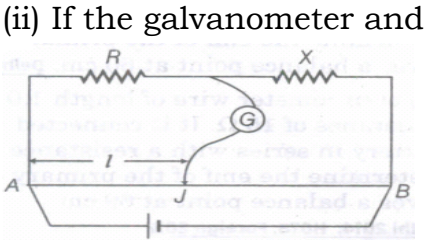
87) Nichrome and copper wires of same length and same radius are connected in series. Current I is passed through them. Which wire gets heated up more? Justify your answer.

88) In a meter bridge, two unknown resistances Rand S when connected in the two gaps, give a null point at 40 cm from one end. What is the ratio of R and.S?

89) An ammeter of resistance 0.80Ω can measure current up to 1.0A.
(i) What must be the value of shunt resistance to enable the ammeter to measure current up to 5.0 A ?
(ii) What is the combined resistance of the ammeter and the shunt?

90) Describe briefly with the help of a circuit diagram, how a potentiometer is used to determine the internal resistance of a cell.

91) In the meter bridge experiment, balance point was observed at J with AJ = l.
(i) The values of R and X were doubled and then interchanged. What would be the new position of balance point.
(ii) If the galvanometer and battery are interchanged at the balanced position, how will the balance point get affected?



92) Obtain the formula for the power loss (i.e. power dissipated) in a conductor of resistance R, carrying a current

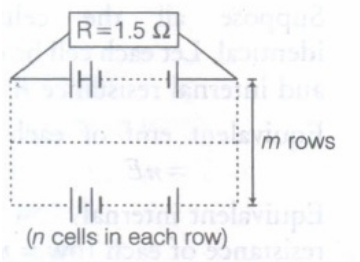
93) Give an example of a material each for which temperature coefficient of resistivity is (i)positive, (il) negative.

94) Why is potentiometer preferred over a voltmeter for determining the emf of a cell?

95) The temperature coefficient of resistivity, for two materials A and B, are 0.0031 rc and 0.0068 / °C respectively. Two resistors R_1 and R_2 t made from materials A and B, respectively, have resistances of 200^0 and 100 0 at 0°C. Show on a diagram, the 'colour code', of a carbon resistor, that would have a resistance equal to the series combination of R_1 and R_2 t at a temperature of 10°C. (Neglect the ring corresponding to the tolerance of the carbon resistor).

96) A wire of resistance 6R is bent in the form of a circle. What is the effective resistance between the ends of the diameter?

97) 12 cells, each of emf 1.5 V and internal resistance of 0.5 Ω, are arranged in m rows each containing n cells connected in series, as shown in the figure. Calculate the values of n and m for which this combination would send maximum current through an external resistance of 1.5 Ω.



98) A cell of emf E and internal resistance r is connected across a variable load resistor R. Draw the plots of the terminal voltage V versus
(i) resistance R and
(ii) current I.

99) State Kirchhoff's first law.

100) State Kirchhoff's second law.

101) What is the significance of direction of electric current?

102) A ware of 20 Q resistance is gradually stretched to double its original length. It is then cut into two equal parts. These parts are then connected in parallel across a 4.0 V battery. Find the current drawn from the battery.

103) When electrons drift in a metal from lower to higher potential, does it mean that all the free electrons of the metal are moving in the same direction?

104) Two similar wires of same length and same area of cross-section but of different material, having resistivity P1 and P2 are connected end to end (in series). Calculate the effective resistivity of their combination.

105) The emf of a cell is always greater than its terminal voltage. Why? Give reason.

106) Two similar wires of same length and same area of cross-section but of different material having resistivity P_1 and P_2 are connected side by side i.e. in parallel. Calculate the effective resistivity of their combination.

107) Why is the potentiometer preferred to a voltmeter for measuring emf of a cell?

108) Why copper is not used for making potentiometer wires?

109) Define mobility of electron in a conductor. How does electron mobility change when
(i) temperature of conductor is decreased and
(ii) applied potential difference is doubled at constant temperature?

110) Nichrome and copper wires of same length and area of cross section are connected in series, current is passed through them why does the nichrome wire get heated first?

111) State the principle on which the working of a meter bridge is based. Under what condition is the error in determining the unknown resistance minimised?

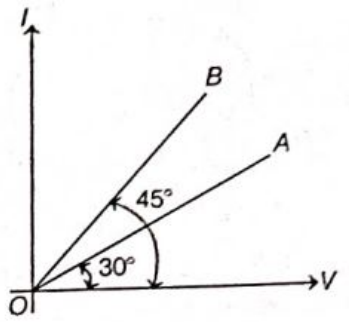
112) How does the mobility in a conductor change, if the potential difference applied across the conductor is doubled keeping the length and the temperature of the conductor constant?

113) When a potential difference is applied across the ends of a conductor, how is the drift velocity of the electrons related to the relaxation time?

114) How is the drift velocity in a conductor affected with the rise in temperature?

115) Two electric heaters have power ratings P_1 and P_2, at voltage V. They are connected in series to a DC source of voltage V. Find the power consumed by the combination. Will they consume the same power, if connected in parallel across the same Source?

116) Two wires A and B of different metals have their lengths in ratio 1 : 2 and their radii in ratio 2 : 1, respectively. I - V graphs for them is shown in the figure.



Find the ratio of their
(i) Resistances (R_A/ R_B) and
(ii) Resistivities (σ_A/σ_B)

117) Find the temperature at which the resistance of a conductor increases by 25% of its value at 27°C. The temperature coefficient of resistance of the conductor is $2.0 \times 10^{-4}°C^{-1}$.

3 Marks 56 x 3 = 168

118) A wire of 15 Ω resistance is gradually stretched to double its original length. It is then cut into two equal parts. These parts are then connected in parallel across a 3.0 volt battery. Find the current drawn from the battery.

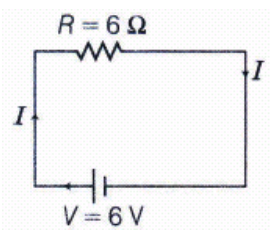
119) In a potentiometer arrangement, a cell of emf 1.20 V gives a balance point at 30 cm length of the wire. This cell is now replaced by another cell of unknown emf. If the ratio of emfs of the two cells is 1.5, calculate the difference in the balancing length of the potentiometer wire in the two cases.

120) A resistance coil marked 3 Ω is found to have a true resistance of 3.115 Ω at 300 K. Calculate the temperature at which marking is correct. Temperature coefficient of resistance of the material of coils is $4.2 \times 10^{-3}\ ^oC^{-1}$.

121) It is found that when R = 4 Ω, the current is 1 A and when R is increased to 9 Ω, the current reduces to 0.05 A. Find the values of the emf E and internal resistance r.

122) A resistor of 5Ω is connected in series with a parallel combination of a number of resistors each of 5Ω. if the total resistance of the combination is 6Ω, how many resistors are in parallel?

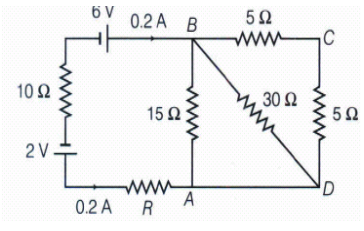
123) (i) Consider circuit in the figure. How much energy is absorbed by electrons from the initial state of no current (Ignore thermal motion) to the state of drift velocity?
(ii) Electrons give up energy at the rate of RI^2 per second to the thermal energy. What time scale would number associate with energy in problem (i)? Given, n = number of electron per volume = 10^{29} per m^3. Length of circuit = 10cm cross-section = A = $(1\ mm)^2$



124) A circuit using a potentiometer and battery of negligible internal resistance is set up as shown to develop a constant potential gradient along the wire AB. Two cells of emf's E_1 and E_2 are connected in series as shown in combinations (1) and (2).
The balance points are obtained, respectively at 400 cm and 240 cm from the point A. Find
(i) E_1/ E_2
(ii) balancing length for the cell E_1 only.

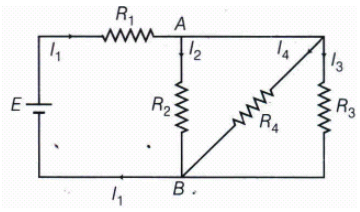
125) The sequence of coloured bands in two carbon resistors R_1 and R_2 is
(i) brown, green, blue and
(ii) orange, black, green.
Find the ratio of their resistances.

126) Calculate the value of the resistance R in the circuit shown in the figure, so that the current in the circuit is 0.2A. What would be the potential difference between points A and B?

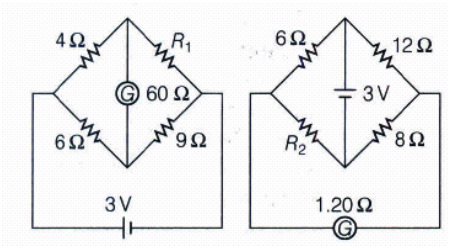


127) A potentiometer wire of length 1 m has a resistance of 10Ω. It is connected to 6 V battery in series with a resistance of 5Ω. Determine the emf of the primary cell, which gives a balance point at 40 cm.

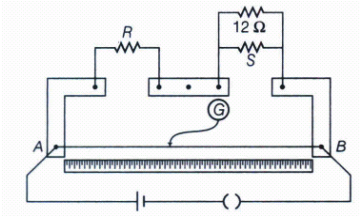
128) In the circuit shown, R_1 = 4 Ω, R_2 = R_3 = 5 Ω, R_4 = 10Ω and E = 6 V. Work out the equivalent resistane of the circuit and the current in each resistor.



129) Figure shows two circuits each having a galvanometer and a battery of 3 V. When the galvanometer in each arrangement do not show any deflection, obtain the ratio R_1/R_2.



130) In a meter bridge, the null point is found at a distance of 40 cm from A. If a resistance of 12Ω is connected in parallel with S, the null point occurs at 50 cm from A. Determine the values of R and S.



131) Define relaxation time of the free electrons drifting in a conductor. How is it related to the drift velocity of free electrons? Use this relation to deduce the expression for the electrical resistivity of the material.

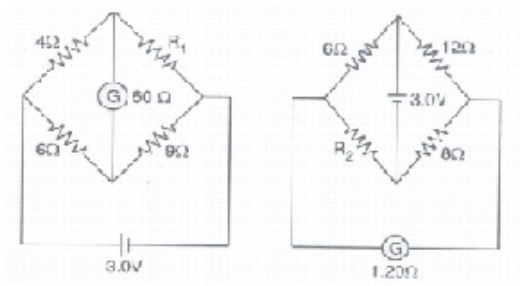
132) Define the term current density of a metallic conductor. Deduce the relation connecting current density (J) and the conductivity o of the conductor, when an electric field E, is applied to it.

133) Write any two factors on which internal resistance of a cell depends. The reading on a high resistance voltmeter, when a cell is connected across it, is 2.2 V. When the terminals of the cell are also connected to resistance of 5 Ω as shown in the circuit, the voltmeter reading drops to 1.8 V. Find the internal resistance of the cell.

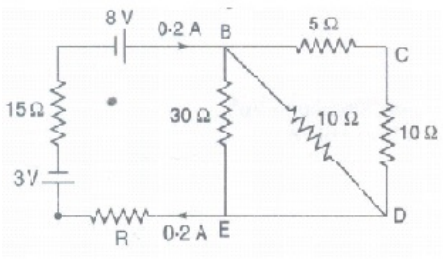
134) Two cells of emfs E_1 and E_2 having internal resistances r_1 and r_2 respectively are connected in parallel as shown. Deduce the expressions for the equivalent emf and equivalent internal resistance of a cell which can replace the combination between the points B_1 and B_2.

135) Answer following:
(a) Why are the connections between the resistors in a meter bridge made of thick copper strips?
(b) Why is it generally preferred to obtain the balance point in the middle of the meter bridge wire?
(c) Which material is used for the meter bridge wire and why?

136) The galvanometer, in each of the two given circuits, does not show any deflection. Find the ratio of the resistors R_1 and R_2, used in these two circuits.



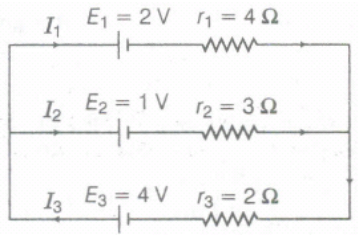
137) Calculate the value of the resistance R in the circuit shown in the figure so that the current in the circuit is 0.2 A. What would be the potential difference between points B and E?



138) What is Wheatstone bridge? Deduce the condition for which Wheatstone bridge is balanced.
The given figure shows a network of resistances R_1, R_2, R_3 and R_4 .
Using Kirchhoff's laws, establish the balance condition for the network.
Use Kirchhoff's law to obtain the balance condition for Wheatstone bridge.

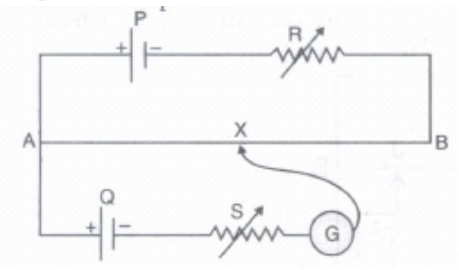
139) In the circuit shown, $R_1 = 4\Omega$, $R_2 = R_3 = 15\Omega R_1 = 30\Omega$ and E = 10 V. Calculate the equivalent resistance of the circuit and the current in each resistor.

140) State Kirchhoff's rules. Use these rules to write the expressions for the currents I_1, I_2 and I_3 in the circuit diagram shown in figure below.



141) (a) State the underlying principle of a potentiometer. Why is it necessary to
(i) use a long wire,
(ii) have uniform area of cross-section of the wire and
(iii) use a driving cell whose emf is taken to be greater than the emf of the primary cells?
(b) In a potentiometer experiment, if the area of the cross-section of the wire increases uniformly from one end to the other, draw a graph showing how potential gradient would vary as the length of the wire increases from one end.

142) State the underlying principle of a potentiometer. Write two factors on which the sensitivity of a potentiometer depends.

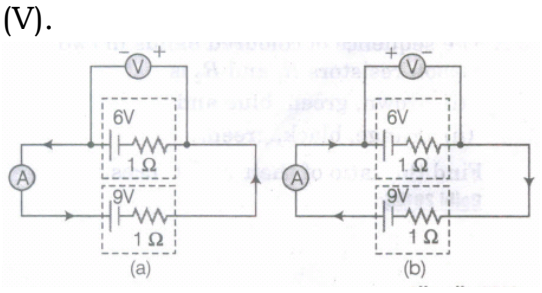


In the potentiometer circuit shown in the figure, the balance point is at X. State, giving reason, how the balance point is shifted, when:
(i) resistance R is increased?
(ii) resistance S is increased, keeping R constant?

143) Write the principle of working of a potentiometer. Describe briefly, with the help of a circuit diagram, how a potentiometer is used to determine the internal resistance of a given cell.

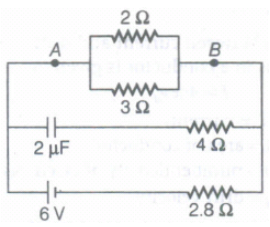
144) Find the relation between drift Velocity and relaxation time of charge carriers in a conductor. A conductor of length is connected to a DC source of emf E. If the length of the conductor is tripled by stretching it, keeping E constant, explain how its drift velocity would be affected.

145) In the two electric circuits shown in the figure, determine the readings of ideal ammeter (A) and the ideal voltmeter (V).



146) Derive the relation between current density j and potential difference V across a current carrying conductor of length l area of cross-section A and the number density n of free electrons.

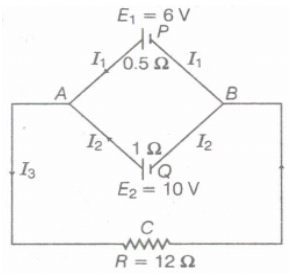
147) Calculate the steady current through the 2Ω resistor in the circuit shown in the figure.



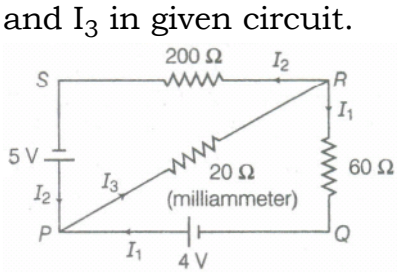
148) Three resistors R_1, R_2 and R_3 are connected in parallel, across a source of emf E and negligible internal resistance. Obtain a formula for the equivalent expressions for the current through each of the three resistors.

149) A straight line plot showing the terminal potential difference (V) of a cell as a function of current (1) drawn from it is shown in the figure. Using this plot, determine
(i) the emf and
(ii) internal resistance of the cell.

150) State Kirchhoffs rules. Apply Kirchhoff s rules to the loops ACBPA and ACBQA to write the expressions for the currents I_1.I_2 and I_3 in the network.

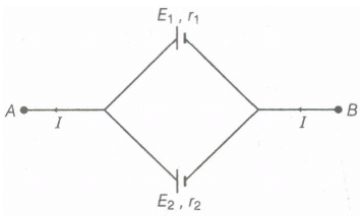


151) State Kirchhoff's rules. Apply these rules to the loops PRSP and PRQP to write the expressions for the currents I_1, I_2 and I_3 in given circuit.



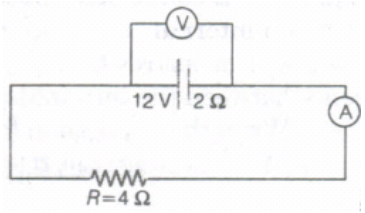
152) (i) State Kirchhoff's rules.
(ii) A battery of 10 V and negligible internal resistance is connected across the diagonally opposite corners of a cubical network consisting of 12 resistors each of 1Ω resistance. Use Kirchhoff s rules to determine
(a) the equivalent resistance of the network and
(b) the total current in the network

153) Two cells of emf E_1, E_2 and internal. resistances r_1 and r_2 respectively are connected in parallel as shown in the figure.

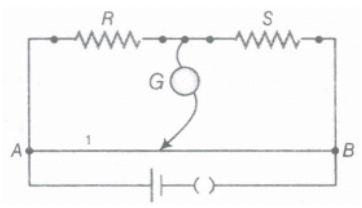


Deduce the expressions for
(i) the equivalent emf of the combination.
(ii) the equivalent resistance of the combination and
(iii) the potential difference between the points A and B.

154) In the figure shown, an ammeter A and a resistor of 4Ω are connected to the terminals of the source. The emf of the source is 12 V having an internal resistance of 2Ω. Calculate the voltmeter and ammeter readings.



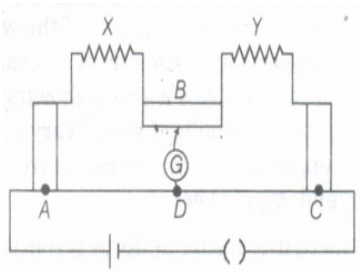
155) Write the principle of working of a metre bridge.
(ii) In a metre bridge, the balance point is found at a distance l_1 with resistance R and S as shown in the figure. An unknown resistance X is now connected in parallel to the resistance S and the balance point is found at a distance l_2. Obtain a formula for X in terms of l_1, l_2 and S.



156) With the help of circuit diagram, explain how a potentiometer can be used to compare emf of two primary cells?

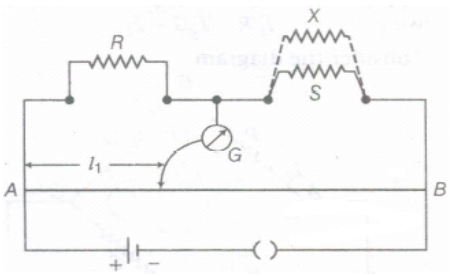
157) Two heating elements of resistances and R_1 when operated at a constant supply of voltage V, consume powers P_1 and P_2, respectively. Deduce the expressions for the power of their combination when they are in turn, connected in
(i) series and
(ii) parallel across their same voltage supply.

158)

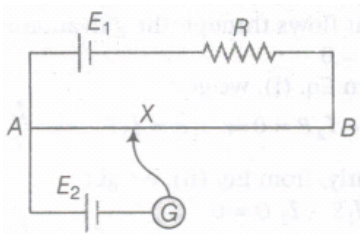


The figure shows experimental set up of a meter bridge. When the two unknown resistances X and Yare inserted, the null point D is obtained 40 cm from the end A.
When a resistance of 10 0 is connected in series with X, the null point shifts by 10cm.
Find the position of the null point when the 100 resistance is instead connected in series with resistance Y.
Determine the values of the resistances X and Y.

159) (i) State the principle of working of a meter bridge.
(ii) In a meter bridge balance point is found at a distance l_1 with resistances R and S as shown in the figure. When an unknown resistance X is connected in parallel with the resistance S, the balance point shifts to a distance l_2, Find expression for X in terms of l_1, l_2 and S.

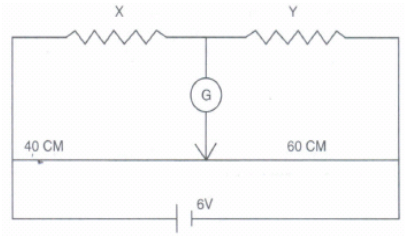


160) (i) In the circuit diagram given below AB is a uniform wire of resistance 15Ω and length 1m is connected to a cell E_1 of emf 2V and negligible internal resistance and a resistance R.
The balance point with another cell E_2 of emf 75 mV is found at 30 em from end A. Calculate the value of R.



(ii) Why is potentiometer preferred over a voltmeter for comparison of emf of cells?
(iii) Draw a circuit diagram to determine internal resistance of a cell in the laboratory.

161) In the given circuit, a meter bridge is shown in the balanced state. The metre bridge wire has a resistance of. Calculate the unknown resistance X and the current drawn from the battery of a negligible internal resistance if the magnitude of Y is 6 Ω . If at the balancing point, we interchange the position of the galvanometer and the cell, how it will affect the position of the galvanometer?

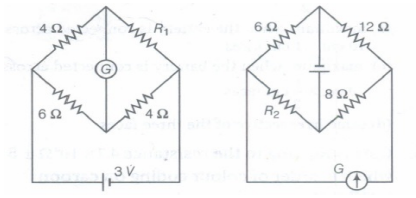


162) (i) Why do the 'free electrons', in a metal wire, 'flowing by themselves', not cause any current flow in the wire? Define 'drift velocity' and obtain an expression for the current flowing in a wire, in a terns of the 'drift velocity' of the free electrons.
(ii) Use the above expression to show that the 'resistivity', of the material of wire, is inversely proportional to the 'relaxation time' for the 'free electonics' in the metal.

163) (a) Define the term conductivity of a metallic wire. Write its SI unit.
(b) Using the concept of free electrons in a conductor, derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence, obtain the relation between current density and the applied electric field E.

164) (i) State the working principle of a potentiometer. With the help of a circuit diagram, explain how a potentiometer is used to compare the emf of two primary cells. Obtain the required expression used for comparing the emfs.
(ii) Write two possible causes for one sided deflection in a potentiometer experiment.

165) Define the term current sensitivity of a galvanometer. In the circuits shown in the figures, the galvanometer shows no deflection in each case. Find the ratio of R_1 and R_2.



166) A potential difference Vis applied across a conductor of length L and diameter D. How are the electric field E and the resistance R of the conductor affected when

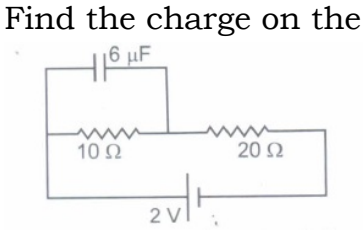
(i) V is halved

(ii) L is halved

(iii) D is doubled. Justify your answer.

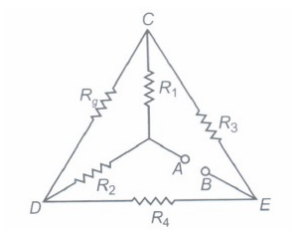
167) State the underlying principle of a potentiometer. Describe briefly, giving the necessary circuit diagram, how a potentiometer is used to measure the internal resistance of a given cell.

168) Find the charge on the capacitor as shown in the circuit.

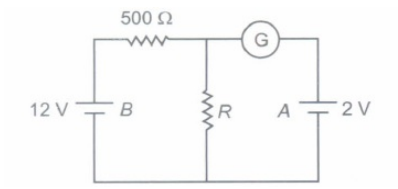


169) (i) Calculate the equivalent resistance of the given electrical network between points A and B.

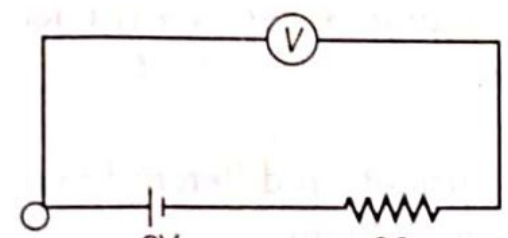
(ii) Also calculate the current through CD and ACB, if a 10 V dc source is connected between A and B, and the value of R is assumed as 2 Ω.



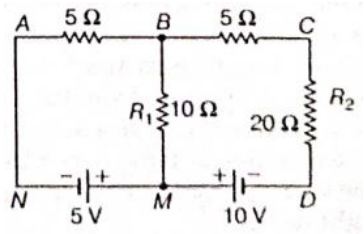
170) In the circuit shown in the figure, the galvanometer G gives zero deflection. If the batteries A and B have negligible internal resistance, find the value of the resistor R.



171) A voltmeter of resistance 998 Ω is connected across a cell of emf 2V and internal resistance 2Ω. Find the potential difference across the voltmeter and also across the terminals of the cell. Estimate the percentage error in the reading of the voltmeter.



172) Find the current flowing through the branches AB and BC in the network shown.



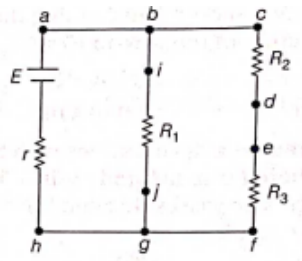
173) A wire of length L_o has a resistance R_o. It is gradually stretched till its length becomes $2L_o$

(i) Plot a graph showing variation of its resistance Rwith its length L during stretching.

(ii) What will be its resistance when its length becomes 2 L_o?

Case Study Questions 1 x 4 = 4

174) An experiment was set-up with the circuit diagram shown in figure. Given that, $R_1 = 10\Omega$, $R_2 = R_3 = 5\Omega$, $r = 0\ \Omega$ and E = 5V



(i) The points with the same potential are

(a) b, c, d**(b)** f, h, j**(c)** d, e, f**(d)** a, b, j

(ii) The current through branch bg is

(a) 1A(b) 1/3 A(c) 1/2 A(d) 2/3 A

(iii) The power dissipated in R_1 is

(a) 2W**(b) 2.5 W(c) 3 W(d) 4.5 W**

(iv) The potential difference across R_3 is

(a) 1.5 V(b) 2 V(c) 2.5 V(d) 3 V

5 Marks 12 x 5 = 60

175) (a) Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area $1.0 \times 10^{-7}\ m^2$ carrying a current of 1.5 A. Assume that each copper atom contributes roughly one conduction electron. The density of copper is $9.0 \times 10^3\ kg/m^3$, and its atomic mass is 63.5 u.

(b) Compare the drift speed obtained above with,

(i) thermal speeds of copper atoms at ordinary temperatures,

(ii) speed of propagation of electric field along the conductor which causes the drift motion.

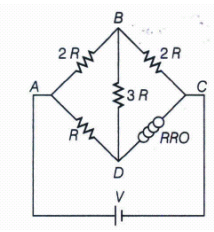
176) (i) In a meter bridge, the balance point is found to be at 39.5 cm from the end A, if an unknown resistor X is in the left gap and a known resistor Y of resistance 1.25 Ω is in the right gap. Determine resistance of X. Why are the connections between resistors in a Wheatstone or meter bridge made of thick copper strips?

(ii) Determine the balance point of the above bridge, if X and Y are interchanged.

(iii) What happens, if the galvanometer and cell are interchanged at the balance point of the bridge? would the galvanometer show any current?

177) (i) Calculate the value of R in the balance condition of the Wheatstone bridge, if the carbon resistor connected across the arm CD has the colour sequence red, red and orange as shown in the figure.

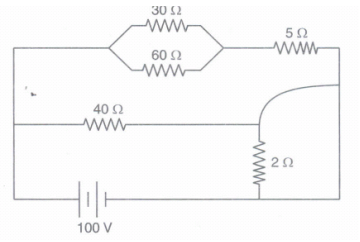
(ii) Use Kirchhoff's rules to obtain the balance condition in a Wheatstone bridge.



(ii) If now the resistance of the arms BC and CD are interchanged, to obtain the balance condition another carbon resistor is connected in place of R. What would now be sequence of colour bands of the carbon resistor? What is the current through the circuit?

178) (a) Define the term 'drift velocity' of charge carriers in a conductor. Obtain the expression for the current density in terms of relaxation time.

(b) A 100 V battery is connected to the electric network as shown. If the power consumed in the 2Ω resistor is 200 W, determine the power dissipated in the 5Ω resistors.

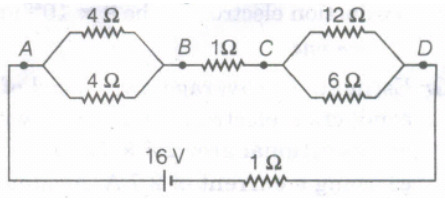


179) Kumaran wanted to pay electricity bill that day. He realized that the consumption shown by the meter was unbelievably low. He thought that the -meter must have been faulty. He wanted to check the meter. But unfortunately, he did not have any idea as to how to do this. There came his friend Subhash to help him. He told Kumaran to run only the electric heater rated 1kW in his house for some time keeping other appliances switched off. He also calculated the power consumed in kilowatt hour and compared the value with the meter. Kumaran as happy and thanked Subhash for his timely help and the knowledge.

(1) What are the values displayed by the friends?

(2) Express kWh in joules. Find the resistance of the heater.

180) A network of resistors is connected to a 16 V battery of internal resistance-of 1Ω as shown in the figure.



(a) Compute the equivalent resistance of the network.

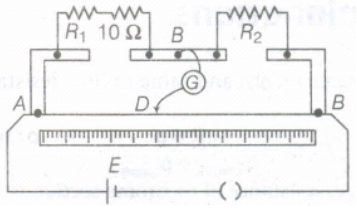
(b) Obtain the current in each resistor.

(c) Obtain the voltage drops V_{AB}, V_{BC} and V_{CD}.

181) State Kirchhoff's rules for an electric network. Using Kirchhoff's rules, obtain the balance condition in terms of the resistances of four arms of Wheatstone bridge.

(ii) In the meter bridge experimental set up, shown in the figure, the null point D is obtained at a distance of 40 cm from end A of the meter bridge wire

If a resistance of 10Ω is connected in series with R_1, null point is obtained at AD = 60 cm. Calculate the values of s, and R_2.



182) (i) State with the help of a circuit diagram, the working principle of a meter bridge. Obtain the expression used for determining the unknown resistance.

(ii) What happens if the galvanometer and cell are interchanged at the balance point of the bridge?

(iii) Why is it considered important to obtain the balance point near the mid-point of the wire?

183) It is desired to supply a current of 2 A through a resistance of 10Ω. As many as 20 cells are provided, each of emf 2 V and internal resistance 0.5Ω. Two friends Shikhaj and Sanjeev try their hand on the problem. Shikhaj succeeds but Sanjeev, fails.

Read the above passage and answer the following questions.

(i) Justify the set up of Shikhaj?

(ii) What might have gone wrong with Sanjeev, when he gets 1.4 A current in the external load?

(iii) What are the basic values shown by Shikhaj and Sanjeev in their work?

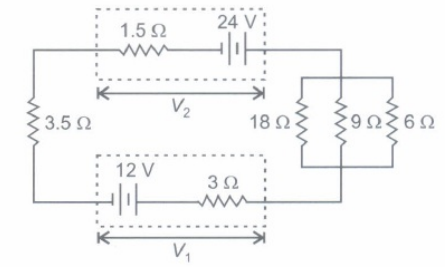
184) When 14 cells in series, are connected to the ends of a resistance of 82.6 Ω, then the current is found to be 0.25A. When same cells after being connected in parallel are joined to the ends of a resistance of 0.053 Ω, then the current is 25A. Calculate the internal resistance and the emf of each cell.

185) A 24 V battery of internal resistance 1.5 Ω is connected to three coils 18 Ω, 9 Ω and 6 Ω in parallel, a resistor of 3.5 Ω and areversed battery (emf = 12V and internal resistance = 3 Ω) as shown. Calculate

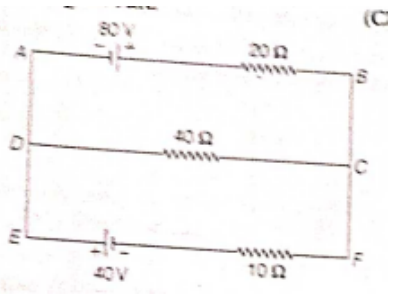
(i) the current in the circuit,

(ii) current in resistor of 18 Ω coil, and

(iii) p.d. across each battery.



186) Using Kirchhoff's rules, calculate the current through the 40Ω and 20 Ω resistors in the following circuit.



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