CHAPTER-3

CURRENT ELECTRICITY

ASSIGNMENT-3

Multiple Choice Questions (Each 1M)

1. Consider a current carrying wire (current *I*) in the shape of a circle. Note that as the current progresses along the wire, the direction of *j* (current density) changes in an exact manner, while the current *I* remain unaffected. The agent that is essentially responsible for is:

(a) source of emf

(b) electric field produced by charges accumulated on the surface of wire.

(c) the charges just behind a given segment of wire which push them just the right way by repulsion.

(d) the charges ahead

2. A metal rod of length 10 cm and a rectangular cross section of 1cm × 1/2 cm is connected to abattery across opposite faces. The resistance will be:

(a) maximum when the battery is connected across 1 cm × 1/2 cm faces

(b) maximum when the battery is connected across 10 cm x 1 cm faces

(c) maximum when the battery is connected across 10 cm x 1/2 cm faces

(d) same irrespective of the three faces

3. Which of the following characteristics of electrons determines the current in a conductor?

(a) Drift velocity alone

(b) Thermal velocity alone

(c) Both drift velocity and thermal velocity

4. A constant voltage is applied between two ends of a metallic wire. If the length is halved and theradius of the wire is doubled, the rate of heat developed in the wire will be

(a) Increased 8 times (b) Unchanged (c) Doubled (d) Halved

5. A heating element has a resistance of 100 Ω at room temperature. When it is connected to a supply of 220 V, a steady current of 2 A passes in it and the temperature is 500°C more than room temperature. What is the temperature coefficient of resistance of the heating element?

(a) 1×10^{-4} °C^{-1} (b) 2×10^{-4} °C^{-1} (c) 0.5×10^{-4} °C^{-1} (d) 5×10^{-4} °C^{-1}

6. A uniform wire of length l and radius r has a resistance of 100 Ω. It is recast into a wire of radius r/2. The resistance of new wire will be

(a) 400 Ω (b)100 Ω (c) 200 Ω (d)1600 Ω

7. In a large building, there are 15 bulbs of 40 W, 5 bulbs of 100 W, 5 fans of 80 W and 1 heater of 1 kW. The voltage of the electric mains is 220 V. The minimum capacity of the main fuse of the building will be

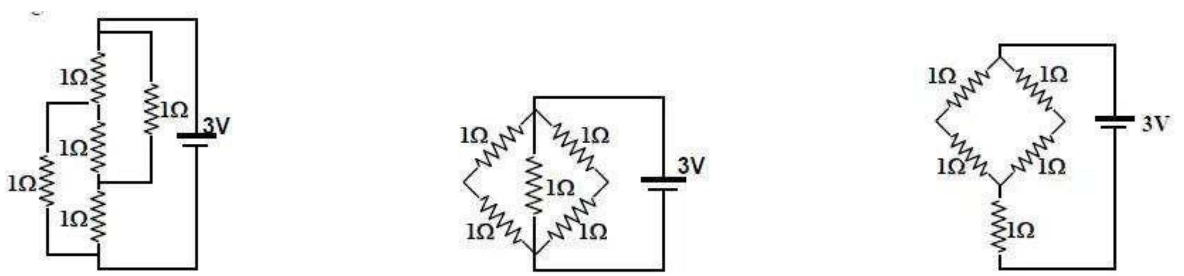
(a) 14 A (b) 8 A (c) 10 A (d) 12 A

8. If a wire is stretched to make it 0.1% longer, its resistance will

(a) increase by 0.05% (b) increase by 0.2%

(c) decrease by 0.2% (d) decrease by 0.05%

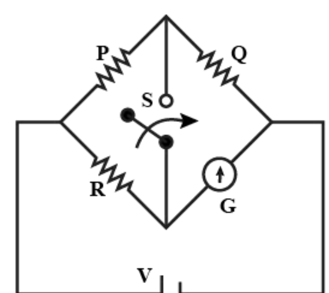
9. Figure shows three resistor configurations R1, R2 and R3 connected to 3 V battery.



R1 R2 R3

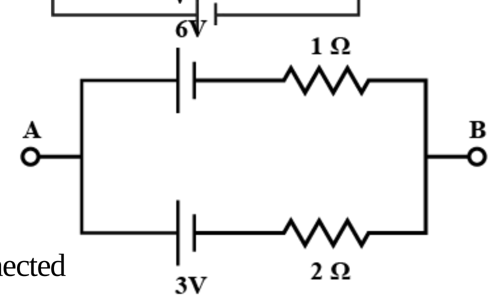
If the power dissipated by the configuration R_1, R_2 and R_3 is P_1, P_2 and P_3, respectively, then

(a) $P_1 > P_2 > P_3$ (b) $P_1 > P_3 > P_2$ (c) $P_2 > P_1 > P_3$ (d) $P_3 > P_2 > P_1$



10. In the circuit shown, P is not equal to R, the reading of the galvanometer is same with switch S open or closed. Then,

(a) $I_R = I_G$ (b) $I_p = I_G$ (c) $I_Q = I_G$ (d) $I_Q = I_R$



11. Two batteries of different emfs and different internal resistances are connected as shown. The voltage across AB in volts is

(a) 4 (b) 5 (c) 6 (d) 7

12. Ten identical cells each of potential E and internal resistance r are connected in seriesto form a closed circuit. An ideal voltmeter connected across 3cells will read

(a) 10E (b) 13E (c) 3E (d) 5E

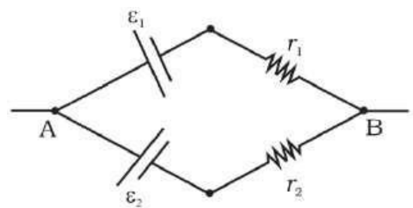
13. The resistance of a wire at a temperature t and 0 degree are related as

(a) $R = R_0(1 + BT)$ (b) $R = R_0(1 - BT)$ (c) $R = R_0(1 + B^2T)$ (d) $R = R_0(1 - B^2T)$

14. Temperature dependence of resistivity ρ(T) of semiconductors, insulators and metals is significantly based on the following factors:

(a) number of charge carriers can change with temperature T.
(b) time interval between two successive collisions can depend on T.
(c) length of material can be a function of T.
(d) mass of carriers is a function of T.

15. Two batteries of emf ε_1 and ε_2 ($\varepsilon_2 > \varepsilon_1$) and internal resistances r1 and r2 respectively are connected in parallel as shown



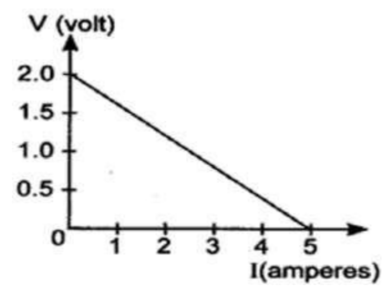
(a) The equivalent emf ε_{eq} of the two cells is between ε_1 and ε_2, i.e., $\varepsilon_1 < \varepsilon_{eq} < \varepsilon_2$

(b) The equivalent emf ε_{eq} is smaller than ε_1.

(c) The ε_{eq} is given by $\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2$ always.

(d) ε_{eq} is independent of internal resistances r_1 and r_2.

16. For a cell, the graph between the potential difference (V) across the terminals of the cell and the current (I) drawn from the cell is shown in the figure

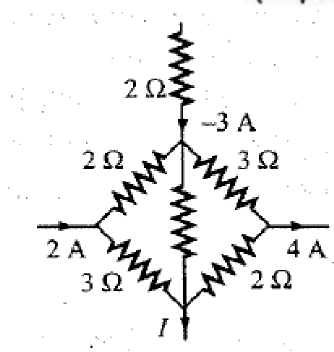


The e.m.f and the internal resistance of the cell are

(a) 2V, 0.5 Ω (b) 2V, 0.4 Ω

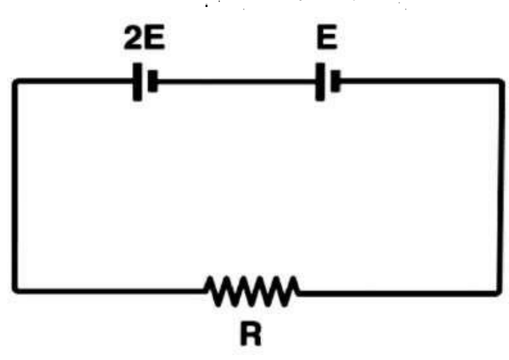
(c) > 2V, 0.5 Ω (d) > 2V, 0.4 Ω

17. What is the current I for the circuit shown in the figure?



(a) 3A (b) 1A (c) -5A (d) 5A

18. Two cells of emf 2E and E with internal resistance r_1 and r_2 respectively are connected in series to an external resistor R (see figure). The value of R, at which the potential difference across the terminals of the first cell becomes zero is



(a) $r_1 - r_2$ (b) $r_1 + r_2$

(c) $(r_1/2) + r_2$ (d) $(r_1/2) - r$

V.S.A(1 MARK)

Q19. How the internal resistance of a cell changes when area of the anode is decreased?

Q20. Why are alloys used for making standard resistances?

Q21. Write the dimensional formula of emf of a cell.

Q22. Alloys of metal have greater resistivity than that of their constituent metals, why?

DIRECTIONS:(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

Q23.**Assertion**: The current density J at a point in ohmic resistor is in direction of electric field E at that point

Reason: A point charge when released from rest in a region having only electrostatic field always moves along electric lines of force

DIRECTIONS: (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If the Assertion is correct but Reason is incorrect.

Q24. **Assertion**: The temperature dependence of resistance is usually given as $R=R_0(1+\alpha\Delta t)$. The resistance of wire changes from 100 ohm to 150 ohm when its temperature is increased from 27 degree Celsius to 227 degrees Celsius. This implies that a =2.5 x 10^{-3} /degree Celsius.

Reason: $R=R_0(1+ \alpha\Delta t)$ is valid only when the change in temperature is small and $\delta R << R0$

DIRECTIONS: (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If the Assertion is correct but Reason is incorrect.

Q 25. **Assertion**: EMF is potential difference between two terminals of the cells when no current is drawn from it.

Reason: It is an effect of terminal potential difference.

DIRECTIONS: (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If the Assertion is correct but Reason is incorrect.

Q26. **Assertion**: The number density of free electrons in metals is very high.

Reason: Number density of metals increases with increase in temperature hence it is the cause of increase in conductivity of metals with temperature.

DIRECTIONS: (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If the Assertion is correct but Reason is incorrect.

Q27. **Assertion**: Internal resistance of a cell decreases when immersed area of electrons in the electrolyte increases

Reason: Internal resistance of a cell in is its characteristic property.

DIRECTIONS: (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If the Assertion is correct but Reason is incorrect.

Q28. **Assertion**: Which of Junction rule reveals that at a junction sum of current is zero.

Reason: Kirchhoff’s Junction rule is based upon law of conservation of charge.

2 MARK QUESTIONS

Q29. A current of 2.4 A flows through a wire of cross-sectional area 1.5 mm^2. Find the current density in the wire. If the wire contains 8 x 10^{28} free electrons calculate the drift velocity of electrons per cubic meter, calculate the drift velocity of electrons.

Q30. An aluminum wire of diameter 0.24 cm is connected in series to a copper wire of diameter 0.16 cm. The wires carry an electric current of 10 A. Find (a) current density of free electrons in the aluminum wire and (b) drift velocity of electrons in the copper wire. Given that number of densities of free electrons in copper = 8.4×10^{28} m^{-3}.

Q31. Given that resistivity of copper is 1.68 x 10^{-8} Ω m.

Calculate the amount of copper required to draw a wire 10 km long having resistance 10 ohm. The density of copper is 8.9 x 10^3 kg m^{-3}.

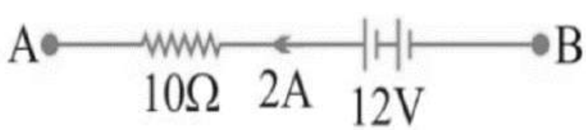
Q32. Which lamp has greater resistance (i) 60W and (ii) 100W when connected to the same supply? Why?

Q33. Nichrome and Cu wires of the same length and same diameter are connected in series in an electric circuit. In which wire will the heat be produced at a higher rate? Give reason.

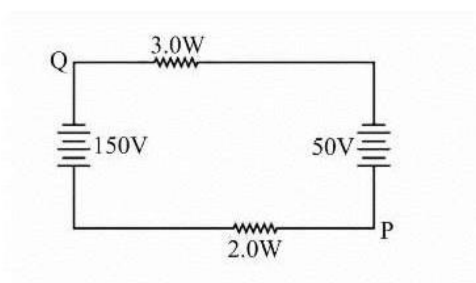
Q34. The resistance of the platinum wire of a platinum resistance thermometer at the ice point is 5 Ω and at steam point is 5.23 Ω. When the thermometer is inserted in a hot bath, the resistance of the platinum wire is 5.795 Ω. Calculate the temperature of the bath.

Q35. A rheostat has 100 turns of a wire of radius 0.4 mm having resistivity 4.2×10^{-7} Ω m. The diameter of each turn is 3 cm. What is the maximum value of resistance it can introduce?

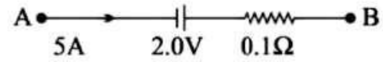
Q36. In the figure, what is the potential difference between A and B?



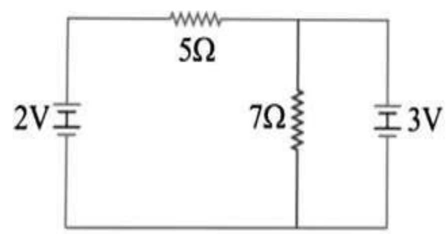
Q37. In the figure, if the potential at point P is 100V, what is the potential at point Q?



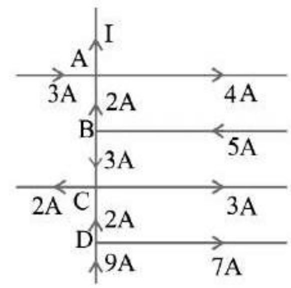
Q38.A battery of emf 2.0 V and internal resistance 0.1Ω is being charged with a current of 5.0 A. What is the potential difference between the terminals of the battery?



Q39. Two resistance 5Ω and 7Ω are joined as shown to two batteries of emf 2V and 3V. If the 3Vbattery is short circuited. What will be the current through 5Ω?



Q40. Find the value of I in the given circuit:



Q41. Is the momentum conserved when charge crosses a junction in an electric circuit? Why or why not?

3 MARK QUESTIONS

Q42. (a) Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area 1.0×10^{-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 9.0×10^3 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.

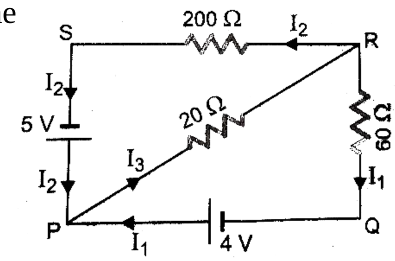
Q43. Two wires of equal length, one of aluminium and the other of copper have the same resistance. Which of the two wires is lighter? Hence explain why aluminium wires are preferred for overhead power cables.

(ρ_{Al} = 2.63 × 10_{-8} Ω m, ρ_{Cu} = 1.72 × 10^{-8} Ω m, Relative density of Al = 2.7, of Cu = 8.9.)

Q44. An electric toaster uses nichrome for its heating element. When a negligibly small current passes through it, its resistance at room temperature (27.0 °C) is found to be 75.3 Ω. When the toaster is connected to a 230 V supply, the current settles, after a few seconds, to a steady value of 2.68 A. What is the steady temperature of the nichrome element? The temperature coefficient of resistance of nichrome averaged over the temperature range involved, is 1.70×10^{-4} $°C^{-1}$.

Q45. The amount of charge passing through the cross-section of a wire in time t is given by $q=at^2+bt+c$ (a) What are the dimensional formulae of constants a, b and c? (b) If the values of constants a, b, c are 3, 5 and 2 in SI units, find the value of current at t=3s.

Q46. Apply Kirchhoff's rules to the length PRSP and PRQP to find the current I_1, I_2 and I_3 in the circuit.

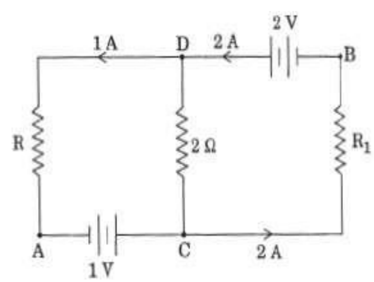


Q47. A cell of e.m.f. 'E' and internal resistance 'r' is connected across a variable resistor 'R'. Plot a graph showing the variation of terminal potential 'V' with resistance 'R'. Predict from the graph the condition under which 'V' becomes equal to 'E'. What is significance of this graph?

Q48. Four cells each of internal resistance 0.8Ω and emf 1.4V, are connected (i) in series (ii) in parallel. The terminals of the battery are joined to the lamp of resistance 10Ω. Find the current through the lamp and each cell in both the cases.

Q49. When resistance of 2Ω is connected across the terminals of a battery, the current is 0.5A. When the resistance across the terminal is 5Ω, the current is 0.25A. (i) Determine the emf of the battery (ii) What will be current drawn from the cell when it is short circuited.

Q50. In the given circuit, assuming point A to be at zero potential, use Kirchhoff's rules to determine the potential at point B and value of R.



5 MARK QUESTIONS

Q51. (a) The electron drift arises due to the force experienced by electrons in the electric field inside the conductor. But force should cause acceleration. Why then do the electrons acquire a steady average drift speed?

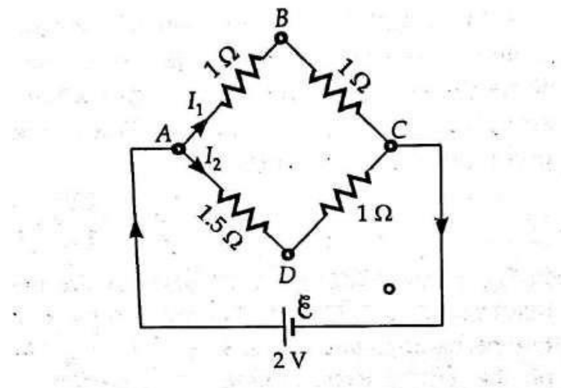
(b) If the electron drift speed is so small, and the electron's charge is small, how can we still obtain large amounts of current in a conductor?

(c) 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?

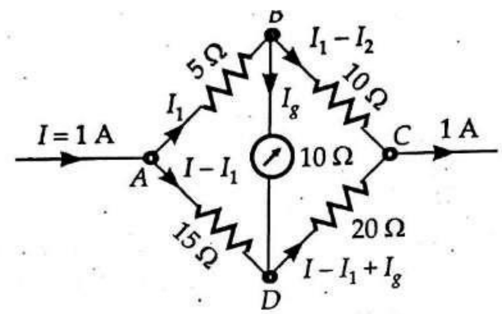
(d) Are the paths of electrons straight lines between successive collisions (with the positive ions of the metal) in the (i) absence of electric field, (ii) presence of electric field?

Q52. Two cells of EMF 3V and 4V and internal resistances 1 ohm and 2 ohms respectively are connected in parallel so as to send current in same direction through an external resistance of 5 ohm. Draw the circuit diagram using Kirchhoff's laws. Calculate the current through each branch of the circuit and potential difference across 5-ohm resistance.

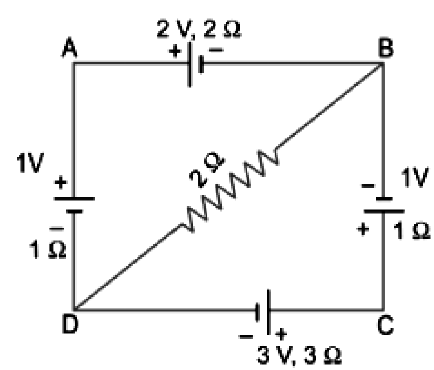
Q53. Calculate the potential difference between the junctions B and D in the Whetstone Bridge shown in figure



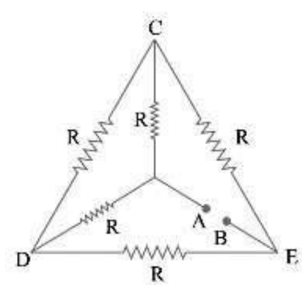
Q54. Determine the current flowing through the galvanometer G of Wheatstone Bridge shown in figure.



Q55. For the circuit given below, find the potential difference b/w points B and D.

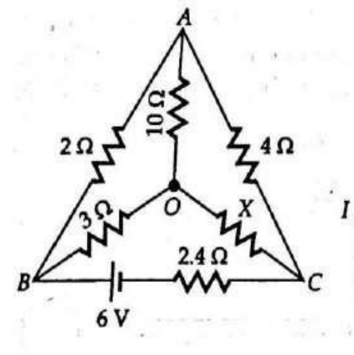


Q56. Calculate Equivalent Resistance of the given electrical network b/w points A and B. Also calculate the current through CD& ACB if a 10V dc source is connected b/w points A and B and the value of R = 2Ω. If battery of V volt is connected find current in circuit and current through DC.



Q57. P, Q, R and S are four resistance wires of 2,2,2 and 3 ohms respectively. Find out the resistance with which S must be shunted in order that bridge may be balanced.

Q58. Find the value of unknown resistance X, in the following circuit, if no current flows through the section AO. Also calculate the current drawn by the circuit from the battery of emf 6V and negligible internal resistance.



Case Based/Passage based integrated questions

53. When a conductor does not have a current through it, its conduction electrons move randomly, with no net motion in any direction. When the conductor does have a current through it, these electrons actually still move randomly, but now they tend to drift with a drift speed Vd in the direction opposite to the applied electric field that causes current. The drift speed is very small as compared to the speeds in the random motion. For example, in the copper conductors of household wiring, electron drift speeds are perhaps 10^5 m/s to 10^3 m/s, where as the random speed is around 10 ms^{-1}.

(i) The electron drift speed is estimated to be only a few mm s^{-1} for currents in the range of a few amperes? How is current established almost the instant a circuit is closed?

(ii) The electron drift arises due to the force experienced by electrons in the electric field inside the conductor. But force should cause acceleration. Why do the electrons acquire a steady average drift speed?

(iii) If the electron drift speed is so small, and the electron's charge is small, how can we still obtain large amounts of current in a conductor?

(iv) 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?

(v) Are the paths of electrons straight lines between successive collisions (with the positive ions of the metal) in the (a) absence of electric field, (b) presence of electric field?

Case Based/Passage based integrated questions-answers

59. (i) As soon as a circuit is closed, everywhere in conductor, electric field is set up (with the speed of light), and the conduction of electron at every point experience a drift.

(ii) Each conduction electron does accelerate, and gain speed until it collides with a positive ion of a conductor, thereby losing its drift speed after collision again it gains kinetic energy but suffers a collision again and so on. Therefore, on the average, electron acquire only a drift speed.

(iii) As number of the density of electrons ($\approx 10^{29}$ m^{-3}) is very large, therefore current flowing is large.

(iv) No. When electric field is applied, the net drift of the electrons is from lower to higher potential. But locally electrons collide with ions and may change its direction during the course of their motion.

(v) Yes. In the (a) absence of electric field, the paths are straight lines.

Reason: As electrons were not acted upon by any kind of forces.

(b) No. In the presence of electric field paths were curved. Reason: As direction of random velocities and acceleration are not always same.

<u>Case-Based MCQ</u>

60. Read the following text and answer the following questions on the basis of the same:

Electric Toaster: Small Industries Service Institute Takyelpat Industrial Estate Imphal has designed an Electric toaster which is operated at 220 volts A.C., single phase and available in four different rated capacity such as 600 W, 750 W, 1000 W and 1250 W. The heating element is made of nichrome 80/20 (80% nickel, 20% chromium), since Nichrome does not get oxidize readily at high temperature and have higher resistivity, so it produces more heat.

The element is wound separately on Mica sheets and fitted with body of toaster with the help of ceramic terminals.

Q. 1. Heating element of the toaster is made of:

(A) copper (B) nichrome (C) chromium (D) nickel

Q. 2. What is meant by 80/20 Nichrome?

(A) 80% Chromium and 20% Nickel

(B) 80% Nickel and 20% Chromium

(C) Purity 80%, Impurity 20%

(D) It is a mixture of Chromium and Nickel

Q.3. Which one will consume more electricity?

(A) 600 W (B) 1000 W (C) 750 W (D) 1200 W

Q.4. Operating voltage of the device is: (A) 220 V AC, single phase

(A) 220 V AC, single phase (B) 220 V AC, three phase (C) 220 V DC (D) 220 V AC/DC

Q. 5. Insulating materials used in the device are:

(A) Mica (B) Ceramic (C) Mica, ceramic, Nichrome (D) Mica,ceramic

Case Based/Passage based integrated questions-answers

60.

1. Ans. Option (B) is correct.

Explanation: The heating element is made of nichrome 80/20 (80% nickel, 20% chromium).

2. Ans. Option (B) is correct.

Explanation: Nichrome 80/20 means an alloy of 80% nickel, 20% chromium.

3. Ans. Option (D) is correct.

Explanation: Electricity consumption is measured by kWH. So, 1200W toaster will consume more electricity

3. Ans. Option (A) is correct.

Explanation: The designed electric toaster is IN operated at 220 volts A.C., single phase.

5. Ans. Option (D) is correct.

Explanation: The element is wound separately on Mica sheets and fitted with body of toaster with the help of ceramic terminals.

Case-Based MCQ

61. Whenever an electric current is passed through a conductor, it becomes hot after some time. The phenomenon of the production of heat in a resistor by the flow of an electric current through it is called heating effect of current or Joule heating. Thus, the electrical energy supplied by the source of emf is converted into heat. In purely resistive circuit, the energy expended by the source entirely appears as heat. But if the circuit has an active element like a motor, then a part of energy supplied by the source goes to do useful work and the rest appears as heat. Joule's law of heating forms the basis of various electrical appliances such as electric bulb, electric furnace, electric press etc.

(i) Which of the following is correct statement?

(a) Heat produced in a conductor is independent of the current flowing.

(b) Heat produced in a conductor varies inversely as the current flowing.

(c) Heat produced in a conductor varies directly as the square of the current flowing.

(d) Heat produced in a conductor varies inversely as the square of the current flowing.

(ii) If the coil of a heater is cut to half, what would happen to heat produced?

(a) Doubled (b) Halved (c) Remains same (d) Becomes four times.

(iii) A 25 W and 100 W are joined in series and connected to the mains. Which bulb will glow brighter?

(a) 100 W (b) 25 W (c) Both bulbs will glow brighter (d) None will glow brighter

(iv) A rigid container with thermally insulated wall contains a coil of resistance 100 Ω, carrying 1A. Change in its internal energy after 5 min will be

(a) 0 KJ (b) 10 KJ (c)20 KJ (d) 30 KJ

(v) The heat emitted by a bulb of 100 W in 1 min is

(a) 100 J (b) 1000 J (c) 600 J (d) 6000 J

Case Based/Passage based integrated questions-answers

61. (i) (c) Heat produced in a conductor varies directly as the square of the current flowing

(ii) (a) Doubled

(iii)(a) 100 W

(iv)(d) 30 kJ

(v) (d) 6000 J

Case Based/Passage based integrated questions

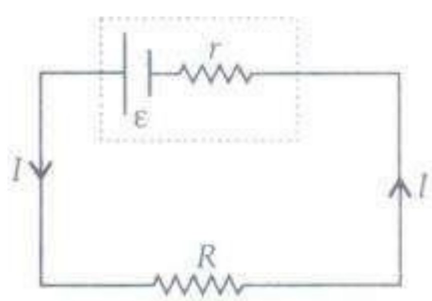
62.Emf of a cell is the maximum potential difference between two electrodes of the cell when no current is drawn from the cell. Internal resistance is the resistance offered by the electrolyte of a cell when the electric current flows through it. The internal resistance of a cell depends upon the following factors;

(i) distance between the electrodes

(ii) nature and temperature of the electrolyte

(iii) nature of electrodes

(iv) area of electrodes.



For a freshly prepared cell, the value of internal resistance is generally low and goes on increasing as the cell is put to more and more use. The potential difference between the two electrodes of a cell in a closed circuit is called terminal potential difference and its value is always less than the emf of the cell in a closed circuit. It can be written as V = E - Ir.

(i) The terminal potential difference of two electrodes of a cell is equal to emf of the cell when

a) during charging b) during discharging c) both a and b d) I= 0

(ii) A cell of emf ε and internal resistance r gives a current of 0.5 A with an external resistance of 12Ω and a current of 0.25 A with an external resistance of 25Ω. internal resistance of the cell and emf of the cell are

a)1Ω, 6.5 V b) 5Ω, 6.5 V c) 1Ω, 7.5 V d) 5Ω, 7.5 V

(iii) Choose the wrong statement.

(a) Potential difference across the terminals of a cell in a closed circuit is always less than its emf.

(b) Internal resistance of a cell decreases with the decrease in temperature of the electrolyte.

(c) Potential difference versus current graph for a cell is a straight line with a -ve slope

(d) Terminal potential difference of the cell when it is being charged is given as V = E + Ir.

(iv) An external resistance R is connected to a cell of internal resistance r, the maximum current flows in the external resistance, when

(a) R = r (b) R < r (c) R> r (d) R=0

(v) IF external resistance connected to a cell has been increased to 5 times, the potential difference across the terminals of the cell increases from 10 V to 30 V. Then, the emf of the cell is

(a) 30 V (b) 60V (c) 50 V (d) 40 V

SOLUTIONS:

62 (i) d) I= 0

(ii) a)1Ω, 6.5 V

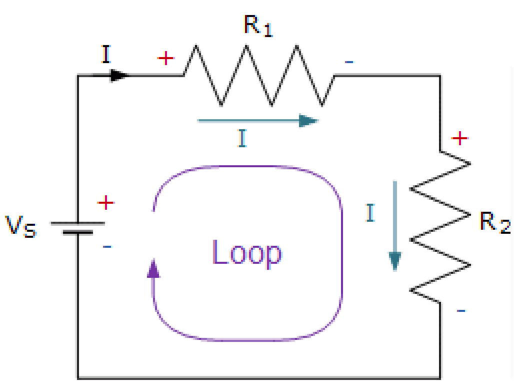
(iii) (b) Internal resistance of a cell decreases with the decrease in temperature of the electrolyte.

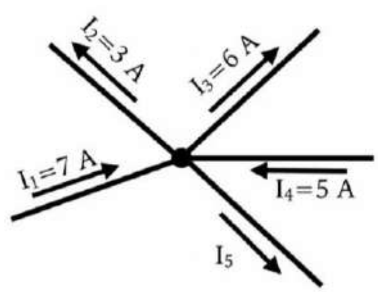
(iv) (d) R=0

(v) (b) 60V

63. KIRCHHOFF'S RULES

Electric circuits generally consist of a number of resistors and cells interconnected sometimes in a complicated way. The formulae we have derived earlier for series and parallel combinations of resistors are not always sufficient to determine all the currents and potential differences in the circuit. Two rules, called Kirchhoff's rules, are very useful for analysis of electric circuits. Given a circuit, we start by labelling currents in each resistor by a symbol, say I, and a directed arrow to indicate that a current I flows along the resistor in the direction indicated. If ultimately, I is determined to be positive, the actual current in the resistor is in the direction of the arrow. If I turn out to be negative, the current actually flows in a direction opposite to the arrow. Similarly, for each source (i.e., cell or some other source of electrical power) the positive and negative electrodes are labelled, as well as, a directed arrow with a symbol for the current flowing through the cell.





The directed sum of the potential differences (voltages) around any closed loop is zero.

1.Kirchoff 1^{ST}Law is conservation of

a) Charge b) Energy c) Potential d) Momentum

2.Kirchchoff junction rule can be written as

a) Σ V=0 b) Σ I =0 c) Σ R = 0 d) Σ q = 0

3. Kirchhoff's Voltage Law is the conservation of

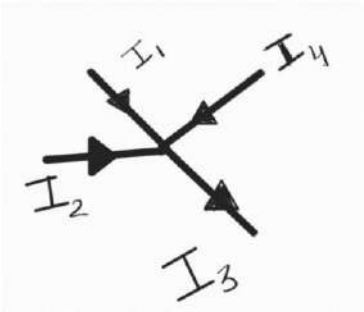
a) Energy b) Charge c) Current d) Momentum

4. Kirchhoff's Voltage Law is applied over

a) Closed Circuit loop b) At a circuit node

c) Acrossbattery d) None of the above

5. Find the current I_3 when I_1=2A, I_2=9A, I_4=4A



SOLUTIONS:

1.a) Charge

2. b) Σ I =0

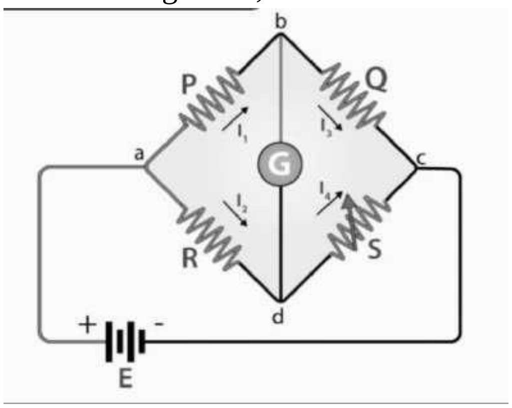
3. a) Energy

4. a) Closed Circuit loop

5. 15A

Case Based/Passage based integrated questions

Q64. As an application of Kirchhoff's rules consider the circuit shown, which is called the Wheatstone bridge. The bridge has four resistors R1, R2, R3 and R4. Across one pair of diagonally opposite points (A and C in the figure) a source is connected. This (i.e., AC) is called the battery arm. Between the other two vertices, B and D, a galvanometer G (which is a device to detect currents) is connected. This line, shown as BD in the figure, is called the galvanometer arm. For simplicity, we assume that the cell has no internal resistance. In general, there will be currents flowing across all the resistors as well as a current I g through G. Of special interest, is the case of a balanced bridge where the resistors are such that I g = 0. We can easily get the balance condition, such that there is no current through G.



1. What is the principle of the Wheatstone bridge?
2. Name the instrument that is used as a null detector in the Wheatstone bridge.
3. Which among the following is a false statement?

a) A galvanometer is used as the null detector in a Wheatstone bridge

b) A galvanometer is an ammeter with low resistance in series

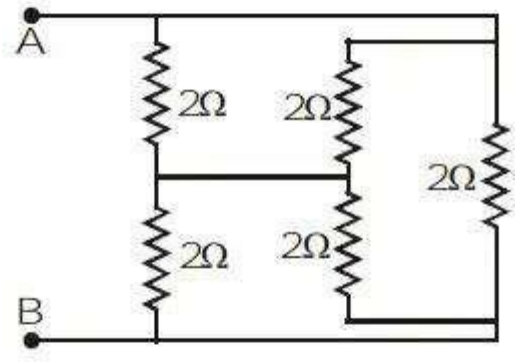
c) Wheatstone bridge is susceptible to high dc current

d) Due to the errors introduced in contact resistance, a Wheatstone bridge cannot be used for accurate measurement

4.PR = QS is the equation of a balanced Wheatstone bridge. Is it true or false?

a) True b) False

5. The equivalent resistance across AB is :



a) 1 Ω

b) 2 Ω

c) 3 Ω

d) 4 Ω

SOLUTIONS:

3. c) Wheatstone bridge is susceptible to high dc current

4. b) False

5. a)1 Ω

Here CDEF will represent a balanced Wheatstone bridge. As the each arm resistance is equal to 2Ω so equivalent resistance for bridge is R_{eq}=2Ω. Thus, we can remove the conducting wire GH and the corresponding circuit is as shown in figure.

Equivalent resistance between A and B is R_{AB}=2||2=2/2=1Ω