CURRENT ELECTRICITY

GUPTA CLASSES
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CURRENT ELECTRICITY

Electric current

The electric current I through a conductor is the rate of flow of electric charge through the area. i.e $I = dq/dt$

1. An electric current is due to the drift of:
   (a) electrons in a conductor (b) positive and negative ions in an elecrolyte
   (c) electrons and ions in gases in discharge, tubes
2. Electric current is a Scalar quantity. Conventionally, the direction of electric current is taken along the direction of motion of positive charges.

Current density

The electric current density $\vec{J}$ at a point inside the conductor is a vector whose direction is the direction of flow of positive charge at that point and whose magnitude is the current through unit area perpendicular to the direction of flow, i.e., $J = I/A$

When the plane of small area A makes angle θ with the direction of current, then $J = \frac{I}{A\cos\theta}$ or $I = JA\cos\theta = \vec{J}\cdot\vec{A}$

Drift Velocity

It is the average velocity with which charge carrier move inside the conductor. For an electron it is given by

$$v_d = -\frac{eE\tau}{m} \qquad \text{also} \qquad v_d = -\frac{eV\tau}{mL}$$

Where e = electronic charge, E = electric field intensity inside conductor, τ = relaxation time (average time between two successive collision), m = mass of electron, V = potential difference across end of conductor and L = length of conductor. Negative sign indicate that direction of motion is opposite to electric field.

Current I is also given by: $I = neAv_d$ (where v_d is drift velocity of the electrons). Usually, $v_d \cong 10^{-4}$ m/s.

Ohm's law

If the physical conditions such as temperature, material and dimensions of a conductor remains constant, the current between two points in a conductor is proportional to the potential difference between these two points, i.e., $I \propto V$ or (V/I) = a constant = R, where R is resistance of the conductor.

1. The conductors which obey Ohm's law are called ohmic conductors. For ohmic conductors (metals and alloys) the graph between current and potential difference is a straight line passing through the origin.
2. The conductors which do not obey Ohm's law are known as non-ohmic conductors. For non-ohmic conductors, the graph between current and potential difference is not a straight line. Diode valve, neon gas, junction diode are the examples of non - ohmic conductors. For non - ohmic conductors, dynamic resistance = $(\Delta V/\Delta I)$

Resistance and conductance

Resistance R of a given conductor, at a constant temperature, is given by

$$R = \frac{\rho L}{A}$$

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where ρ is called the specific resistance of the material

1. In terms of material parameters $R = \frac{m}{ne^2\tau}\frac{l}{A}$ and $\rho = \frac{m}{ne^2\tau}$
2. Resistance of a conductor depends upon the temperature, nature and dimensions of the material of the conductor.
3. The specific resistance ρ of a conductor depends upon the temperature and nature of the material of the conductor. It is independent of the dimensions of the conductor.
4. The conductance G is the reciprocal of resistance, i.e., $G = 1/R$.
5. Electrical conductivity of a material is defined as the reciprocal of the resistivity, $\sigma = 1/\rho$.
6. In MKS system unit of resistance is ohm, unit of specific resistance is ohm x metre, unit of conductance is mho or siemen and unit of conductivity is $(\text{ohm - metre})^{-1}$ or mho/metre,

Variation of resistance

The variation of resistance with temperature is approximately given by the linear relation $R_t = R_0(1 + \alpha t)$, where α is the temperature coefficient of resistance. α has the unit $°C^{-1}$ or K^{-1}.

At temperature t_1, $R_1 = R_0(1 + \alpha t_1)$ and at temperature t_2, $R_2 = R_0(1 + \alpha t_2)$. Combining, we get: $\alpha = \frac{R_1 - R_2}{R_1 t_2 - R_2 t_1}$ per°C

α is positive for conductors, negative for semiconductors, electrolytes, carbon, mica and India rubber, and is zero for superconductors (resistance of a superconductor is also zero).

1. Resistance of bismuth wire increases when placed in a magnetic field.
2. Resistance of carbon granules decreases when pressure is increased.
3. Resistance of semiconductor decreases when light falls on it.
4. Resistance of an intrinsic semiconductor decreases when doped with a trivalent or pentavalent impurity.
5. The specific resistance of alloys increases with a rise in temperature but this increase is much smaller when compared to pure metals.

Resistances in series

In series combination, the effective or total resistance R is given by: $R = R_1 + R_2 + R_3 + ...$ The current is same in every part of the circuit.

Resistances in parallel

In parallel combination of resistances, the effective resistance R is given by: $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots\ldots$The potential difference is same across each resistance and current is different in each resistance.

Electric cell

1. The e.m.f. (E) of a cell in volt is given by the work done (in joule) to unit charge move from the positive pole via external circuit to the negative pole and then through the electrolyte to the positive pole.
2. When a cell is being charged, then terminal potential difference $V = E + Ir$, and when the cell is being discharged, then $V = E - Ir$ (where I represents the current and r the internal resistance of the cell).
3. In an open circuit, i.e., when $I = 0$, $V = E$.

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4. The internal resistance r of the cell is the resistance of the column of liquid between the two plates of the cell and it depend on the (a) separation of plates, (b) area of cross-section of the column of liquid between the plates and (c) nature, temperature and the degree of dissociation of electrolyte between them. In general internal resistance of cell increases with usage.
5. A cell is called **ideal** if its internal resistance is zero.
6. A cell is said standard if its EMF and internal resistance do not change with usage.

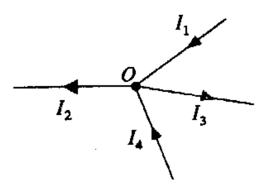
Combinations of cells

1. Two cells of e.m.f. E_1 and E_2, and internal resistances r_1 and r_2 when connected in series correctly, then equivalent e.m.f. $E = E_1 + E_2$ and equivalent internal resistance $r = r_1 + r_2$. However, if the two cells are connected wrongly then equivalent e.m.f., $E = E_1 - E_2$ but the equivalent internal resistance will remain same, i.e; $r = r_1 + r_2$.
2. If n cells of e.m.f. E and internal resistance r are connected in series with external resistance R, then current

$$I = \frac{nE}{R + nr}$$

3. If m cells, each of e.m.f. E and internal resistance r are connected in parallel with each other and the combination is connected in series with an external resistance R, then $I = \frac{E}{R + r/m} = \frac{mE}{mR + r}$.
4. If n cells each of e.m.f. E and internal resistance r are connected in series and m such rows are connected in parallel and the combination is connected in series with an external resistance R, then $I = \frac{nE}{R + \frac{nr}{m}} = \frac{mnE}{mR + nr}$
5. It is useful to connect cells in series when $R >> r$ and in parallel when $R << r$.
6. It is useful to connect cells in mixed grouping when $R \cong r$. For maximum current $R \cong nr/m$.
7. In any grouping current is maximum when internal resistance equals external resistance.

Kirchhoffs Current Law (KCL): The algebraic sum of the currents meeting at a junction in an electrical circuit is zero.



If we take the signs of currents flowing towards point O as positive, then currents flowing away from point O will be assigned negative sign. Thus, applying Kirchhoffs current law to the junction O in Fig. we have, $(I_1) + (I_4) + (-I_2) + (-I_3) = 0$

Kirchhoffs current law is based on the law of conservation of charge.

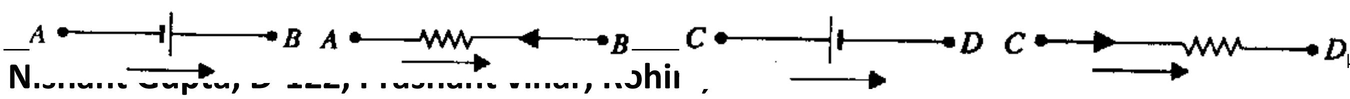
(A junction is that point in an electrical circuit where three or more circuit elements meet.)

Kirchhoff's Voltage Law (KVL) : In any closed electrical circuit or mesh, the algebraic sum of all the electromotive forces (e.m.fs) and voltage drops in resistors is equal to zero, i.e.,

In any closed circuit or mesh, Algebraic sum of e.m.fs + Algebraic sum of voltage drops = 0

Sign Convention

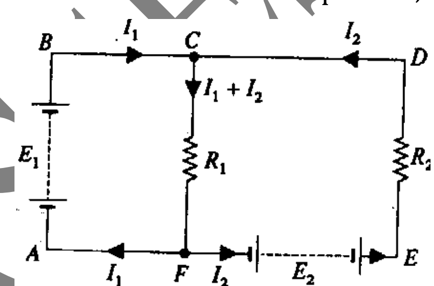
While applying Kirchhoff's voltage law to a closed circuit, algebraic sums are considered. Therefore, it is very important to assign proper signs to e.m.fs and voltage drops in the closed circuit. The following sign convention may be followed :



1. In Fig as we go from A to B (i.e., negative terminal of cell meet first), the EMF of cell is considered negative.
2. In Fig as we go from A to B (i.e., against flow of current) the potential drop across resistance is considered negative.
3. In Fig as we go from C to D (i.e., positive terminal of cell meet first), the EMF of cell is considered positive.
4. In Fig as we go from C to D (i.e., in direction of flow of current) the potential drop across resistance is considered positive.

Illustration of Kirchhoff's Laws

1. Consider the circuit shown in fig. The directions in which currents are assumed to flow is unimportant, since if wrong direction is chosen, it will be indicated by the negative sign in the final result.



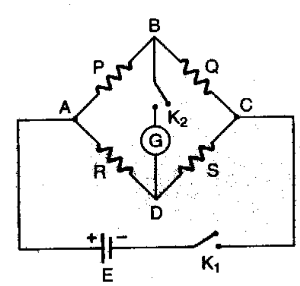
2. The magnitude of current in any branch of the circuit can be found by applying Kirchhoff's current law. Thus at point C in Fig the incoming currents to the junction C are I_1 and I_2. Obviously, the current in branch CF will be $I_1 + I_2$.
3. There are three closed loops in Fig viz., ABCFA, CDEFC and ABCDEFA. Since there are only two unknown quantities (i.e., I_1 and I_2), we need only two equations in terms of I_1 and I_2. This can be achieved by applying Kirchhoffs voltage law to any two closed loops.
4. **Loop ABCFA:** As we go round the loop in order ABCFA, e.m.f. E_1 will be given negative sign. The voltage drop in branch CF is $(I_1 + I_2)R_1$ and shall bear positive sign. Applying Kirchhoff's voltage, law to the closed loop ABCFA, we have, $-E_1 + (I_1 + I_2)R_1 = 0$ or $E_1 = (I_1 + I_2)R_1$ ...(1)
5. **Loop CDEFC:** As we go round the loop in the order CDEFC, drop I_2R_2 is negative, e.m.f, E_2 is positive and drop $(I_1 + I_2)R_1$ is negative. Therefore, applying Kirchhoffs voltage law to this loop, we get,

$$-I_2R_2 + E_2 - (I_1 + I_2)R_1 = 0 \quad \text{or} \quad I_2R_2 + (I_1 + I_2)R_1 = E_2 \qquad ...(2)$$

Since E_1, E_2, R_1 and R_2 are known, we can find the values of I_1 and I_2 from the above two equations.

Wheatstone's bridge

In Wheatstone's bridge, as shown in fig.

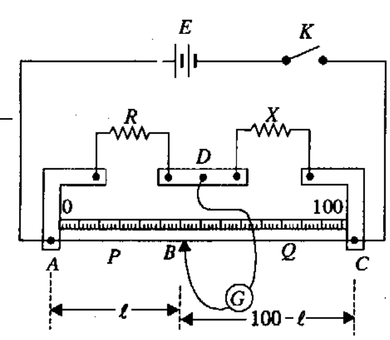


1. When $QR = PS$, no current flows in arm BD and the bridge is said balanced,
2. When $QR > PS$, current flows from B to D.
3. When $QR < PS$, current flows from D to B.
4. The bridge is most sensitive when all the four resistors are of the same order.
5. Metre bridge, post office box and Carey Foster's bridge are practical applications of Wheatstone's bridge.

Slide Wire Bridge (or Metre Bridge)

It is a sensitive device used for measuring the unknown resistance. Its operation is based on the principle of Wheatstone bridge.

1. In Fig AC is 1m long wire made of manganin (or constantan) and having uniform area of cross-section.



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2. The resistance R is a known resistance (resistance box) and X is unknown resistance whose value is to be determined.
3. A battery E is connected between points A and C through key K; the positive terminal of E being connected to point A.
4. One end of galvanometer G is connected to point D (junction point of R and X) and the other end is connected to jockey B which can slide over the wire AC.

Theory (i) Introduce a suitable value of R and close the key K,

(ii) Move the jockey on the wire AC to obtain the null point. Let point B be the null point on the wire AC. Suppose the resistance of portion AB of the wire is P and of portion BC is Q. Let length AB = l cm. Then length BC = $(100 - l)$ cm,

Now $P \propto l$ and $Q \propto (100 - l)$

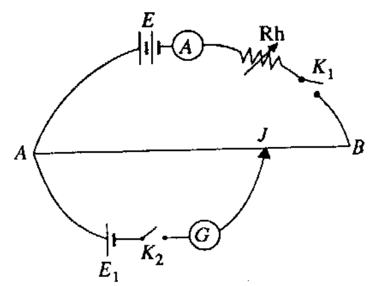
According to Wheatstone bridge principle, the relation between four resistances (P, Q, X and R) at null point is given by;

$$\frac{P}{Q} = \frac{R}{X} \qquad X = \left(\frac{100-l}{l}\right)R$$

Since the values of l and R are known, the value of unknown resistance X can be determined.

Note: The resistance R should be so selected that null point is obtained near the middle of the wire AC. This will result in minimum percentage of error in the measurement.

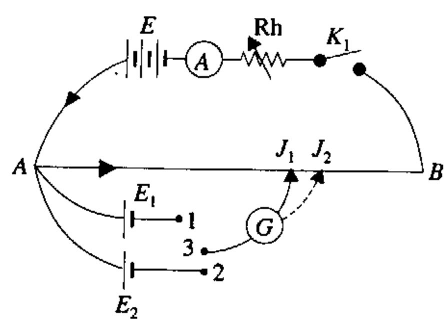
Potentiometer



It is an accurate device for measuring the e.m.f of a cell or potential difference (p.d.) between two points of an electric circuit. Fig. shows the potentiometer in its simplest form. AB a long uniform wire is connected to a battery E (driver battery) through an ammeter, rheostat Rh and key K_1. The current in wire AB can be changed with the help of the rheostat. The positive terminal of the cell whose e.m.f. E_1 is to be measured is connected to the end A of the wire. The negative terminal of this cell is connected through a galvanometer G and key K_2 to a jockey 'J' which can slide along the wire AB and can make contact at any point on the wire. The potentiometer is said to be balanced if there is no current in the galvanometer. The potential gradient across the wire ($k = V/l$) is constant. *Sensitivity of a potentiometer can be increased by decreasing potential gradient i.e. by increasing length of wire.*

Determination of e.m.f. of a cell. Fig shows the arrangement for determining the e.m.f. of a cell.

1. First key K_1 is closed and rheostat is set at the desired position to obtain a steady current 'I' in the wire AB. Now key K_2 is also closed and the jockey is moved over the wire AB till the potentiometer is balanced (point J). The potential difference across AJ equals E.M.F of cell i.e $E = kl$



Comparison of e.m.fs of two cells: Fig shows the arrangement for comparing the e.m.fs E_1 and E_2 of two cells with the help of potentiometer. The terminals 1 and 3 are closed so that only cell of e.m.f.E_1 is put in the circuit. The jockey is moved on wire till galvanometer reads zero (point J1). i.e $E_1 = kl_1$ ....(1)

Now terminals 2 and 3 are closed. This puts the cell of e.m.f. E_2 in the circuit. In this case null point is obtained at point J_2 on the potentiometer wire.

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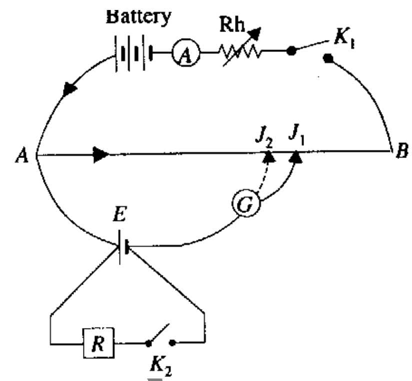
i.e $\qquad E_2 = kl_2 \qquad$ ……………(2)

and $\qquad E_1/E_2 = l_1/l_2$

Determination of internal resistance of a cell:

Fig shows the arrangement for determining the internal resistance (r) of a cell of e.m.f. E .



The key K_1 is closed and current in potentiometer wire AB is adjusted to a suitable constant value with the help of rheostat. Keeping key K_2 open, the position of jockey is adjusted till galvanometer reads zero (point J1).

i.e $\qquad$ E.M.F. of cell, $\quad E = kl_1 \qquad$ ……………(1)

Now suitable resistance R is inserted and key K_2 is closed. Again the position of the null point is obtained on the potentiometer wire (point J2). Now the null point corresponds to the p.d. V across the terminals of the cell. $\quad$ i.e $\qquad V = kl_2$

…………..(2)

From (1) and (2) $\qquad E/V = l_1/l_2$

It can be easily calculated $\qquad r = \left(\dfrac{l_1 - l_2}{l_2}\right)R$

Since the values of l_1, l_2, and R are known, the value of the internal resistance r of the cell can be determined.

Heating effect of current

Electrical power P in watt supplied by an energy source in transferring a charge of q coulomb through a potential difference of V volts in a time t second is: $P = \dfrac{\text{work}}{\text{time}} = \dfrac{Vq}{t} = VI$

1. Power can also be expressed as: $P = I^2R = (V^2/R)$
2. Heat Q produced in a resistor of R is given by: $Q = \dfrac{V^2t}{R}$, where Q is in Joule
3. Electric appliances are connected usually in parallel with the mains $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$ and $I_p = I_1 + I_2 + I_3$. Potential difference across all appliances is the same, i.e., V. Total power in parallel $P_p = P_1 + P_2 + P_3$
4. If the electrical appliances of same voltage rating but powers P_1, P_2, P_3 .... are connected in series, then the total power consumed is given by: $\dfrac{1}{P_S} = \dfrac{1}{P_1} + \dfrac{1}{P_2} + \dfrac{1}{P_3}$
5. The power supplied by a battery is maximum when the external resistance R is equal to the internal resistance r.

$$P_{max,} = \frac{V^2}{4R} = \frac{V^2}{4r}$$

6. Fuse wire is made from an alloy that has a low melting point but high specific resistance, e.g., usually tin - lead alloy is used. For a fuse wire $I \propto r^{3/2}$ (where r is radius of wire) and is independent of length of wire.

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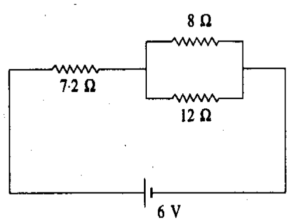
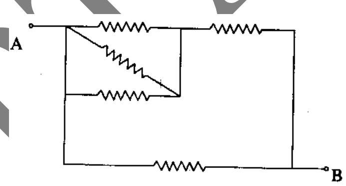
7. Standard resistance coils are made from an alloy that has a high specific resistance but negligibly small temperature coefficient of resistance, e.g., Manganin or constantan.
8. The material of the filament of an electric bulb should have a high melting point, hence tungsten is used.

Current Electricity ASSIGNMENT

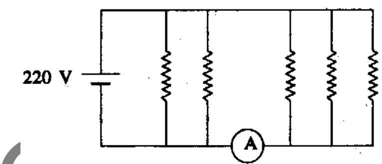
1. 1A copper wire of length 2 m and area of cross-section l.7 x 10^{-6} m^2 has a resistance of 2 x 10^{-2} ohm. The resistivity of copper is
(a) l.7 x 10^{-8} ohm-metre (b) l.9 x 10^{-8} ohm-metre
(c) 2.1 x 10^{-7} ohm-metre (d) 2.3 x 10^{-7} ohm-metre
2. 4A resistance of 6 ohm is connected in series with another resistance of 4 ohm across a battery of 20 V. The p.d. across the 6 ohm resistor is
(a) 3V (b) 6 V (c) 9V (d) 12 V
3. 3Three conductors draw respectively currents of 1 A, 2 A and 4 A when connected in turn across a battery. If they are connected in series across the same battery, the current drawn will be
(a) 2/7 A (b) 3/7 A
(c) 4/7 A (d) 5/7 A
4. 2In the given circuit, the p.d. across the 7.2 Ω resistor is



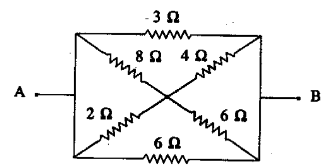
(a) 3.0 V (b) 3.6 V
(c) 4.2 V (d) 4.8 V
5. 3The resistance of a wire is R. It is stretched uniformly so that its length is doubled. The resistance now becomes
(a) 2 R (b) R/2 (c) 4 R (d) R/4
6. 3Five identical resistances are connected in a network as shown. The resistance measured between A and B is 1 Ω. The resistance of each wire is



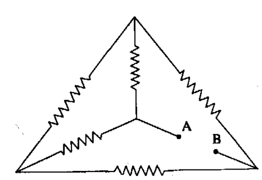
(a) ¼ Ω (b) 4/7 Ω (c) 7/4 Ω (d) 8/7 Ω
7. 2The equivalent resistance of n identical resistors connected in paralled is x. If the resistors are connected in series, the equivalent resistance would be
(a) nx (b) n^2x (c) x/n (d) x/n^2
8. 1The resistance of a wire is R. It is cut into four equal parts and all the parts are bundled together side by side. The resistance of the bundle is
(a) R/16 (b) R/8 (c) R/4 (d) R
9. 3Five identical resistors, each of value 1100Ω. are connected to a 220 V battery as shown. The reading of the ideal ammeter A is



(a) 1/5 A (b) 2/5 A (c) 3/5 A (d) 4/5 A
10. 1A cell has an emf of 1.5 V. When short circuited, it gives a current of 3A. The internal resistance of the cell is
(a) 0.5 Ω (b) 2.0 Ω (c) 4.5 Ω (d) 1 /4.5 Ω
11. 1In the network shown, equivalent resistance between A and B is



(a) 4/3 Ω (b) ¾ Ω
(c) 24/17 Ω (d)17/24 Ω
12. 1A battery of 6 V is connected to the terminals of a 3 m long wire of uniform thickness and resistance 100Ω The difference of potential between two points separated by 50 cm on the wire is
(a) 1.0 V (b) 1.5 V (c) 2.0 V (d) 3.0 V
13. 3A primary cell has an emf of 1.5V. When a 5 Ω resistor is connected across it, the current is 0.2 A. The internal resistance of the cell is
(a) 0.5 Ω (b) 1.25Ω (c) 2.5 Ω (d) 3.0 Ω
14. 2Five cells, each of emf E and internal resistance r, are connected in series. If, by mistake, one of the cells is connected wrongly, the eqivalent emf and internal resistance of the combination are
(a) 5E, 5r (b) 3E, 5r (c) 5E, 3r (d) 3E, 3r
15. 1Each of the resistances in the network shown is equal to R. The resistance between the terminals A and B is



(a) R (b) 5R
(c) 3R (d) 6 R
16. 2The temperature at which the resistance of a copper wire would be double its value at 0°C is (temperature coefficient of resistance of Cu = 3.9 x 10^{-3} /°C)
(a) 128°C (b) 256°C (c) 512°C (d) 740°C

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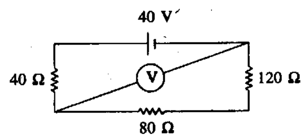
17. 3Two identical cells send the same current through a 2 Ω resistor, whether connected in series or in parallel. The internal resistance of each cell is

(a) 0.5 Ω (b) 1.5 Ω (c) 2 Ω (d) 2.5 Ω

18. 4Two cells, having emfs E_1 and E_2, ($E_1 > E_2$), when placed in series produce null deflection at a distance of 204 cm in a potentiometer. When placed in opposition, they produce null deflection at a distance of 36 cm. If E_2 = 1.4 V, E_1 is

(a) 14 V (b) 10 V (c) 4.2 V (d) 2 V

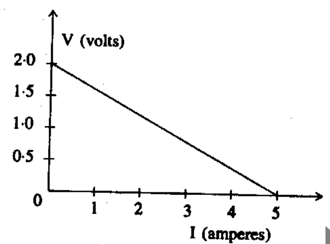
19. 4In the given circuit the resistance of the voltmeter is 800 Ω. Its reading is



(a) 8 V (b) 16 V

(c) 24 V (d) 32 V

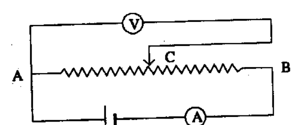
20. 1For a cell, the graph between the potential difference (V) across the terminals of the cell and the current (*I*) drawn from the cell is shown in the figure. The emf and the internal resistance of the cell are



(a) 2V, 0.5Ω (b) 2V, 0.4 Ω

(c) >2V, 0.5 Ω (d) none

21. 3In the given circuit, as the sliding contact C is moved from A to B,



(a) the readings of both the ammeter and the voltmeter remain constant
(b) the readings of both the ammeter and the voltmeter increase
(c) the reading of the ammeter remains constant but that of the voltmeter increases
(d) the reading of the ammeter remains constant but that of the voltmeter decreases.

22. 4Kirchhoffs two laws for electrical circuits are manifestations of the conservation of
(a) charge only
(b) both energy and momentum
(c) energy only
(d) both charge and energy

23. 3Three 4 Ω resistors are connected in the form of an equilateral triangle. Total resistance between any two corners is

(a) 8 Ω (b) 3/8 Ω (c) 8/3 Ω (d) 4/3 Ω

24. 2Sensitivity of a potentiometer can be increased by
(a) increasing the emf of the cell
(b) increasing the length of the wire
(c) decreasing the length of the wire
(d) none of the above,

25. 3Carbon resistors used in electronic circuits are marked for their resistance values and tolerance by a colour scheme. A given resistor has colour scheme brown, black, green and gold. Its value in ohms is

(a) 3.2 x 10^5 ±5% (b) 1.0 x 10^6 ±10%

(c) 1.0 x 10^6 ±5% (d) 1.0 x 10^3 ±5%

26. 3When a potential difference is applied across a copper wire, the drift velocity of the electron is v. If the same potential difference is applied across another copper wire of the same length but double the diameter, the drift velocity will be

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

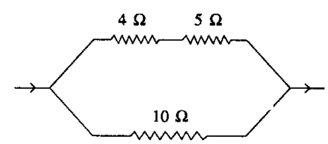
27. The drift velocity of electrons in a wire of radius r is proportional to

(a) r (b) r^2 (c) r^3 (d) none of the above

28. Two electric bulbs whose resistances are in the ratio 1 : 2 are connected in parallel to a constant voltage source. The power dissipated in them have the ratio

(a) 1 : 2 (b) 1 : 1 (c) 2 : 1 (d) 1 : 4

29. In the following circuit if the heat evolved in the 10 ohm resistor is 10 cal/s, the heat evolved in the 4 ohm resistor is approximately



(a) 4 cal/s (b) 5 cal/s (c) 10 cal/s (d) 20 cal/s

30. A housewife uses a 100 W bulb 8 hours a day, and an electric heater of 300 W for 4 hours a day. The total cost for the month of June at the rate of 50 poise per unit will be

(a) Rs 20 (b) Rs 25 (c) Rs 30 (d) Rs 30.50

31. If two bulbs of 25 W and 100 W, rated at 220 V. are connected in series across a 440 supply
(a) 100 W bulb will fuse
(b) 25 W bulb will fuse
(c) none will fuse
(d) both will fuse

32. 3You are given a resistance coil and a battery. In which of the following cases is largest amount of heat generated ?
(a) When the coil is connected to the battery directly
(b) When the coil is divided into two equal parts and both the parts are connected to the battery in parallel
(c) When the coil is divided into four equal parts and all the four parts are connected to the battery in parallel

(d) When only half the coil is connected to the battery

33. A 100 W, 220 V bulb is operated on a 110 V line. The power consumed is

(a) 25 W (b) 50W (c) 75 W (d) 90 W

34. Two bulbs which consume powers P_1 and P_2 are connected in series. The power consumed by the combination is

(a) $P_1 + P_2$ (b) $(P_1P_2)^{1/2}$

(c) $P_1P_2/P_1 + P_2$ (d) $2P_1P_2/P_1 + P_2$

35. A 24 V battery of internal resistance 4Ω is connected to a variable resistor. The rate of heat production in the resistor is maximum when the current in the circuit is

(a) 2 A (b) 3 A (c) 4 A (d) 6 A

36. The neutral temperature of a thermocouple is 275°C and the temperature of inversion is 600°C. The temperature of the cold junction is

(a) -50°C (b) -25°C (c) 25°C (d) 50°C

37. The thermo emf of a copper-constant couple is 40 μV per degree. The smallest temperature difference that can be detected with this couple and a galvanometer of 100Ω resistance capable of measuring the min. current of 1 μA is

(a) 1°C (b) 1.5°C (c) 2°C (d) 2.5°C

38. Which is independent of the temperature of the cold junction?

(a) inversion temperature
(b) neutral temperature
(c) both inversion and neutral temperatures
(d) neither inversion nor neutral temperature.

39. The emf developed in a thermocouple is given by $V = \alpha T + ½ \beta T^2$, where T is the temperature of the hot junction, the cold junction being at 0°C, The thermo electric power of this couple is

(a) $\alpha + \beta T$ (b) $\alpha T + \beta T/2$

(c) α/β (d) $2\alpha/\beta$

40. The cold junction of a thermocouple is at 0°C and the thermo emf (in volts) as a function of the temperature t of the hot junction is given by $V = 10 \times 10^{-6}\, t - (1/40) \times 10^{-6}\, t^2$. The neutral temperature and the maximum value of emf are

(a) 200°C, 2 mV (b) 400°C. 2 mV

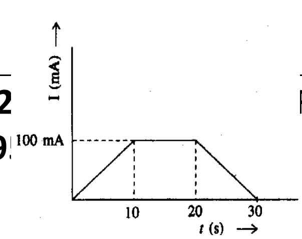
(c) 100°C, 1 mV (d) 200°C, 1 mV

41. A current of 1 A flowing for 25 min through a silver voltameter deposits 1.5 g of silver. The electrochemical equivalent of silver is

(a) 0.001 g/C (b) 0.01 g/C

(c) 0.1 g/C (d) 0.06 g/C

42. In a copper voltameter, the mass deposited in 30 s is m grams. If the current-time graph is as shown in the figure, the electrochemical equivalent of copper, in g/C, is



(a) 0.1 m (b) 0.6m (c) m/2 (d) m

43. If 1 A of current is passed through $CuSO_4$ solution for 10 s, the number of copper atoms deposited at the cathode will be about

(a) 1.6×10^{20} (b) 8×10^{19}

(c) 3.1×10^{19} (d) 6.2×10^{19}

44. A current of 1.5 A flows through a copper voltameter. The thickness of copper deposited on the electrode surface of area 50 cm^2 in 20 minutes is (density of Cu = 9000 kg/m^3; e.c.e of Cu = 3.3×10^{-7} kg/C)

(a) 1.3×10^{-4}m (b) 1.3×10^{-5} m

(c) 2.6×10^{-4} m (d) 2.6×10^{-5} m

Answers:

1-a 2-d 3-c 4-b 5-c 6-c 7-b 8-a 9-c 10-a 11-a 12-a 13-c 14-b 15-a 16-b 17-c 18-d 19-d 20-a 21-c 22-d 23-c 24-b 25-c 26-c 27-d 28-c 29-b 30-c 31-b 32-c 33-a 34-c 35-b 36-a 37-d 38-b 39-a 40-d 41-a 42-c 43-c 44-b