EXERCISE-1

*** MARK IS MORE THAN ONE CORRECT QUESTIONS.**

SECTION (A) : DEFINITION OF CURRENT, CURRENT DENSITIES & DRIFT VELOCITIES

A.1 Calculate the number of electrons crossing a given cross-section in 1 second to constitute a current of 1 A.

A.2 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.

A.3 The current through a wire depends on time as $i = i_0 + \alpha t$, where $i_0 = 10$ A and $\alpha = 4$ A/s. Find the charge crossed through a section of the wire in 10 seconds, and average current for that interval.

A.4 A current of 1.0 A exists in a copper wire of cross-section 1.0 mm^2. Assuming one free electron per atom calculate the drift speed of the free electrons in the wire. The density of copper is 9000 km/m^3. (atomic weight of copper = 63.5 and Avagadro number = 6×10^{23})

A.5 Consider a wire of length 4m and cross-sectional area 1 mm^2 carrying a current of 2A. If each cubic metre of the material contains 10^{29} free electrons, find the average time taken by an electron to cross the length of wire.

A.6 The drift velocity of electrons in a conducting wire is of the order of 1mm/s, yet the bulb glows very quickly after the switch is put on because
(A) the random speed of electrons is very high, of the order of 10^6 m/s
(B) the electrons transfer their energy very quickly through collisions
(C) electric field is set up in the wire very quickly, producing a current through each cross section, almost intantaneousty
(D) All of above

A.7 Read the following statements carefully :
Y : The resistivity of a semiconductor decreases with increase of temperature
Z : In a conducting solid, the rate of collisions between free electrons and ions increases with increase of temperature
Select the correct statement from the following
(A) Y is true but Z is false
(B) Y is false but Z is true
(C) Both Y and Z are true
(D) Y is true and Z is the correct reason for Y

A.8 A silver wire of length 10 metre and cross-sectional area 10^{-8} m^2 is suspended vertically and a weight of 10 N is attached to it. Young's modulus of silver and its resistivity are 7×10^{10} N/m^2 and 1.59×10^{-8} Ω-m respectively. The increase in its resistance is equal to
(A) 0.0455 Ω (B) 0.455 Ω (C) 0.91 Ω (D) 0.091 Ω

SECTION (B) : RESISTANCE

B.1 The resistance of an electric heater is 25 Ω. Its ends are connected to the poles of a 90 V battery. How much current will flow in the heater wire ?

B.2 Calculate the resistance of an aluminium wire of length 50 cm and cross-sectional area 2.0 mm^2. The resistivity of aluminium is $\rho = 2.6 \times 10^{-8}$ Ω - m.

B.3 A potential difference of 200 volt is applied to a coil at a temperature of 15ºC and the current is 10 A. What will be the mean temperature of the coil when the current has fallen to 5 A, the applied voltage being the same as before? Given : $\alpha = \frac{1}{234}$ ºC^{-1}.

B.4 What length of a copper wire of cross-sectional area 0.01 mm^2 will be needed to prepare a resistance of 1kΩ? Resistivity of copper = 1.7×10^{-8} Ω-m.

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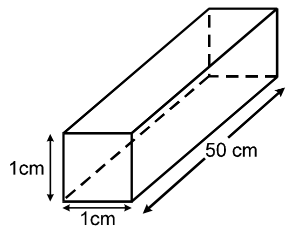
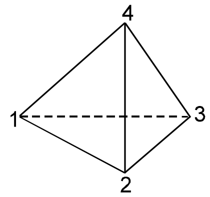
B.5 A rectangular carbon block has dimensions 1.0 cm × 1.0 cm × 50 cm. Resistances are measured, first across two square ends and then across two rectangular ends, respectively. If resistivity of carbon is $3.5 \times 10^{-5}\ \Omega$-m, then values of measured resistances respectively are:
(A) $17.5 \times 10^{-2}\ \Omega$, $7 \times 10^{-5}\ \Omega$
(B) $7 \times 10^{-5}\ \Omega$, $7.5 \times 10^{-2}\ \Omega$
(C) $17.5 \times 10^{-4}\ \Omega$, $7 \times 10^{-7}\ \Omega$
(D) $7.5\ \Omega$, $7 \times 10^{-2}\ \Omega$

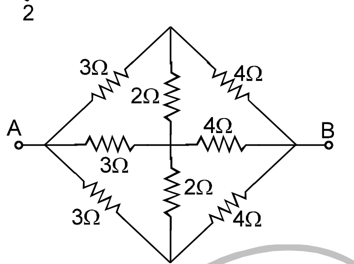


B.6 A wire is in the form of a tetrahedron. The resistance of each edge is r. The equivalent resistances between corners 1–2 and 1–3 are respectively

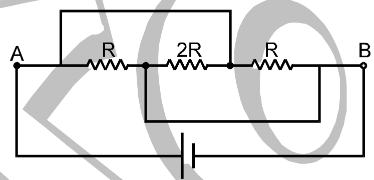


(A) $\frac{r}{2}, \frac{r}{2}$ (B) r, r
(C) $\frac{r}{2}$, r (D) r, $\frac{r}{2}$

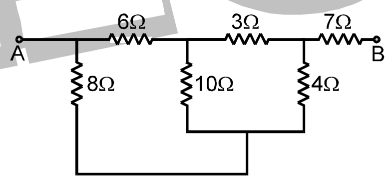
B.7 The equivalent resistance between A and B will be (in Ω)
(A) 2/7 (B) 8
(C) 4/3 (D) 7/3



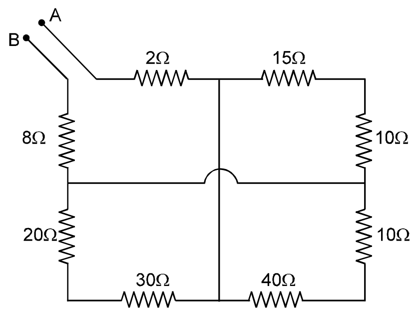
B.8 In the figure shown the current flowing through 2 R is :
(A) from left to right (B) from right to left
(C) no current (D) None of these



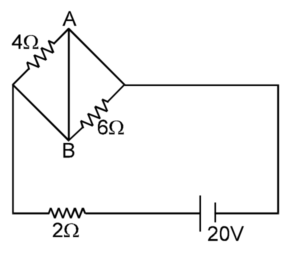
B.9 The equivalent resistance between the points A and B is :
(A) $\frac{36}{7}\ \Omega$ (B) $10\ \Omega$
(C) $\frac{85}{7}\ \Omega$ (D) none of these



B.10 The equivalent resistance between points A and B is :
(A) $32.5\ \Omega$ (B) $22.5\ \Omega$
(C) $2.5\ \Omega$ (D) $45.5\ \Omega$



B.11 In the circuit shown in figure
(A) power supplied by the battery is 200 watt
(B) current flowing in the circuit is 5 A
(C) potential difference across 4 Ω resistance is equal to the potential difference across 6Ω resistance
(D) current in wire AB is zero



B.12 (a) The current density across a cylindrical conductor of radius R varies according to the equation

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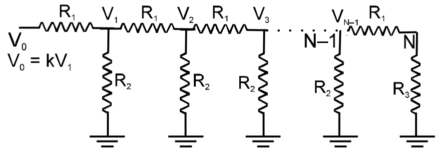
$J = J_0\left(1-\frac{r}{R}\right)$, where r = distance from the axis. Thus the current density is a maximum J_0 at the axis r = 0 and decreases linearly to zero at the surface r = R. Calculate the current in terms of J_0 and the conductor's cross-sectional area $A = \pi R^2$.

(b) Suppose that instead the current density is a maximum J_0 at the surface and decreases linearly to zero at the axis so that $J = J_0\frac{r}{R}$. Calculate the current.

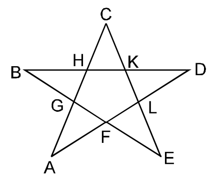
B.13 A network of resistance is constructed with R_1 and R_2 as shown in the figure. The potential at the points 1, 2, 3,........, N are V_1, V_2, V_3,........., V_n respectively each having a potential K time smaller than previous one. Find:



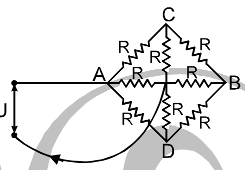
(i) $\frac{R_1}{R_2}$ and $\frac{R_2}{R_3}$ in terms of K.

(ii) Current that passes through the resistance R_2 nearest to the V_0 in terms V_0, K and R_3.

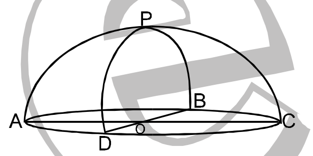
B.14 The figure is made of a uniform wire and represents a regular five pointed star. The resistance of a section EL is 2 ohm. Find the resistance of the star across F and C. (sin 18º $\simeq \frac{1}{3}$)



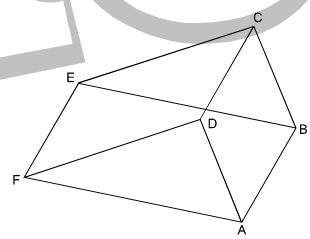
B.15 The resistance of each resistor in the circuit diagram shown in figure is the same and equal to R. The voltage across the terminals is U. Determine the current I in the leads if their resistance can be neglected.



B.16 A hemispherical network of radius a is made by using a conducting wire of resistance per unit length 'r'. Find the equivalent resistance across OP.

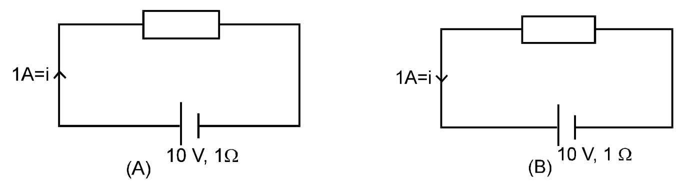


B.17 In the circuit shown in figure, all wires have equal resistance r. The equivalent resistance between A and B is ____________ .



SECTION (C) : POWER, ENERGY, BATTERY, EMF, TERMINAL VOLTAGE & KIRCHOFF'S LAWS

C.1 In following diagram boxes may contain resistor or battery or any other element



then determine in each case
(a) E.m.f. of battery
(b) Battery is acting as a source or load
(c) Potential difference across each battery
(d) Power input to the battery or output by the battery.
(e) The rate at which heat is generaled inside the battery.
(f) The rate at which the chemical energy of the cell is consumed or increased.
(g) Potential difference across box
(h) Power output across box.

C.2 The figure shows the current I in a single-loop circuit with a battery B and resistance R (and wires of negligible resistance).

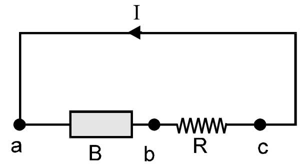
(a) Should the emf arrow at B be drawn leftward or rightward?

At points a, b and c, rank

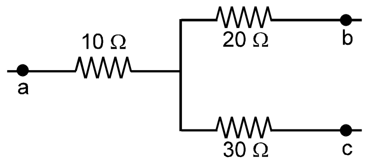
(b) The magnitude of the current,

(c) The electric potential, and

(d) The electric potential energy of the charge carriers (electron), greatest first.



C.3 Figure shows a part of an electric circuit. The potentials at the points a, b and c are 30 V, 12V and 2V respectively. Find the currents through the three resistors.

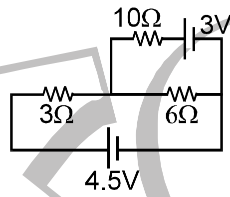


C.4 For driving a current of 3 ampere for 5 minutes in an electrical circuit, 900 joule of work is to be done. Find the emf of the source in the circuit.

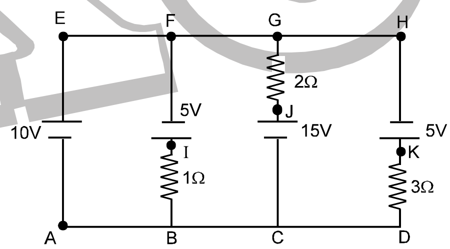
C.5 (a) A car has a fresh storage battery of emf 12 V and internal resistance $5.0 \times 10^{-2}\ \Omega$. If the starter draws a current of 90 A, what is the terminal voltage of the battery when the starter is on ?
(b) After long use, the internal resistance of the storage battery increases to 500 Ω. What maximum current can be drawn from the battery? Assume the emf of the battery to remains unchanged.
(c) If the discharged battery is charged by an external emf source, is the terminal voltage of the battery during charging greater or less than its emf 12 V?

C.6 The potential difference between the terminals of a 6.0 V battery is 7.2 V when it is being charged by a current of 2.0 A. What is the internal resistance of the battery ?

C.7 Find the current through the 10 Ω resistor shown in figure

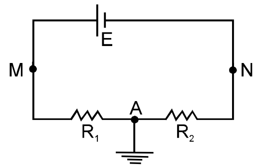


C.8 In following circuit potential of point 'A' is zero then determine
(a) Potential of each point
(b) Potential difference across each resistance
(c) Identify the battery which act as a source
(d) Current in each battery
(e) Which resistance consume maximum power
(f) Which battery consume or increased maximum energy.



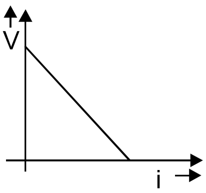
C.9 One kilowatt electric heater is to be used with 220 V D.C. supply.
(a) What is the current in the heater.
(b) What is its resistance.
(c) What is the power dissipated in the heater.
(d) How much heat in calories is produced per second.
(e) How many grams of water at 100º C will be converted per minute into steam at 100ºC with the heater. (latent heat of vaporisation of water = 540 cal/g)]

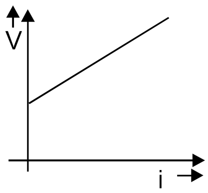
C.10 The efficiency of a cell when connected to a resistance R is 60%. What will be its efficiency if the external resistance is increased to six times.

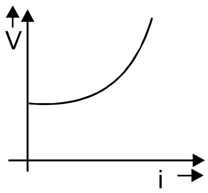


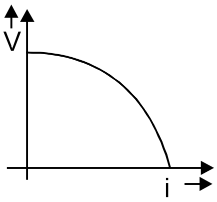
C.11 An electric heating element consumes 500 W when connected to a 100 V line. If the line voltage becomes 150 V, the power consumed will be :
(A) 500 W (B) 750 W (C) 1000 W (D) 1125 W

C.12 If internal resistance of a cell is proportional to current drawn from the cell. Then the best representation of terminal potential difference of a cell with current drawn from cell will be:

(A)


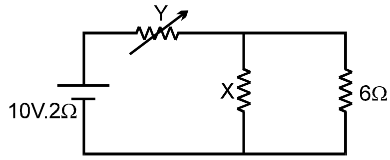
(B)


(C)


(D)


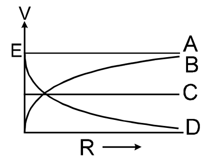
C.13 A resistor of resistance R is connected to a cell of internal resistance 5 Ω. The value of R is varied from 1 Ω to 5 Ω. The power consumed by R:
(A) increases continuously
(B) decreases continuously
(C) first decreases then increases
(D) first increases then decreases.

C.14 In the figure shown the thermal power generated in 'y' is maximum when y = 4 Ω. Then X is:



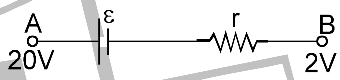
(A) 2 Ω
(B) 3 Ω
(C) 1 Ω
(D) 6 Ω

C.15 A cell of emf E having an internal resistance r is connected to an external resistance R. The potential difference V across the resistance R varies with R as shown in figure by the curve :



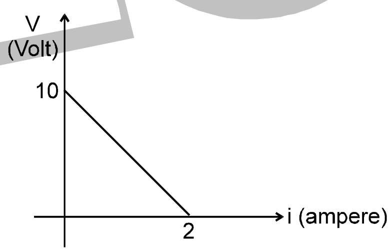
(A) A
(B) B
(C) C
(D) D

C.16 In the figure shown part of circuit :



(A) current will flow from A to B
(B) current may flow from A to B
(C) current will flow from B to A
(D) the direction of current will depend on *r*.

C.17 A battery of emf E and internal resistance r is connected across a resistance R. Resistance R can be adjusted to any value greater than or equal to zero. A graph is plotted between the current passing through the resistance (i) and potential difference (V) across it. Select the correct alternative (s)

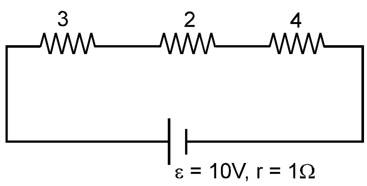


(A) internal resistance of the battery is 5Ω
(B) emf of the battery is 10 V
(C) maximum current which can be taken from the battery is 2 A
(D) V-i graph can never be a straight line as shown in figure.

C.18 Potential difference across the terminals of a non ideal battery is
(A) zero when it is short circuited
(B) less than its emf when current flows from negative terminal to positive terminal inside the battery
(C) zero when no current is drawn from the battery
(D) greater than its emf when current flows from positive terminal to negative inside the battery.

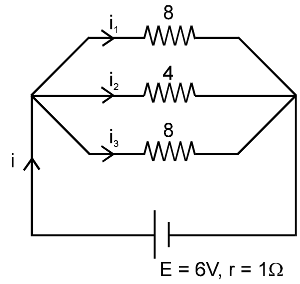
SECTION : (D) EQUIVALENT OF RESISTANCE

D.1 In given circuit determine



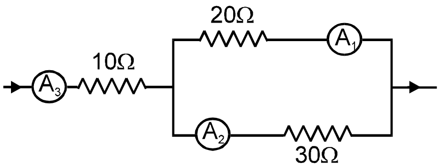
(a) Equivalent resistance (Including internal resistance).
(b) Current in each resistance
(c) Potential difference across each resistance
(d) The rate at which the chemical energy of the cell is consumed
(e) The rate at which heat is generated inside the battery
(f) Electric power output
(g) Potential difference across battery
(h) Which resistance consumes maximum power
(i) Power dissipated in 3 Ω resistance.

D.2 In given circuit determine
(a) Equivalent resistanace (Including internal resistance).
(b) Current i, i_1, i_2 and i_3
(c) Potential difference across battery and each resistance
(d) The rate at which the chemical energy of the cell is consumed
(e) The rate at which heat is generated inside the battery
(f) Electric power output
(g) Which resistance consumes maximum power ?
(h) Power dissipated across 4Ω resistance

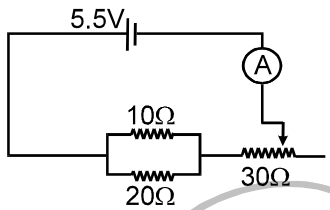


D.3 Three equal resistors connected in series across a source of emf together dissipate 10 watts of power. What would be the power dissipated if the same resistors are connected in parallel across the same source of emf ? [JEE - 72]

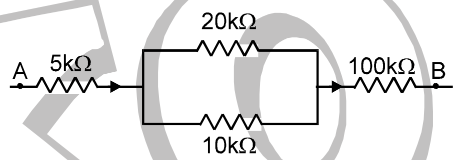
D.4 If the reading of ammeter A_1 in figure is 2.4 A, what will the ammeters A_2 and A_3 read ? Neglect the resistance of the ammeters.



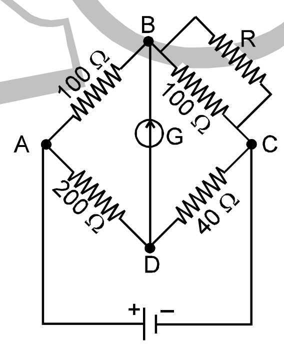
D.5 The resistance of the rheostat shown in figure is 30 Ω. Neglecting the meter resistance, find the minimum and maximum currents through the ammeter as the rheostat is varies.



D.6 Figure shows a part of a circuit. If a current of 12 mA exists in the 5kΩ resistor, find the currents in the other three resistors. What is the potential difference between the points A and B ?

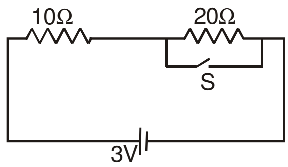


D.7 The given Wheatstone bridge is showing no deflection in the galvanometer joined between the points B and D (Figure). Calculate the value of R.

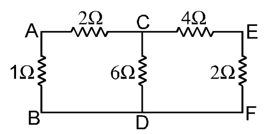


D.8 A wire of resistance 0.1 ohm cm^{-1} bent to form a square ABCD of side 10 cm. A similar wire is connected between the corners B and D to form the diagonal BD. Find the effective resistance of this combination between corners A and C. IF a 2V battery of neglgible internal resistance is connected across A and C calculate the total power dissipated.

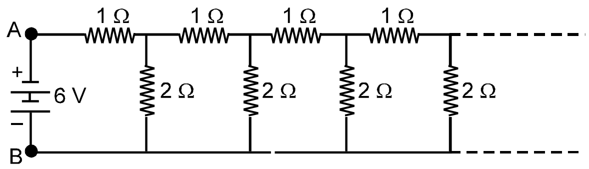
D.9 Consider the circuit shown in figure. Find the current through the 10Ω resistor when the switch S is
(a) open (b) closed.



D.10 Find the equivalent resistance of the circuit given in figure between the following point:
(i) A and B (ii) C and D
(iii) E and F (iv) A and F
(v) A and C

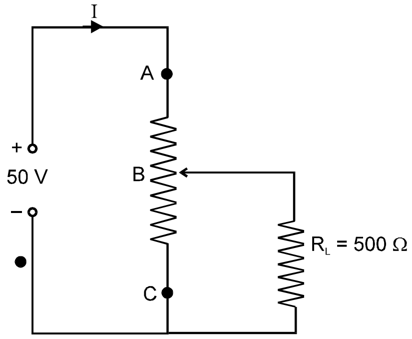


D.11 An infinite ladder network of resistances is constructed with 1 ohm and 2 ohm resistances. The 6 V battery between A and B has negligible internal resistance.



Show that effective resistance between A and B is 2 ohm.
What is the current that passes through 2 Ω resistance nearest to the battery?

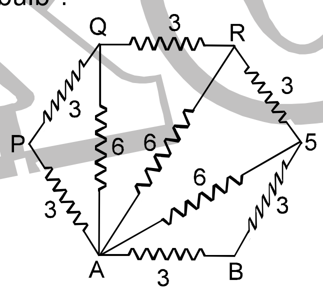
D.12 As shown in figure a variable rheostat of 2 k Ω is used to control the potential difference across 500 ohm load. (i) If the resistance AB is 500 Ω, what is the potential difference across the load ? (ii) If the load is removed, what should be the resistance at BC to get 40 volt between B and C ?



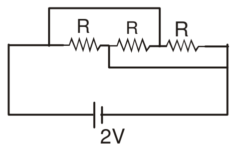
D.13 An electric current of 5 amp. is divided in three branches forming a parallel combination. The length of the wire in the three branches are in the ratio, 2,3 and 4; their diameters are in the ratio 3, 4 and 5. Find the currents in each branch if the wire of the same material.

D.14 Two electric bulbs, each designed to operate with a power of 500 watts in 220 volt line, are in series with a 110 volt line. What will be the power generated by each bulb ?

D.15 All resistance in diagram (fig.) are in ohms. Find the effective resistance between the points A and B.

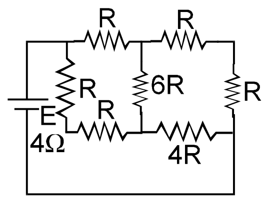


D.16 Three equal resistance each of R ohm are connected as shown in figure. A battery of 2 volts of internal resistance 0.1 ohm is connected across the circuit. Calculate the value of R for which the heat generated in the circuit is maximum.



D.17 A battery of internal resistance 4 ohm is connected to the network of resistance as shown. In the order that the maximum power can be delivered to the network, the value of R in ohm should be :

(A) 4/9 (B) 2
(C) 8/3 (D) 18

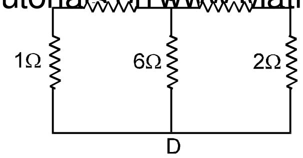


D.18 Two coils connected in series have resistances 600 Ω and 300 Ω and temperature coefficient of resistivity 0.001 k^{-1} and 0.004 k^{-1} respectively at 20°C.

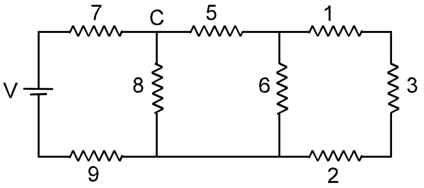
(a) The resistance of the combination at temperature 50°C is
(A) 426 Ω (B) 954 Ω (C) 1806 Ω (D) 214 Ω

(b) The effective temperature coefficient of the combination is
(A) 0.001 degree^{-1} (B) 0.003 degree^{-1}
(C) 0.002 degree^{-1} (D) 0.004 degree^{-1}

D.19 Equivalent resistance between point C and D in the combination of resistance shown is :
(A) 3 Ω (B) 1 Ω
(C) 1.5 Ω (D) 0.5 Ω



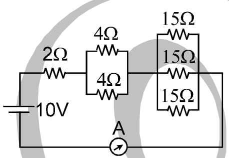
D.20 In the ladder network shown, current through the resistor 3 Ω is 0.25 A. The input voltage 'V' is equal to
(A) 10 V
(B) 20 V
(C) 5 V
(D) 7.5 V



D.21 An electric tea kettle has two electric heating coils. When one of the coils is switched on the tea begins to boil in 6 minutes. When the other is switched on, the boiling begins in 8 minutes.
(a) If both the coils are now arranged in series and switched on, boiling starts in
(A) 24/7 minutes (B) 12 minutes
(C) 14 minutes (D) 4 minutes
(b) If the coils are arranged in parallel and switched on, then boiling starts in
(A) 24/7 minutes (B) 12 minutes
(C) 14 minutes (D) 4 minutes

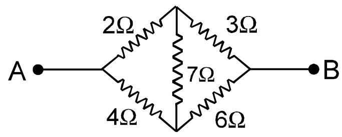
D.22 If 2 bulbs rated 2.5 W – 110 V and 100 W – 110 V are connected in series to a 220 V supply then
(A) 2.5 W bulb will fuse (B) 100 W bulb will fuse
(C) both will fuse (D) both will not fuse

D.23 The current through the circuit shown in figure is 1 A. If each of the 4Ω resistor is replaced by 2Ω resistor, the current in circuit will become nearly :
(A) 1.11 A (B) 1.25
(C) 1.34 A (D) 1.68 A



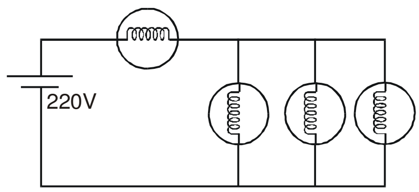
D.24 A 50 W bulb is in series with a room heater and the combination is connected across the mains. To get max. heater output, the 50 W bulb should be replaced by
(A) 25 W (B) 10 W (C) 100 W (D) 200 W

D.25 Five resistance are connected as shown in fig. The effective resistance between the points A and B is -

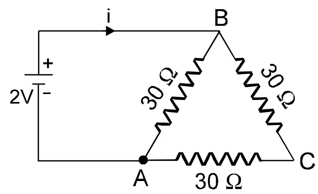


(A) 10/3 Ω (B) 20/3 Ω (C) 15 Ω (D) 6 Ω

D.26 Four identical bulbs each rated 100 watt, 220 volts are connected across a battery as shown. The total electric power consumed by the bulbs is:
(A) 75 watt (B) 400 watt
(C) 300 watt (D) 400/3 watt



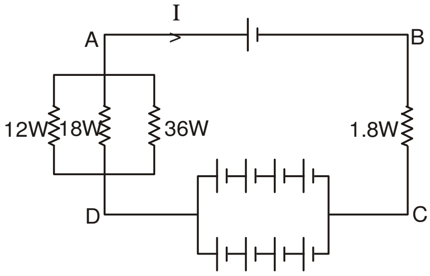
D.27 The current i in the circuit of fig. is -
(A) $\frac{1}{45}$ amp. (B) $\frac{1}{15}$ amp.
(C) $\frac{1}{10}$ amp. (D) $\frac{1}{5}$ amp.



SECTION (E) : COMBINATION OF CELLS

E.1 Six lead-acid type of secondary cells, each of emf 2.0 V and internal resistance 0.015 Ω, are joined in series to provide a supply to a resistance of 8.5 Ω. Determine : (i) the current drawn from the supply and (ii) its terminal voltage.

E.2 In the figure each cell has an emf of 1.5 V and internal resistance of 0.40 Ω. Calculate:
(i) current I
(ii) current in the 36 Ω resistor
(iii) potential difference across A and B.



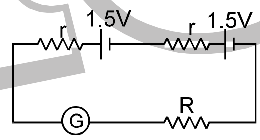
E.3 12 cells each having the same emf are connected in series and are kept in a closed box. Some of the cells are wrongly connected. This battery is connected in series with an ammeter and two cells identical with each other and also identical with the previous cells. The current is 3 A when the external cells aid this battery and is 2 A when the cells oppose the battery. How many cells in the battery are wrongly connected?

E.4 How would you connect (series and parallel) 24 cells, each of internal resistance 1 ohm, so as to get maximum output across the load of 10 ohm.

E.5 Two nonideal batteries are connected in parallel. Consider the following statements
(I) The equivalent emf is smaller than either of the two emfs.
(II) The equivalent internal resistance is smaller than either of the two internal resistance.
(A) Both I and II are correct (B) I is correct but II is wrong
(C) II is correct but I is wrong (D) Each of I and II is wrong.

E.6 A series parallel combination battery consisting of a large number N = 300 of identical cells, each with an internal resistances r = 0.3 Ω, is loaded with an external resistance R = 10 Ω. The number 'n' of parallel groups consisting of an equal number of cells connected in series, at which the external resistance generates the highest thermal power is
(A) 2 (B) 3 (C) 4 (D) 6

E.7 A galvanometer together with an unknown resistance in series is connected across two identical batteries of each 1.5 V. When the batteries are connected in series, the galvanometer records a current 1 A and when the batteries are in parallel, the current s 0.6 A. The internal resistance of the batteries is



E.8 N cells each of e.m.f. E & identical resistance r are grouped into sets of K cells connected in series. The (N/K) sets are connected in parallel to a load of resistance R, then;

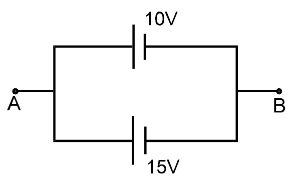
(A) Maximum power is delivered to the load if $K = \sqrt{\frac{NR}{r}}$.

(B) Maximum power is delivered to the load if $K = \sqrt{\frac{r}{NR}}$

(C) Maximum power delivered to the load is $\frac{NE^2}{4r}$

(D) Maximum power delivered to the load is $\frac{E^2}{4Nr}$

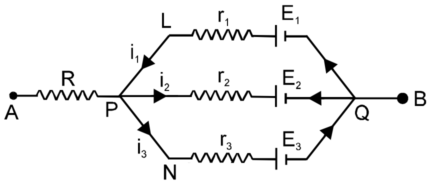
E.9 Two cells of e.m.f. 10 V & 15 V are connected in parallel to each other between points A & B. The cell of e.m.f. 10 V is ideal but the cell of e.m.f. 15 V has internal resistance 1 Ω. The equivalent e.m.f. between A and B is:
(A) 12.5 V (B) not defined
(C) 15 V (D) 10 V



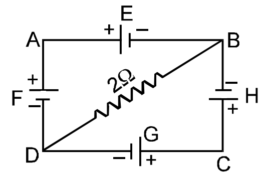
E.10 A battery is made by joining m rows of identical cells in parallel. Each row consists of n cells joined in series.

This battery sends a maximum current I in a given external resistor. Now the cells are so arranged that instead of m rows, n rows are joined in parallel and each row consists of m cells joined in series. Find the current through the same external resistor

E.11 In the circuit shown in fig. $E_1 = 3$ volt, $E_2 = 2$ volt, $E_3 = 1$ volt and $R = r_1 = r_2 = r_3 = 1$ ohm.
(i) Find potential difference between the points A and B and the currents through each branch.
(ii) If r_2 is short circuited and the point A is connected to point B, find the currents through E_1, E_2, E_3 and the resistor R.
[JEE - 81]



E.12 In the circuit shown in fig. E, F, G and H are cells of emf 2, 1,3 and 1 volts and their internal resistances are 2, 1, 3 and 1 ohm respectively. Calculate.
[JEE - 81]
(i) The potential difference between B and D and
(ii) The potential difference across the terminals of each of the cells G and H.



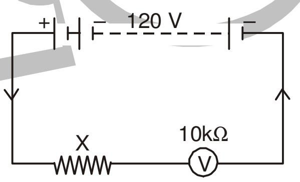
(A) $\frac{2}{3}\Omega$ (B) 1 Ω (C) $\frac{4}{3}\Omega$ (D) $\frac{1}{3}\Omega$

SECTION (F) INSTRUMENTS

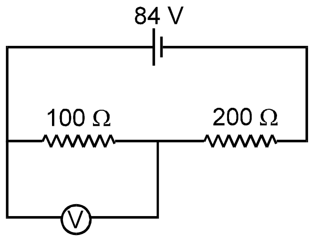
F.1 A galvanometer having 30 divisions has current sensitivity of 20 μA/div. It has a resistance of 25 ohm. How will you convert it to an ammeter measuring upto 1 ampere ? How will you now convert this ammeter into a voltmeter reading upto 1 volt ?

F.2 A galvanometer has a resistance of 30 ohm and a current of 2 mA is needed to give a full scale deflection. What is the resistance needed and how is it to be connected to convert the galvanometer.
(a) Into an ammeter of 0.3 ampere range
(b) Into a voltmeter of 0.2 volt range ?

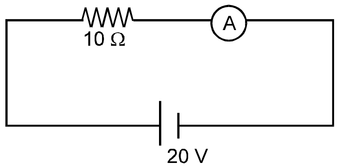
F.3 A D.C. supply of 120 volt is connected to a large registance X. A volt meter of resistance 10 kΩ. Placed in series in the circuit reads 4 volts. What is the value of X? What do you think is the purpose in using a voltmeter, instead of an ammeter, to determine the large resistance X?



F.4 A voltmeter of resistance 400Ω is used to measures the potential difference across the 100Ω resistor in the circuit shown in the figure. (a) What will be the reading of the voltmeter ? (b) What was the potential difference across 100 Ω before the voltmeter was connected ?

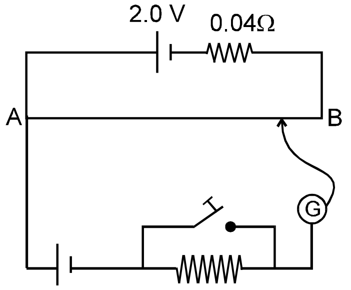


F.5 The ammeter shown in figure consists of a 480 Ω coil connected in parallel to a 20 Ω shunt. Find the reading of the ammeter.



F.6 Figure shows a potentiometer with a cell of emf 2.0 V and internal resistance 0.04 Ω maintaining a potential drop across the resistor wire AB. A standard cell which maintains a constant emf of 1.02 V (for very moderate currents up to a few ampere) gives a balance point of 67.3 cm length of the wire. To ensure very low currents drawn from the standard cell, a very high resistance of 600 kΩ is put in series with it which is shorted close to the balance point. The standard cell is then replaced by a cell of unknown emf E and the balance point found similarly turns out to be at 82.3 cm length of the wire.

(a) What is the value of E ?



(b) What purpose does the high resistance of 600 kΩ have ?

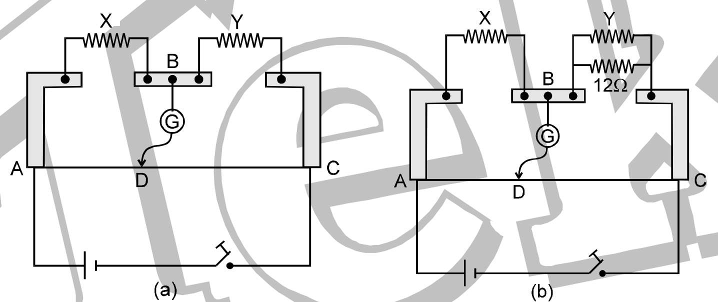
(c) Is the balance point affected by this high resistance?

(d) Is the balance point affected by the internal resistance of the driver cell?

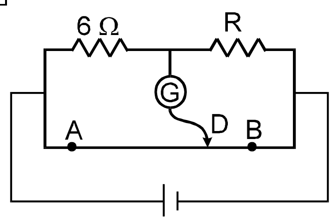
(e) Would the method work in the above situation if the driver cell of the potentiometer had an emf of 1.0 V instead of 2.0 V?

(f) Would the circuit work well for determining externally small emf, say, of the order of few mV (such typical emf of thermocouple)?

F.7 Figure shows a metre bridge (which is nothing but a practical Wheatstone Bridge) consisting of two resistors X and Y together in parallel with a metre long constantan wire of uniform cross-section. With the help of a movable contact D, one can change the ratio of the resistances of the two segments of the wire until a sensitive galvanometer G connected across B and D shows no deflection. The null point is found to be at a distance of 33.7 cm from the end A. The resistor Y is shunted by a resistance of 12.0 Ω and the nul point is found to shift by a distance of 18.2 cm. Determine the resistance of X and Y.



F.8 The meter-bridge wire AB shown in figure is 50 cm long. When AD = 30 cm, no deflection occurs in the galvanometer. Find R.



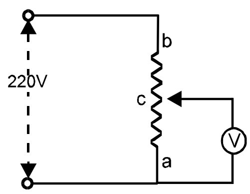
F.8 A battery of emf 1.4 V and internal resistance 2 Ω is connected to a resistor of 100 Ω through an ammeter. The resistance of the ammeter is 4/3 Ω. A voltmeter has also been connected to find the potential difference across the resistor.

(i) Draw the circuit diagram.

(ii) The ammeter reads 0.02 A. What is the resistance of the voltmeter.

(iii) The voltmeter read 1.10 V, what is the zero error in the voltmeter.

F.9 A potential difference of 220 volts is maintained across a 12000 Ω rheostat as shown in fig. The voltmeter V has a resistance of 6000 Ω and point C is at one fourth of the distance from a to b. What is the reading of voltmeter ? [JEE - 77]



F.10 The reading of voltmeter is

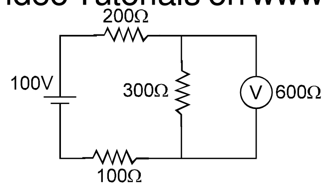
Teko Classes, Maths : Suhag R. Kariya (S. R. K. Sir), Bhopal Phone : 0 903 903 7779, 0 98930 58881.

(A) 50V

(B) 60 V

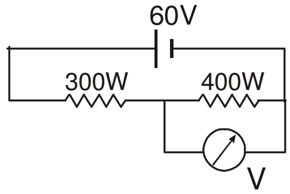
(C) 40V

(D) none



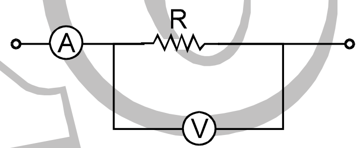
F.11 When a galvanometer is shunted with a 4Ω resistance, the deflection is reduced to one - fifth. If the galvanometer is further shunted with a 2Ω wire, the further reduction (find the ratio of decrease in current to the previous current) in the deflection will be (the main current remains the same).
(A) (8/13) of the deflection when shunted with 4Ω only
(B) (5/13) of the deflection when shunted with 4Ω only
(C) (3/4) of the deflection when shunted with 4Ω only
(D) (3/13) of the deflection when shunted with 4Ω only

F.12 In the circuit shown, reading of the voltmeter connected across 400 Ω resistance is 30 V. If it is connected across 300 Ω resistance then reading will be
(A) 45 V (B) 32.5 V
(C) 22.5 V (D) 18 V

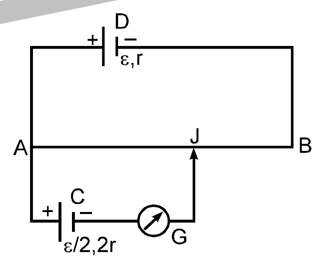


F.13 Select the correct alternative(s):
A micrometer has a resistance of 100 Ω and a full scale range of 50 μA. It can be used as a voltmeter or as a higher range ammeter provided a resistance is added to it. Pick the correct range and resistance combination(s).
(A) 50 V range with 10 K Ω resistance in series
(B) 10 V range with 200 K Ω resistance in series
(C) 5 mA range with 1 Ω resistance in parallel
(D) 10 mA range with 1 Ω resistance in parallel.

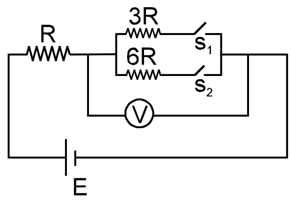
F.14 In the circuit shown the readings of ammeter and voltmeter are 4A and 20V respectively. The meters are non-ideal, then R is
(A) 5 Ω (B) less than 5Ω
(C) greater than 5Ω (D) between 4Ω and 5Ω.



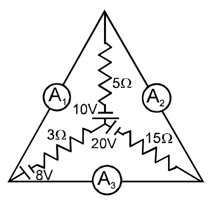
F.15 In the fig. the potentiometer wire AB of length L & resistance 9 r is joined to the cell D of e.m.f. ε & internal resistance r. The cell C's e.m.f. is ε/2 and its internal resistance is 2 r.
The galvanometer G will show no deflection when the length AJ is:
(A) 4L/9 (B) 5L/9
(C) 7L/18 (D) 11L/18



F.16 In the circuit shown in figure reading of voltmeter is V_1 when only S_1 is closed, reading of voltmeter is V_2 when only S_2 is closed and reading of voltmeter is V_3 when both S_1 and S_2 are closed. Then
(A) $V_3 > V_2 > V_1$ (B) $V_2 > V_1 > V_3$
(C) $V_3 > V_1 > V_2$ (D) $V_1 > V_2 > V_3$



F.17 In the given circuit the ammeter A_1 and A_2 are ideal and the ammeter A_3 has a resistance of 1.9×10^{-3} Ω. Find the readings of all three meters.

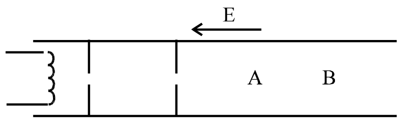


F.18 In a potentiometer circuit, two wires of same material of resistivity ρ, one of required radius of

cross-section 'a' and other of radius of cross-section '2 a' are joined in series. They are of length ℓ and 2ℓ respectively. This combination acts as the potentiometer wire of length 3ℓ. The emf of the cell in the primary circuit is ε and internal resistance is $\frac{\rho\ell}{2\pi a^2}$. This cell is connected to the potentiometer wire by a conducting wire of negligible resistance with positive terminal of the cell connected to one end (call it A) of longer wire. The negative terminal of the cell is connected to one and of the smaller wire. The remaining ends of the two wires are joined togethor. Find:
(i) The maximum voltage which can be balanced on the potentiometer wire.
(ii) The balancing length, measured from point A, obtained in measurement of emf of cell of emf $\frac{\varepsilon}{2}$.
(iii) If positive terminal of cell of emf $\frac{\varepsilon}{2}$ and internal resistance $\frac{\rho\ell}{2\pi a^2}$ is connected to point A and other terminal is joined to the junction of the two wires, then find the current through this cell.

ONE OR MORE THAN ONE CORRECT

1. Electrons are emitted by a hot filament and are accelerated by an electric field as shown in fig. The two stops at the left ensure that the electron beam has a uniform cross-section.



(A) The speed of the electron is more at B than at A.
(B) The electric current is from left to right
(C) The magnitude of the current is larger at B than at A.
(D) The current density is more at B than at A.

2. A current passes through a wire of nonuniform cross-section. Which of the following quantities are independent of the cross-section?
(A) the charge crossing in a given time interval (B) drift speed
(C) current density (D) free-electron density.

3. The conductivity current density in a wire is 10 A/cm^2 and the electric field in the wire is 5 V/cm. If ρ = resistivity of material, σ = of the material then (in S.I. units):
(A) $\rho = 5 \times 10^{-3}$ (B) $\rho = 200$ (C) $\sigma = 5 \times 10^{-3}$ (D) $\sigma = 200$

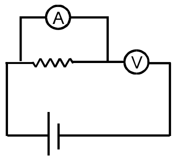
4. A bulb is connected to a battery of emf 10 V so that the resulting current is 10 mA. When the bulb is connected to 220 V mains, the current is 50 mA. Choose the correct alternative (s)
(A) In the first case, the resistance of the bulb is 1kΩ and in second case, it is 4.4 kΩ.
(B) It is not possible since ohm's law is not followed
(C) the increase in resistance is due to heating of the filament of the bulb when it is connected to 220 V mains
(D) None of these

5. Choose the correct alternatives
(A) It is easier to start a car engine on a warm day than on a chilly cold day because the internal resistance of battery decreases with rise in temperature
(B) It is more economical to transmit electric power at high voltage and low current rather than at low voltage and high current because heat loss is proportional to square of current.
(C) The heating coil of an electric iron is enclosed in mica sheets because mica is a bad conductor of heat and good conductor of electricity
(D) The heating coil of an electric iron is enclosed in mica sheets because mica is a good conductor of heat and bad conductor of electricity.

6. In a potentiometer wire experiment the emf of a battery in the primary circuit is 20volt and its internal resistance is 5Ω. There is a resistance box (in series with the battery and the potentiometer wire) whose resistance can be varied from 120Ω to 170Ω. Resistance of the potentiometer wire is 75Ω. The following potential differences can be measured using this potentiometer
(A) 5V (B) 6V (C) 7V (D) 8V

7. By mistake, a voltmeter is placed in series and an ammeter is parallel with a resistance in an electric circuit,

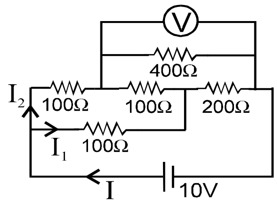
with a cell in series.



(A) If the devices are ideal, ammeter will read zero current and voltmeter will read the emf of cell
B) If the devices are ideal, a large current will flow through the ammeter and it will be damaged
(C) The main current in the circuit will be very low and practically all current will flow through the ammeter, if resistance of ammeter is much smaller than the resistance in parallel.
(D) The devices may get damaged if emf of the cell is very high and the meters are nonideal.

EXERCISE-2

1. An electrical circuit is shown in the figure. Calculate the potential difference across the resistance of 400 ohm, as will be measured by the voltmeter V of resistance 400 ohm, either by applying Kirchhoff's rules or otherwise. **[JEE - 96, 5]**

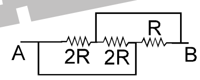


2. A wire of resistance R is connected in series with the galvanometer to measure a the potential difference of 5V. If 5×10^{-3} A current gives a full scale deflection in the galvanometer of 1Ω resistance then the value of R is : **[REE - 96,1]**
(A) 888 Ω (B) 999 Ω (C) 898 Ω (D) 989 Ω

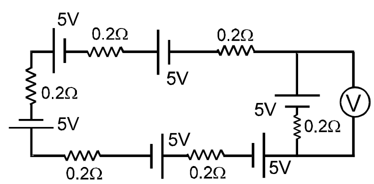
3. 5×10^{-3} A current gives a full scale deflection in a galvanometer of 1Ω resistance. To measure 5 V with this galvanometer, a resistance of ______ is connected in ______ of the galvanometer. **[REE - 96, 1]**

4. 1 m long metallic wire is broken into two unequal parts P and Q. P of the wire is uniformly extended into another wire R. Length of R is twice the length of P and the resistance of R is equal to that of Q. Find the ratio of the resistance of P and R and also the ratio of lengths of P and Q. **[REE - 96]**

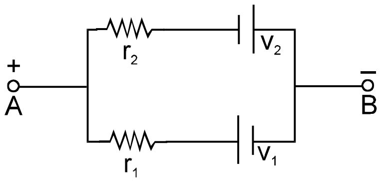
5. (i) The equivalent resistance between points A and B of the circuit shown in figure is :
(A) 3R
(B) 5R
(C) 4R
(D) R/2 **[JEE - 97,2]**



(ii) The reading of Ideal voltmeter as shown in figure is.
(A) 0
(B) 5 V
(C) 2.5 V
(D) None **[JEE - 97,2]**

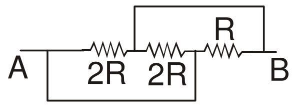


6. (i) A steady current flows in a metallic conduction of nonuniform cross-section. The quantity/quantities constant along the length of the conductor is/are :
(A) current, electric field and drift speed (B) drift speed only
(C) current and drift speed
(D) current only
(ii) The dimensions of electrical conductivity are ______.
(iii) Find the emf (v) and internal resistance (r) of a single battery which is equivalent to a parallel combination of two batteries of EMF's v_1 and v_2 and internal resistances r_1 and r_2 respectively, with polarities as shown in the fig.



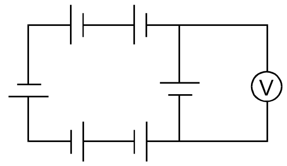
[JEE - 97, 2 + 1 + 5]

7. (i) The equivalent resistance between points A and B of the circuit given below is _______ Ω.



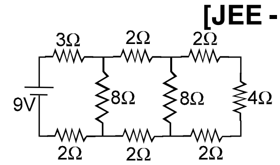
(ii) In the circuit shown, each battery is 5 V and has an internal resistance of 0.2 Ω. The reading in the ideal voltmeter v is ______ V.

[JEE - 97, 2, 2]

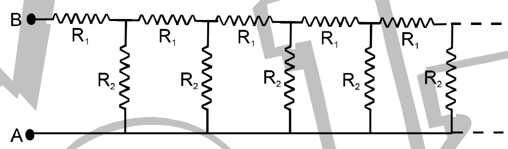


8. In the circuit shown in the figure, the current through: **[JEE - 98,2]**

(A) The 3 Ω resistor is 0.50 A
(B) The 3 Ω resistor is 0.25 A
(C) The 4 Ω resistor is 0.50 A
(D) The 4 Ω resistor is 0.25 A

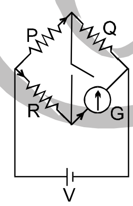


9. Consider an infinite ladder network shown in fig. A voltage is applied between points A and B. If the voltage is halved after each section, find the ratio R_1/R_2. Suggest a method to terminate it after a few sections without introducing much error with attention. **[REE - 98]**



10. In the circuit shown, $P \neq R$, the reading of the galvanometer is same with switch S open or closed. Then **[JEE - 99,2]**

(A) $I_R = I_G$ (B) $I_P = I_G$ (C) $I_Q = I_G$ (D) $I_Q = I_R$



11. When a potential difference is applied across, the current passing through
(A) An insulator at 0 K is zero
(B) A semiconductor at 0 K is zero
(C) A metal at 0 K is finite
(D) A p-n diode at 300 K is finite, if it is reverse biased **[JEE- 99, 2]**

12. A nichrome wire of uniform cross-sectional area is bent to form a rectangular loop ABCD. Another nichrome wire of the same cross-section is connected to form the diagonal AC. Find out the ratio of the resistances across BD and AC if AB = 0.4 m and BC = 0.3 m. **[REE - 2000]**

13. An electric kettle has coils A and B, when coil A is switched on, the water boils in 10 minute, and when coil B is switched on the water boils in 20 minute. Calculate the time taken by water, to boil if the coils connected in **[REE - 2000]**
(a) Series and
(b) Parallel all switched on.

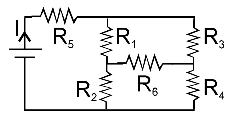
14. A quantity X is given by $\varepsilon_0 L \dfrac{\Delta V}{\Delta t}$ where ε_0 is the permittivity of free space, L is a length, ΔV is a potential difference and Δt is a time interval. The dimensional formula for X is the same as that of:
(A) Resistance (B) Charge (C) Voltage (D) Current **[JEE - 01,3]**

15. A portion of length L is cut out of a conical solid wire. The two ends of this portion have circular cross-section of radii r_1 and r_2 ($r_2 > r_1$). It is connected lengthwise to a circuit and a current I is flowing in it. The resistivity of the material of the wire is ρ. Calculate the resistance of the considered portion and the voltage developed across it. **[REE - 01, 7]**

16. A wire of length L and 3 identical cells of negligible internal resistances are connected in series. Due to the current the temperature of the wire is raised by ΔT in a time t. A number N of similar cells is now connected in series with a wire of the same material and cross-section but of length 2 L. The temperature of the wire is raised by the same amount ΔT in the same time t. The value of N is: **[JEE - 01,3]**

(A) 4 (B) 6 (C) 8 (D) 9

17. In the given circuit, it is observed that the current I is independent of the value of the resistance R_6. Then the resistance values must satisfy:



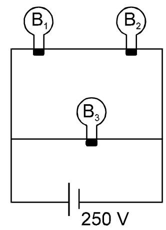
(A) $R_1 R_2 R_5 = R_3 R_4 R_6$

(B) $\frac{1}{R_5} + \frac{1}{R_6} = \frac{1}{R_1 + R_2} + \frac{1}{R_3 + R_4}$

(C) $R_1 R_4 = R_2 R_3$

(D) $R_1 R_3 = R_2 R_4 = R_5 R_6$ **[JEE - 01,3]**

18. A 100 W bulb B_1 and two 60 W bulbs B_2 and B_3 are connected to a 250 V source as shown in the figure. Now W_1, W_2 and W_3 are the output powers of the bulbs B_1, B_2 and B_3 respectively. Then:



(A) $W_1 > W_2 = W_3$

(B) $W_1 > W_2 > W_3$

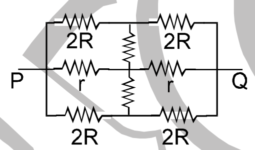
(C) $W_1 < W_2 = W_3$

(D) $W_1 < W_2 < W_3$ **[JEE - 02,3]**

19. The potential difference applied to an X-ray tube is 5 kV and the current through it is 3.2 mA. Then the number of electrons striking the target per second is **[JEE - 02,3]**

(A) 2×10^{16} (B) 5×10^{16} (C) 1×10^{17} (D) 4×10^{15}

20. The effective resistance between points P and Q of the electrical circuit shown in the figure is:

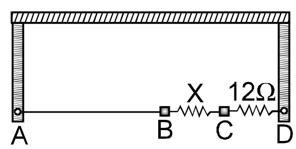


(A) $\frac{2Rr}{R+r}$

(B) $\frac{2R(R+r)}{3R+r}$

(C) $2r + 4R$ (D) $\frac{5R}{2} + 2r$ **[JEE - 02,3]**

21. A thin uniform wire AB of length 1 m, an unknown resistance X and a resistance of 12 Ω are connected by thick conducting strips, as shown in the figure. A battery and a galvanometer (with a sliding jockey connected to it) are also available. Connections are to be made to measure the unknown resistance X using the principle of Wheatstone bridge. Answer the following question.

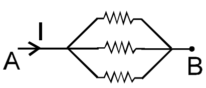


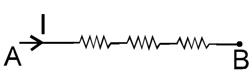
(a) Are there positive and negative terminals on the galvanometer?

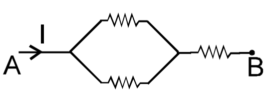
(b) Copy the figure in your answer book and show the battery and the galvanometer (with jockey) connected at appropriate points.

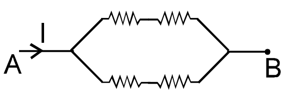
(c) After appropriate connections are made, it is found that no deflection takes place in the galvanometer when the sliding jockey touches the wire at a distance of 60 cm from A. Obtain the value of the resistance X. **[JEE - 02]**

22. Arrange the order of power dissipated in the given circuits, if the same current is passing through the system. The resistance of each resistor is ' r '. **[JEE - 03,3]**

(i) 

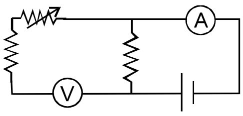
(ii) 

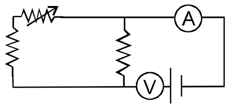
(iii) 

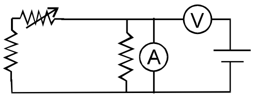
(iv) 

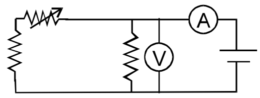
(A) $P_2 > P_3 > P_4 > P_1$ (B) $P_1 > P_4 > P_3 > P_2$ (C) $P_1 > P_2 > P_3 > P_4$ (D) $P_4 > P_3 > P_2 > P_1$

23. Which of the following circuit is correct for verification of ohm's law.

(A) 

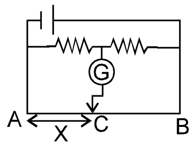
(B) 

(C) 

(D) 

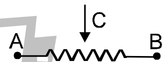
[JEE - 03,3]

24. In the given circuit, no current is passing through the galvanometer. If the cross-sectional diameter of the wire AB is doubled, then for null point of galvanometer, the value of AC would be:



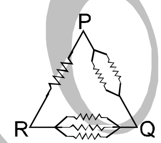
(A) 2 X
(B) X
(C) $\frac{X}{2}$
(D) None **[JEE - 03,3]**

25. Connect a battery to the terminals and complete the circuit diagram so that it works as a potential divider meter. Indicate the output terminals also.



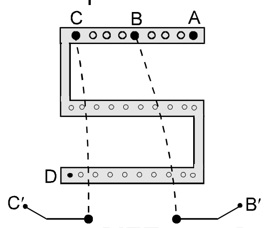
[JEE - 03,2]

26. In the given circuit all resistors are of equal value then equivalent resistance will be maximum between the points.



(A) PR
(B) PQ
(C) RQ
(D) same for all **[JEE - 04, 4]**

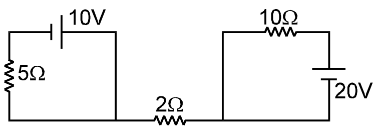
27. Between which points should the terminals of unknown resistance be connected in a post office box arrangement to get its value



(A) A and B
(B) B and C
(C) C and D
(D) A and D **[JEE - 04, 4]**

28. Draw the circuit diagram for the verification of ohm's low using resistance R = 100Ω. Using galvanometers, and resistances of 10^{-3} and 10^{+6} Ω, clearly indicating the position of ammeter & voltmeter. **[JEE - 04, 4/60]**

29. In the figure shown the current through 2Ω resistor is

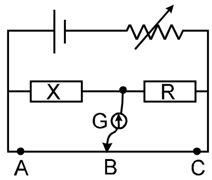


(A) 2A
(B) 0 A
(C) 4 A
(D) 6A **[JEE (Scr.) - 05, 3/84]**

30. A galvanometer has resistance 100Ω and it requires current 100μA for full scale deflection. A resistor 0.1Ω is connected in parallel to make it an ammeter. The smallest current required in the circuit to produce the full scale deflection is

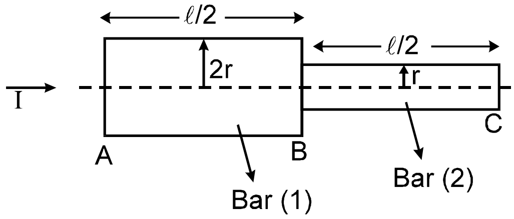
(A) 1000.1 mA (B) 1.1 mA (C) 10.1 mA (D) 100.1 mA

31. For the three values of resistances R namely R_1, R_2 and R_3 the balanced positions of jockey are at A, B and C respectively. Which position will show most accurate result for calculation of X. Give reason. B is near the mid point of the wire.



[JEE (Mains) - 05, 2/60]

32. Two bars of radius 'r' and '2r' are kept in contact as shown. An electric current I is passed through the bars. Which one of the following is correct?



(A) Heat produced in bar (1) is 2 times the heat produced in bar (2)
(B) Electric field in both halves is equal
(C) Current density across AB is double that of across BC.
(D) Potential difference across AB is 4 times that of across BC. **[IIT - 06 ; 3/184]**

ANSWER

Exercise - 1

SECTION (A) :

A.1 6.25×10^{18} electrons/second.
A.2 1.1×10^{-3} ms^{-1} or 1.1 mm s^{-1}
A.3 300 C, 30 A
A.4 0.074 mm/s
A.5 3.2×10^4 s $\approx$ 8.9 hours.
A.6 C **A.7** C **A.8** B

SECTION (B) :

B.1 3.6 A **B.2** 0.0065 Ω **B.3** 249ºC
B.4 0.6 km. **B.5** A **B.6** A
B.7 D **B.8** B **B.9** C
B.10 B **B.11** AC
B.12 (a) $J_0 A/3$ (b) $2 J_0 A/3$
B.13 (i) $\frac{(K-1)^2}{K}$; $\frac{K}{(K-1)}$ (ii) $\left[\frac{(K-1)}{K^2}\right] \frac{V_0}{R_3}$
B.14 2 Ω **B.15** $I = \frac{15}{7}\frac{U}{R}$
B.16 $\frac{(2+\pi)ar}{8}$ **B.17** $\frac{3r}{5}$

SECTION (C) :

C.1 (a) E = 10 V each
(b) (A) act as a source and (B) act as load
(c) $V_A = 9V$, $V_B = 11$ V
(d) $P_A = 9$ W, $P_B = 11$ W
(e) Heat rate = 1 W each
(f) 10 watt.
(g) 9V, 11V (h) 9W, 11 W

C.2 (a) rightward (b) all tie (c) b, then a and c tie (d) a, then c and b tie.
C.3 1 A, 0.4 A , 0.6 A
C.4 1 volt
C.5 (a) 7.5 V, (b) 24 mA (c) greater than 12 V.
C.6 0.6 Ω
C.7 zero
C.8 (a) $V_A = V_B = V_C = V_D = 0$ V, $V_E = 10$ V $= V_F = V_G = V_H$ $V_I = 15$ V, $V_J = 15$ V, $V_K = 15$ V
(b) $V_1 = 15$ V, $V_2 = 5V$, $V_3 = 15$ V
(c) each act as a source
(d) 17.5 A (↑), 15A(↓) 2.5 A (↑), 5A (↓) from left to right in given circuit.
(e) 1 Ω resistance
(f) left most battery.
C.9 (a) 4.55 A (b) 48.4 Ω
(c) 1000 W (d) 240 cal s^{-1}
(e) 80/3 gm

C.10 90% **C.11** D **C.12** D
C.13 A **C.14** B **C.15** B
C.16 B **C.17** ABC **C.18** ABD

SECTION : (D)

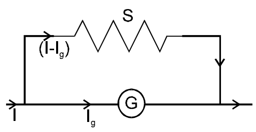
D.1 (a) R = 10 Ω (b) 1A in each (c) $V_3 = 3V$, $V_2 = 2V$, $V_4 = 4V$ (d) 10 W (e) 1 W (f) 9W
(g) 9V (h) 4 Ω resistance (i) 3 W.
D.2 (a) R = 3 (b) i = 2A, $i_1 = \frac{1}{2}$ A $i_2 = 1$A $i_3 = \frac{1}{2}$ A
(c) V = 4V in each (d) 12 W (e) 4W (f) 8 W
(g) 4Ω (h) 4W
D.3 90 watt.
D.4 1.6 A, 4.0 A.
D.5 0.15 A, 0.83 A
D.6 4 mA in 20 kΩ resistor, 8 mA in 10 kΩ resistor and 12 mA in 100 kΩ resistor, 1340 V
D.7 25 Ω
D.8 4 watt.
D.9 (a) 0.1 A (b) 0.3 A
D.10 (i) $R_{AB} = 5/6$ Ω (ii) $R_{CD} = 1.5$ Ω
(iii) $R_{EF} = 1.5$ Ω (iv) $R_{AF} = 5/6$ Ω
(v) $R_{AC} = 4/3$ Ω
D.11 1.5 A
D.12 (i) 21.43 V, (ii) 1600 Ω
D.13 $i_1 = 1.40$ amp. , $i_2 = 1.66$ amp. , $i_3 = 1.94$ amp.
D.14 31.25 watt.
D.15 $R_f = 2Ω$.
D.16 0.3 Ω
D.17 B **D.18** (a) B (b) C
D.19 C **D.20** B **D.21** (a) C (b) A
D.22 A **D.23** A **D.24** D
D.25 A **D.26** A

SECTION (E) :

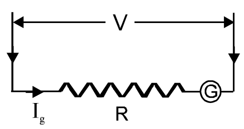
E.1 1.4 A, 11.9 V
E.2 (i) 0.5 A (ii) 0.0833 A (iii) 1.7 V
E.3 One
E.4 2 rows of cells, each containing 12 cells in series must be connected in parallel
E.5 C **E.6** B **E.7** D **E.8** C
E.9 D **E.10** $I \frac{2mn}{m^2+n^2}$
E.11 (i) 2 volt (ii) 2 amp.
E.12 (i) $\frac{2}{13}$ volt. (ii) 1.46V

SECTION (F)

F.1 R = 0.015 Ω in parallel ; R = 0.985 Ω in series.

F.2 

(a) S = 0.2013 Ω (b) R = 70 Ω



F.3 290 kΩ , Due to very small value of current, Ammeter has not been used. The ammeter reading would have been very small. Note that this is unusual use of a voltmeter. It is meant only for the measurement of high registance.

F.4 (a) 24 V, (b) 28 V

F.5 0.125 A.

F.6 (a) 1.25 V

(b) The high resistance to keep the initial current low when null point is being located. This saves the standard cell from damage.

(c) This high resistance does not affect the balance point because then there is no flow of current through the standard cell branch.

(d) The internal resistance of driver cell affects the current through the potentiometer wire. Since potential gradient is changed, therefore, the balance point must be affected.

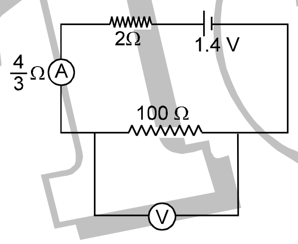
(e) No. It is necessary that the emf of the driver cell is more than the emf of the cells.

(f) This circuit will not work well for meaurement of small emf. (mV) because the balanced point will be very near to end A, and percentage error in EMF measured due to length measument would be very large $E = \frac{V}{100}\ell \Rightarrow \frac{dE}{E} = \frac{d\ell}{\ell}$ will be large if ℓ is very small.

F.7 6.86 Ω , 13.5 Ω

F.8 4 Ω.

F.8 (i)



(ii) 200 Ω (iii) 0.23 V

F.9 40 volt. **F.10** C

F.11 A **F.12** C

F.13 BC ***F.14*** *C*

F.15 B **F.16** B

F.17 $I_1 = 82/27$, $I_2 = 34/27$, $I_3 = 0$

F.18 (i) $v_0 = \frac{3\varepsilon}{4}$ (ii) $\frac{5\ell}{2}$

(iii) $\frac{\varepsilon}{7R}$, where $R = \frac{\rho\ell}{A}$ and $A = 2\pi a^2$

ONE OR MORE THAN ONE CORRECT

1. CD **2.** AD **3.** AD

4. AC **5.** ABD **6.** ABC

7. ACD

EXERCISE # 2

1. $\frac{20}{3}$V **2.** B **3.** 999Ω, Series

4. $\frac{1}{4}, \frac{1}{4}$ **5.** (i) D (ii) A

6. (i) D **(ii)** $M^{-1}L^{-3}T^{3}A^{2}$ **(iii)** $\frac{\left(\frac{v_1}{r_1} - \frac{v_2}{r_2}\right)}{\left(\frac{r_1 r_2}{r_1 + r_2}\right)}$

7. (i) $\frac{R}{2}$ **(ii)** 0 **8.** D ***9.*** $\frac{1}{2}$

10. A **11.** A , B , C ***12.*** $\frac{R_{BD}}{R_{AC}} = \frac{59}{35}$

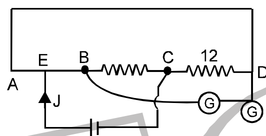
13. *(a) t_s = 30 min. (b) $t_p = \frac{20}{3}$ min.* ***14.*** *D*

15. $R = \frac{\rho L}{\pi r_1 r_2}$; V = IR **16.** B

17. C **18.** D **19.** A **20.** A

21. **(a)** No

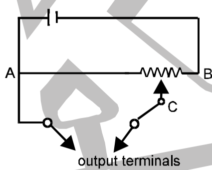
(b)



(c) 8 Ω

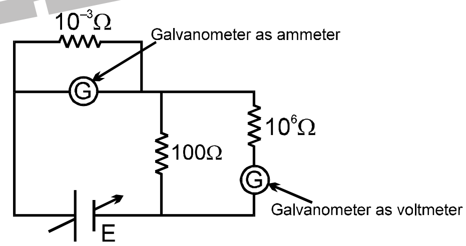
22. A **23.** D **24.** B

25.



26. A

27. D **28.**



29. B **30.** D

31. Position B, Reason → $x = R\frac{\ell}{100-\ell}$

$\Rightarrow \frac{dx}{x} = \frac{d\ell}{\ell} - \frac{d(100-\ell)}{100-\ell}$

$\Rightarrow \frac{dx}{x} = \frac{d\ell}{\ell} + \frac{d\ell}{100-\ell}$

$\frac{dx}{x} = \frac{100\,d\ell}{\ell(100-\ell)}$

% error in $x = \frac{dx}{x}$ will be minimum when $\ell\,(100-\ell)$ will be maximum i.e. ℓ = 50 cm.

32. D