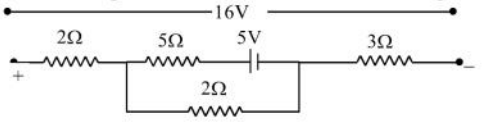
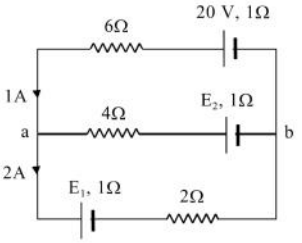
Electric Current DPP
SUBJECTIVE

LEVEL - I

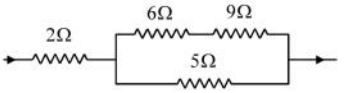
1. Calculate the current through the 5V cell of the circuit shown in figure.



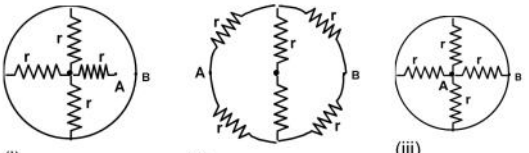
2. Find the emf's E_1 and E_2 in the given network. Find also the potetial difference between points 'a' & 'b'.



3. In the circuit shown; the 5 Ω resistor develops 45 J/s energy due to current flowing through it. Calculate
(a) heat developed / sec. through 2Ω resistor.
(b) p.d. difference across the 6Ω resistor.



4. Find the equivalent resistance of the circuit between A and B.



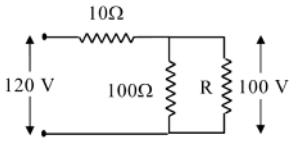
(i) (ii) (iii)

5. An electric kettle has two heating-coils. When one of the coils is switched on , the water in the kettle boils in 6 minutes, and when the other is switched on , the water boils in 8 minutes. In what time will the water boil if both coils are switched on simultaneously
(a) in series (b) in parallel ?

6. The scale of a voltmeter with a resistance of 2000Ω intended for measuring a potential difference up to 30V has 150 graduations.

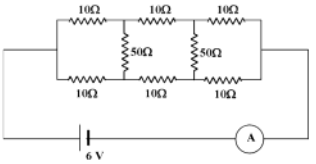
(a) What resistance should be selected and how should it be connected to measure a potential difference upto 75 V by means of this voltmeter ?
(b) How will the value of a voltmeter graduation change in this case ?

7. Find out the value of resistance R in the figure.



8. A ammeter meter with a scale ranging from 0 to 15 mA has a resistance of 5Ω. How should the instrument be connected together with a resistor (and with what resistance) to measure : (1) a current from 0 to 0.15 A, (2) a potential difference from 0 to 150 V

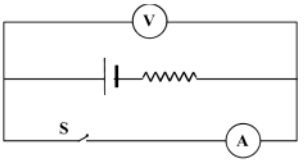
9. Find the current measured by the ammeter in the circuit shown in figure.



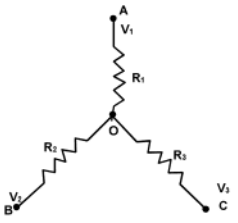
10. If a copper wire is strethced to make it 0.1 % longer. What is the percentage change in the resistance?

11. A power station supplies 100 kW to a load via cables of which resistance is 5 Ω. Find the power loss in the cable if the potential difference across the load is
(a) 10^4V (b) 2 x 10^5 V

12. Figure shows an arrangement to measure the emf and internal resistance of a battery. The voltmeter has a high resistance and the ammeter has a low resistance. Suppose the voltmeter reads 1.52 V when the switch S is open. When the switch is closed the voltmeter reading drops to 1.45 V and the ammeter reads 1.0 A. Find the emf and the internal resistance of the battery.



13. Find the currents in the resistances R_1 = 10Ω, R_2 = 20Ω and R_3 = 30Ω as shown in the figure. The terminals A, B and C are maintained at potentials V_1 = 10V, V_2 = 6V and V_3 = 15V.

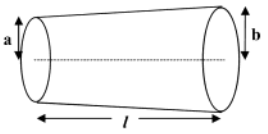


14. An electric current of 5 A is passed through a circuit containing three wires arranged in parallel. If the length and radius of the wire are in the ratio 2 : 3 : 4 and 3 : 4 : 5 then find the ratio of current passing through wires.

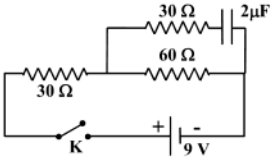
15. Two electric bulbs rated P_1 and P_2 watt at V volt, are connected in series across V volt mains. Calculate their total power consumption P.

LEVEL - II

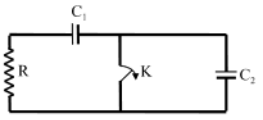
1. Figure shows a conductor of length l having a circular cross-section . The radius of cross-section varies linearly from a to b. The resistivity of the material is ρ. Assuming that b - a << l , find the resistance of the conductor.



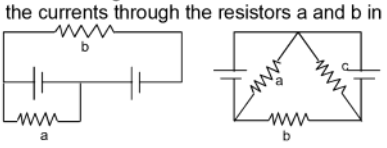
2. For the arrangement shown in the figure, the key is closed at t = 0.
(a) Find the current coming out of the battery just after the switch is closed.
(b) Also, find the current in the steady - state condition .
(c) Find the charge on the capacitor in the steady state condition.



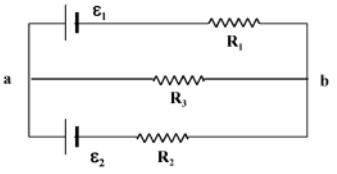
3. A capacitor of capacitance C_1 is discharged through a resistor R. When the discharge current attains the value I_o, the key K is opened. Find the amount of heat Q liberated in the resistor from this moment.



4. Each of the resistors shown in fig. has a resistance of 10 Ω and each of the batteries has an emf of 10 V. Find the currents through the resistors a and b in the two circuits.

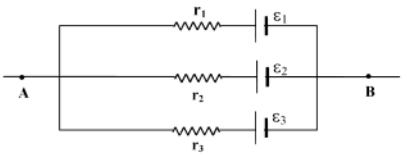


5. Find the potential difference $V_a - V_b$ in the circuits shown in figure.

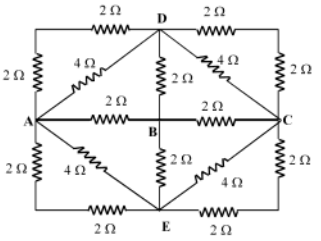


(a)

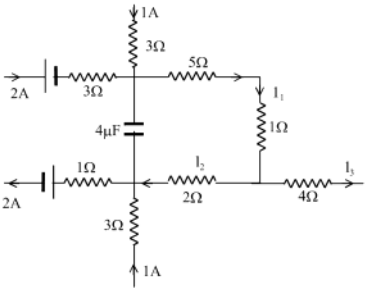
6. In the circuit shown in figure, $\varepsilon_1 = 3$ V, $\varepsilon_2 = 2$ V, $\varepsilon_3 = 1$V and $r_1 = r_2 = r_3 = 1\Omega$. Find the potential difference between the points A and B and the current through each branch.



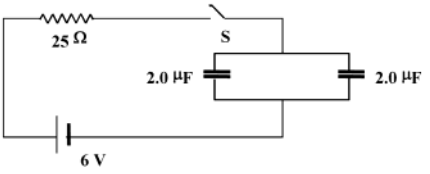
7. Find the equivalent resistance of the circuit between points (a) A & C and (b) A & B



8. A part of a circuit is shown in steady state along with the current flowing in the branches, with value of each resistance is shown in figure. Calculate the energy stored in the capacitor

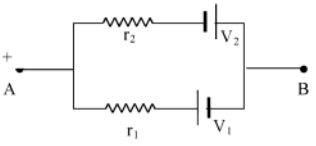


9. Find the charge on each of the capacitors 0.20 ms after the switch S is closed in figure.



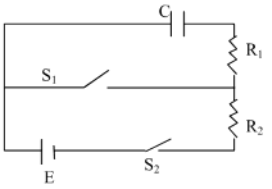
10. A capacitor of capacitance C is given a charge Q . At t = 0, it is connected to an ideal battery of emf ε through a resistance R. Find the charge on the capacitor at time t.

11. Find the emf (V) and internal resistance (r) of a single battery which is equivalent to a parallel combination of two batteries of emfs V_1 and V_2 and internal resistance r_1 and r_2 respectively, with polarities as shown in fig.



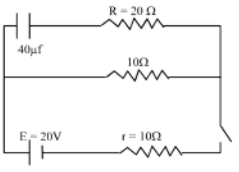
12. A galvanometer of resistance 40 Ω requires a current of 10 mA to give a full scale deflection. A shunt is put in position to convert it to a meter reading up to 1.0 A full scale deflection. A resistance R, intended to convert the galvanometer to one reading up to 1.0 V full scale deflection, is now attached to the instrument but the shunt is inadvertently left in position. Calculate the voltage which would produce full scale deflection of the galvanometer.

13. The capacitor shown in the figure has been charged to a potential difference of V volt so that it carries a charge CV with both the switches S_1 and S_2 remaining open. Switch S_1 is closed at t = 0. At $t = R_1C$ switch S_1 is opened and S_2 is closed. Find the charge on the capacitor at $t = 2R_1C + R_2C$.



14. In the laboratory, a student charges a 2 μF capacitor by placing it across a 1.5 V battery. While disconnecting it, the student holds its two lead wires in two hands. Assuming that the resistance of the body between the hands is 60 kΩ, what is the time constant of the series circuit composed of the capacitor and the student's body ? How long does it take for the charge on the capacitor to drop to 1/e of its original vlaue ? To 1/100 ?

15. In the shown figure switch is closed at t=0. Find potential difference across the resistance R = 20Ω, 1 mili second after closing the switch.



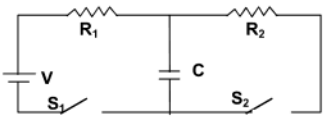
OBJECTIVE

LEVEL – I

1. A current passes through a resistor. Let k_1 & k_2 represent the average kinetic energy of the conduction electrons and metal ions respectively.
(A) $k_1 < k_2$ (B) $k_1 = k_2$
(C) $k_1 > k_2$ (D) any of these three may occur

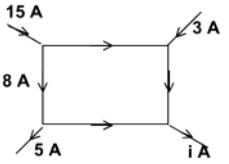
2. A current passes through a wire of nonuniform cross section. Which of the following quantities are independent of cross section
(A) the charge crossing in a given time interval
(B) drift speed
(C) current density
(D) free electron density

3. A battery of emf V volts, resistance R_1 & R_2, a condenser C and switches S_1 and S_2 are as shown in figure. The capacitor C gets fully charged to V volts when



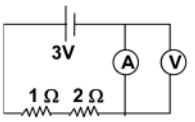
(A) S_1 & S_2 are both closed (B) S_1 & S_2 are both open
(C) S_1 closed and S_2 open (D) S_2 closed & S_1 open.

4. The value of current i in the circuit shown in figure is



(A) 3 ampere (B) 13 ampere
(C) 23 ampere (D) – 3 ampere

5. In the circuit shown in figure, the voltmeter reading would be (voltmeter and ammeter are ideal)

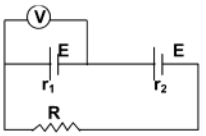


(A) 0 volt. (B) 0.5volt.
(C) 1 volt. (D) 2 volt.

6. Two electric bulbs rated P_1 and P_2 watt at V volt are connected in series across V volt mains then their total power consumption P is
(A) $(P_1 + P_2)$ (B) $\sqrt{P_1P_2}$
(C) $P_1 P_2 /(P_1 + P_2)$ (D) $(P_1 + P_2)/P_1P_2$

7. If two bulbs of 25 W & 100 W rated at 200 volts are connected in series across a 440 volts supply.
(A) 100 watt bulb will fuse (B) 25 watt bulb will fuse
(C) None of the bulb will fuse (D) both the bulbs will fuse

8. In the adjoining figure. The reading of an ideal voltmeter is zero, then the relation between R. r_1 & r_2 is



(A) $R = r_2 - r_1$ (B) $R = r_1 - r_2$

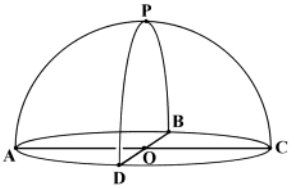
(C) $R = r_1 + r_2$ (D) $R = \frac{r_1 r_2}{r_2 + r_1}$

9. An external resistance R is connected to a cell of emf E and internal resistance r. The power developed in the external circuit is maximum when

(A) $R < r$ (B) $R > r$

(C) $R = r$ (D) $R = 0$

10. A hemispherical network of radius a is made by using a conducting wire of resistance per unit length r . The equivalent resistance across OP is



(A) $\frac{ra(\pi+3)}{8}$ (B) $\frac{ra(\pi+2)}{8}$

(C) $\frac{ra(\pi+4)}{8}$ (D) $\frac{ra(\pi+1)}{8}$

11. Kirchoff's law of electricity follows

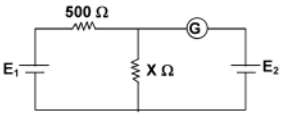
(A) Law of conservation of energy only

(B) Law of conservation of charge only

(C) Laws of conservation of both charge and energy

(D) sometime law of conservation of energy & some time law of conservation of chage.

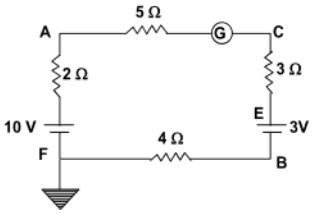
12. In the adjoining circuit, the battery E_1 has an E.M.F. of 12 volts and zero internal resistance. While the battery E_2 has an E.M.F. of 2 volts if the galvanometer G reads zero than the value of the resistance X in ohms is



(A) 10 (B) 100

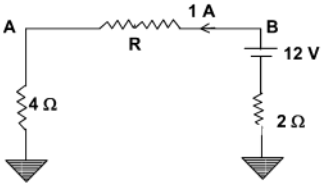
(C) 14 (D) 200

13. In the circuit shown in the figure the point F is grounded which of the following is a wrong statement.



(A) Potential at E is zero
(B) Potential at B is zero
(C) The current in the circuit will be 0.5 A
(D) The current in the circuit is same whether or not F is grounded

14. Which value of R is correct as shown in the figure ?



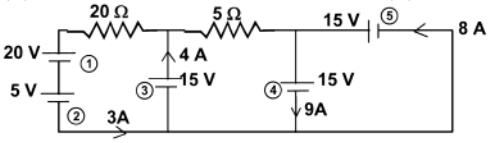
(A) R = 80 ohms
(B) R = 6 ohms
(C) R = 10 ohms
(D) Potential difference between points A & E is 2V

15. An electric heater has a resistance 150Ω and can bear a maximum current of 1A. if the heater is to be used on 220 V mains, the least resistance required in the circuit will be
(A) 70 Ω
(B) 5Ω
(C) 2.5Ω
(D) 1.4 Ω

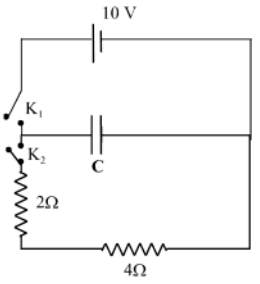
LEVEL – II

1. In the given network the batteries getting charged are

(A) 1 and 3
(B) 1 3 and 5
(C) 1, 2 and 4
(D) 1, 2 and 5



2. A capacitor of capacitance 3 μF is first charged by connecting it across a 10 V battery by closing key K_1 then it is allowed to get discharged through 2Ω and 4Ω resistor by closing the key K_2 . The total energy dissipated in the 2Ω resistor is equal to

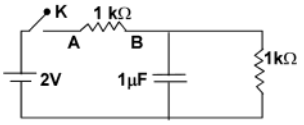


(A) 0.5 mJ
(B) 0.05 mJ
(C) 0.15 mJ
(D) none of these.

3. The potential difference across the terminals of a battery is 8.5 V when there is a current of 3A in the battery from the negative to the positive terminal. When the current is 2A in the reverse direction , the potential difference becomes 11 V. The internal resistance of the battery is
(A) 2.5Ω
(B) 5.5 Ω
(C) 2.83 Ω
(D) 0.5 Ω

4. A certain circuit with a resistance R is supplied with power simultaneously from N identical storage batteries. If the current in the circuit is to be same whether the batteries are connected in series or in parallel, the internal resistance of each of storage batteries should be equal to
(A) R/2
(B) R/4
(C) R
(D) 2R

5. When the key k is pressed at time t = 0, which of the following statements about the current in the resistor AB of the given circuit is true.



(A) 2 mA at all ?
(B) i oscillates between 1 mA and 2 mA
(C) 1 mA at all t
(D) At t = 0, i = 2 mA and with time it goes to 1 mA

6. A circuit whose resistance R is connected to n similar cells. If the current in the circuit is the same whether the cells are connected in series or in parallel then the internal resistance r of each cell is given by

(A) r = R/n (B) r = nR
(C) r = R (D) r = 1/R

7. A cell of e.m.f. E and internal resistance r is connected in series with an external resistance nr then the ratio of the terminal potential difference to E.M.F. is

(A) 1/n (B) $\frac{1}{n+1}$
(C) $\frac{n}{n+1}$ (D) $\frac{n+1}{n}$

8. To measure a potential difference across a resistor of resistance R Ω a voltmeter of resistance R_v is used. To measure the potential with a minimum accuracy of 95 % then

(A) $R_v = 5R$ (B) $R_v = 15\ R$
(C) $R_v = 10\ R$ (D) $R_v \geq 19\ R$

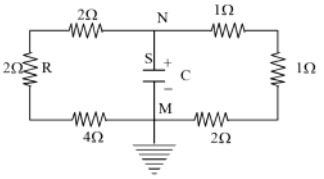
9. A cell of E.M.F. E and internal resistance r supplies currents for the same time t through external resistance R_1 and R_2 respectively. If the heat produced in both cases is the same then the internal resistance is

(A) $\frac{1}{r_1} = \frac{1}{R_1} + \frac{1}{R_2}$ (B) $r = \frac{R_1 + R_2}{2}$
(C) $r = \sqrt{R_1 R_2}$ (D) $R_1 + R_2$

10. When no current is passed through a conductor

(A) the free electrons do not move
(B) the average speed of a free electrons over a large period of time is zero
(C) the average velocity of a free electrons over a large period of time is zero
(D) The average of the velocities of all the free electrons at an instant is zero.

11. A capacitor of capacity 6μG and initial charge 160 μJ is connected with a key s and resistance as shown in figure. Point M is earthed. If key is closed at t = 0; then the current through resistance R at t = 16 μS is

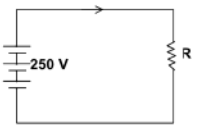


(A) $\frac{10}{3e}$ A (B) $\frac{10}{e}$ A
(C) $\frac{20}{3e}$ (D) none of these

12. A uniform wire of resistance is 36 Ω is shaped into a regular haxagon. The equivalent resistance between any two corners can have
(A) the minimum value is 5 ohm and maximum value is 9 Ω

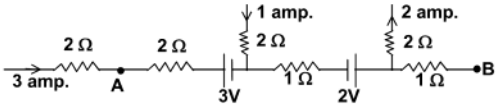
(B) the minimum value is 6 ohm and maximum value is 9 Ω
(C) the maximum value is 9 ohm and minimum value is 4 Ω
(D) the maximum value is 6 ohm and minimum value is 4 Ω

13. In the circuit below the resistance R has a value that depends on the current. R is 20 ohms when I is zero and the amount of increase in resistance is numerically equal to one half of the current. What is the value of current I in circuit ?



(A) 8.33 A
(B) 10 A
(C) 12.5 A
(D) 18.5 A

14. The potential difference between points A & B in a section of a circuit shown is



(A) 5 volts
(B) 1 volts
(C) zero volts
(D) 13 volts

15. Two conducting wires of same length are made from the same material. One wire is solid with diameter 1mm while the other is hollow with outside diameter 2mm and inside diameter 1mm. The ratio of their resistances will be
(A) 1 : 2
(B) 1: 3
(C) 3 : 1
(D) 2 : 1

ANSWERS

SUBJECTIVE

LEVEL - I

1. $\frac{1}{15}$ A
2. $E_1 = 7V$
   $E_2 = 18V$
   $V_a - V_b = 13V$
3. 32J/s, 6V
4. (i) (4/3)r (ii) r (iii) r/4
5. 1) 14 minutes 2) 3 minutes 26 sec.
6. .(i) R = 3000 Ω in series with the voltmeter
   (ii) Graduation will change to 0.5 V/division.
7. 100 Ω
8. R = 0.555 Ω in parallel with the instrument.
   R = 9995 Ω in series with the instrument.
9. 0.4A
10. 0.2%
11. (a) 500 W, (b) 1.25 W
12. 1.52 V, 0.07 Ω
13. $\frac{1}{55}$ A, $\frac{21}{110}$ A, $\frac{19}{110}$ A
14. 54 : 64 : 75
15. $P_1P_2/(P_1+P_2)$

LEVEL - II

1. $\frac{\rho l}{\pi ab}$
2. (a) 0.18 A, (b) 0.1 A, (c) 12 μC
3. $\frac{(I_oR)^2C_1C_2}{2(C_1+C_2)}$
4. (i) current in a = 1A, current in b = 2A
   (ii) current in a = 1A, current in b = 0
5. (a) $\frac{\frac{\varepsilon_1}{R_1}+\frac{\varepsilon_2}{R_2}}{\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}}$
6. 2 V, $i_1 = 1A$, $i_2 = 0$, $i_3 = -1$ A.
7. (a) (4/3)Ω (b) (14/15)Ω
8. 8×10^{-4}J
9. 10.4 μC
10. $C\varepsilon\left(1-e^{-t/CR}\right)+Qe^{-t/CR}$
11. $V = \frac{V_1r_2 - V_2r_1}{r_1+r_2}, r = \frac{r_1r_2}{r_1+r_2}$
12. 60.4 V
13. $q_f = EC\left(1-\frac{1}{e}\right)+\frac{VC}{e^2}$
14. 0.12s, 0.55 s
15. (8/e) V

OBJECTIVE

LEVEL - I

1.	C	2.	A, D
3.	C	4.	B
5.	A	6.	C
7.	B	8.	B
9.	C	10.	B
11.	C	12.	B
13.	A, C	14.	B
15.	A		

LEVEL - II

1.	C	2.	B
3.	D	4.	C
5.	D	6.	C
7.	B	8.	D
9.	C	10.	C, D
11.	A	12.	A
13.	B	14.	D
15.	C		