DCAM classes
Dynamic Classes for Academic Mastery

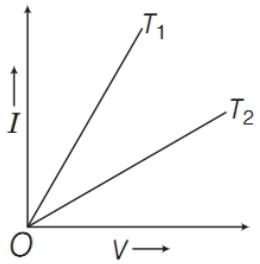
Previous Years

Examination Questions

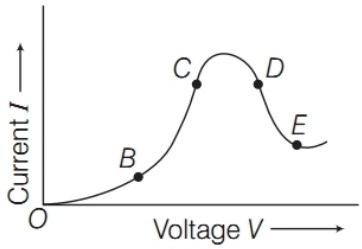
1 Mark Questions

1. A copper wire of non-uniform area of cross-section is connected to a DC battery. The physical quantity which remains constant along the wire is ..... Delhi 2020
2. How does the mobility of electrons in a conductor changes, if the potential difference applied across the conductor is doubled keeping the length and temperature of the conductor constant? Delhi 2019
3. When a potential difference is applied across the ends of a conductor, how is the drift velocity of the electrons related to the relaxation time? Delhi 2019
4. How is the drift velocity in a conductor affected with the rise in temperature? Delhi 2019
5. *I-V* graph for a metallic wire at two different temperatures T_1 and T_2 is as shown in the figure below. Which of the two temperature is lower and why?

   Delhi 2015



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



   (i) of negative resistance.
   (ii) where Ohm's law is obeyed. All India 2015
7. Plot a graph showing the variation of resistivity of a conductor with temperature. Foreign 2015
8. How does the random motion of free electrons in a conductor gets affected when a potential difference is applied across its ends ? Delhi 2014
9. Plot a graph showing variation of current *versus* voltage for the material GaAs. Delhi 2014
10. Show variation of resistivity of copper as a function of temperature in graph. Delhi 2014; All India 2014

11. Define the term drift velocity of charge carriers in a conductor and write its relationship with the current flowing through it. **Delhi 2014**

12. Define the term electrical conductivity of a metallic wire. Write its SI unit. **Delhi 2014**

13. Show variation of resistivity of Si with temperature in graph. **Delhi 2014, 12**

14. Define the term mobility of charge carriers in a conductor. Write its SI unit. **Delhi 2014**

15. How does one explain increase in resistivity of a metal with increase of temperature ? **All India 2014C**

16. Write a relation between current and drift velocity of electrons in a conductor. Use this relation to explain how the resistance of a conductor changes with the rise in temperature? **All India 2013**

17. Two materials Si and Cu are cooled from 300 K to 60 K. What will be the effect on their resistivity? **Foreign 2013**

18. A conductor of length l is connected to a DC source of potential difference V. If the length of the conductor is tripled by gradually stretching it keeping V constant, how will drift speed of electrons be affected ? **Foreign 2012**

19. When electrons drift in a metal from lower to higher potential, does it mean that all the free electrons of the metal are moving in the same direction? **Delhi 2012**

20. Show on a graph the variation of resistivity with temperature for a typical semiconductor. **Delhi 2012**

21. Define resistivity of a conductor. Write its SI unit. **All India 2011**

2 Marks Questions

22. Using the concept of drift velocity of charge carriers in a conductor deduce the relationship between current density and resistivity of the conductor. **Delhi 2015C**

23. Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area $1.0 \times 10^{-7}\,m^2$ carrying a current of 1.5 A. Assume that the density of conduction electrons to be $9 \times 10^{28} m^{-3}$. **All India 2014**

Or

Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area $2.5 \times 10^{-7}\ m^2$ carrying a current of 1.8 A. Assume the density of conduction electrons to be $9 \times 10^{28} m^{-3}$.

All India 2014

Or

Estimate the average drift speed of conduction electrons in a copper wire of cross-sectional area $2.5 \times 10^{-7}\,m^2$ carrying a current of 2.7 A. Assume the density of conduction electrons to be $9 \times 10^{28} m^{-3}$.

All India 2014

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

Delhi 2014C

25. Derive an expression for the current density of a conductor in terms of the drift speed of electrons. **Foreign 2014**

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

All India 2013C

27. Plot a graph showing temperature dependence of resistivity for a typical semiconductor. How is this behaviour explained? **Delhi 2011**

3 Marks Questions

28. Show on a plot the variation of resistivity of (i) a conductor and (ii) a typical semiconductor as a function of temperature.

Using the expression for the resistivity in terms of the number density and relaxation time between the collisions explain how resistivity in the case of a conductor increases while it decreases in a semiconductor with the rise of temperature. **All India 2019**

29. (i) Define the term conductivity of a metallic wire. Write its SI unit.

(ii) Using the concept of free electrons in a conductor derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence, obtain the relation between current density and the applied electric field E. **2018**

30. (i) Define the term of drift velocity.

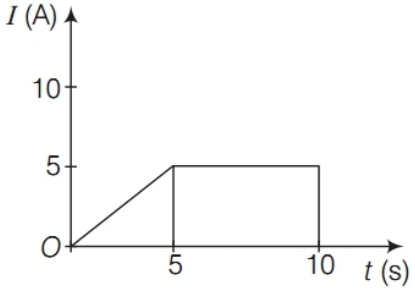
(ii) On the basis of electron drift derive an expression for resistivity of a conductor in terms of number density of free electrons and relaxation time. On what factors does resistivity of a conductor depend?

(iii) Why alloys like Constantan and Manganin are used for making standard resistors? **Delhi 2016**

31. Find the relation between drift velocity and relaxation time of charge carriers in a conductor. A conductor of length L is connected to a DC source of emf E. If the length of the conductor is tripled by stretching it keeping E constant then, explain how its drift velocity would be affected. **Delhi 2015**

32. (i) Deduce the relation between current I flowing through a conductor and drift velocity v_d of the electrons.

(ii) Figure shows a plot of current I flowing through the cross-section of a wire *versus* the time t. Use the plot to find the charge flowing in 10s through the wire. **All India 2015C**



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

All India 2012

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

(ii) 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 the number density of conduction electrons is 9×10^{28} m^{-3}] **Delhi 2012C**

5 Marks Question

35. (i) Derive an expression for drift velocity of electrons in a conductor. Hence, deduce Ohm's law.

(ii) A wire whose cross-sectional area is increasing linearly from its one end to the other is connected across a battery of potential difference V volt. Which of the following quantities remain constant in the wire?

(a) Drift speed

(b) Current density

(c) Electric current

(d) Electric field

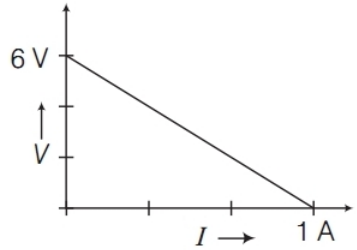
Justify your answer. **Delhi 2017**

Previous Years

Examination Questions

1 Mark Questions

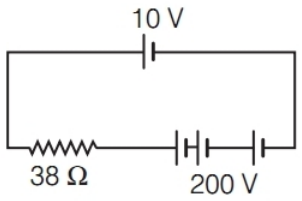
1. The plot of the variation of potential difference across a combination of three identical cells in series *versus* current is shown below. What is the emf and internal resistance of each cell? **Delhi 2014**



2. Two identical cells each of emf E having negligible internal resistance are connected in parallel with each other across an external resistance R. What is the current through this resistance?

All India 2013

3. A 10 V battery of negligible internal resistance is connected across a 200 V battery and a resistance of 38 Ω as shown in the figure. Find the value of the current in circuit. **Delhi 2013**

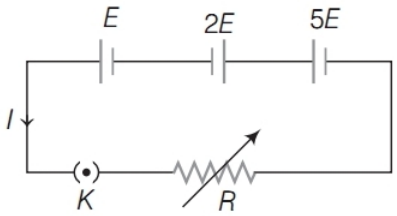


4. The emf of a cell is always greater than its terminal voltage. Why? Give reason.

Delhi 2013

5. A cell of emf E and internal resistance r draws a current I. Write the relation between terminal voltage V in terms of E, I and r. **Delhi 2013**

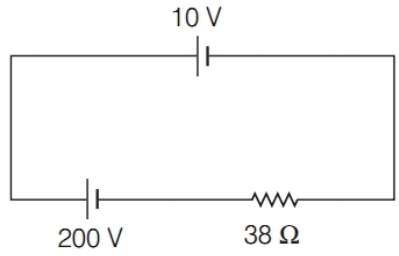
6. Three cells of emf $E, 2E$ and $5E$ having internal resistances $r, 2r$ and $3r$ respectively are connected across a variable resistance R as shown in the figure. Find the expression for the current. Plot a graph for variation of current with R. **All India 2010C**



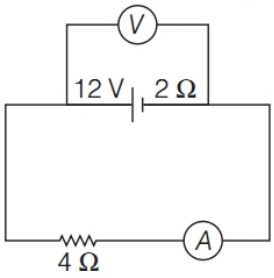
2 Marks Questions

7. A 10 V cell of negligible internal resistance is connected in parallel across a battery of emf 200 V and internal resistance 38 Ω as shown in the figure. Find the value of current in the circuit.

2018



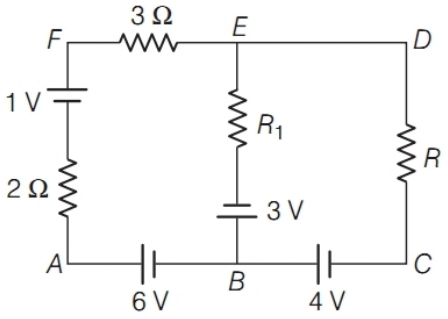
8. A battery of emf 12 V and internal resistance 2 Ω is connected to a 4 Ω resistor as shown in the figure.



(i) Show that a voltmeter when placed across the cell and across the resistor which in turn gives the same reading.

(ii) To record the voltage and the current in the circuit, why is voltmeter placed in parallel and ammeter in series in the circuit? **All India 2016**

9. Use Kirchhoff's rules to determine thepotential difference between the points *A* and *D*. When no current flows in the arm *BE* of the electric network shown in the figure below **Delhi 2015**

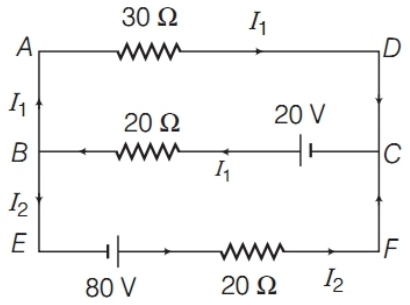


10. Two cells of emfs 1.5 V and 2.0 V having internal resistances 0.2 Ω and 0.3 Ω respectively are connected in parallel. Calculate the emf and internal resistance of the equivalent cell. **Delhi 2014**

11. A cell of emf *E* and internal resistance *r* is connected across a variable resistor *R*. Plot a graph showing the variation of terminal voltage *V* of the cell *versus* the current *I*. Using the plot show that emf of the cell and its internal resistance can be determined. **All India 2014**

12. Distinguish between emf (ε) and terminal voltage (*V*) of a cell having internal resistance *r*. Draw a plot showing the variation of terminal voltage (*V*) *versus* the current (*I*) drawn from the cell. Using this plot show how does one can determine the internal resistance of the cell? **All India 2014 C**

13. Use Kirchhoff's rules to determine the value of the current I_1 flowing in the circuit as shown in the figure.**Delhi 2013C**



14. A battery of emf *E* and internal resistance *r* when connected across an external resistance of 12 Ω produces a current of 0.5 A. When connected across a resistance of 25 Ω it produces a current of 0.25 A. Determine (i) the emf and (ii) the internal resistance of the cell. **All India 2013C**

15. A cell of emf *E* and internal resistance *r* is connected to two external resistances R_1 and R_2 and a perfect ammeter. The current in the circuit is measured in four different situations

(i) Without any external resistance in the circuit

(ii) With resistance R_1only

(iii) With R_1 and R_2 in series combination

(iv) With R_1 and R_2 in parallel combination

The currents measured in the four cases are 0.42 A, 1.05 A, 1.4 A and 4.2 A, but not necessarily in that order. Identify the currents corresponding to the four cases mentioned above. **Delhi 2012**

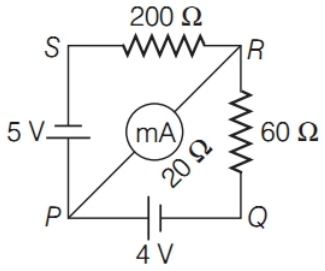
16. A battery of emf 10 V and internal resistance 3 Ω is connected to a resistor. If the current in the circuit is 0.5 A ,then find

(i) the resistance of the resistor.

(ii) the terminal voltage of the battery.

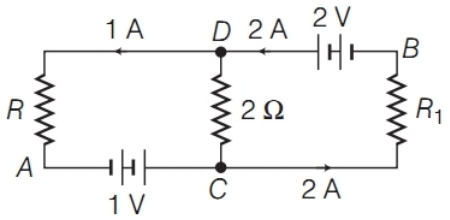
Delhi 2012C

17. The network $PQRS$ as shown in the circuit diagram has the batteries of 4 V and 5 V and negligible internal resistance. A milliammeter of 20 Ω resistance is connected between P and R. Calculate the reading in the milliammeter. **All India 2012C**

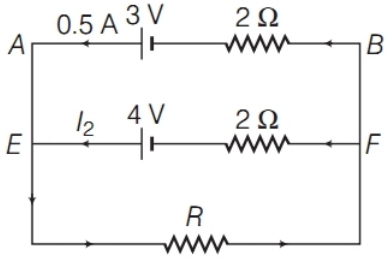


18. In the given circuit assuming point A to be at zero potential use Kirchhoff's rules to determine the potential at point B.

All India 2011



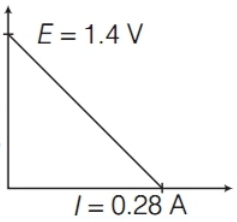
19. Using Kirchhoff's rules in the given circuit, determine **All India 2011**



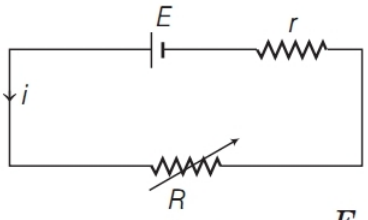
(i) the current I_2 in the arm EF and

(ii) the voltage drop across the unknown resistor R.

20. A straight line plot showing the terminal potential difference (E) of a cell as a function of current (I) drawn from it is shown in the figure.



Using this plot, determine



Current in circuit, $i = \dfrac{E}{R + r}$

(i) the emf and

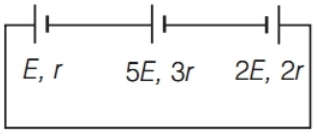
(ii) internal resistance of the cell.

Delhi 2011C

21. Two cells of emf $2E$ and E and internal resistances $2r$ and r respectively are connected in parallel. Obtain the expressions for the equivalent emf and the internal resistance of the combination .

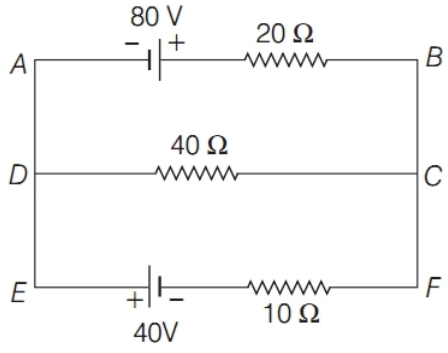
All India 2010C

22. Three cells of emf $E, 2E$ and $5E$ having internal resistances $r, 2r$ and $3r$, variable resistance R as shown in the figure. Find the expression for the current. Plot a graph for variation of current with R. **All India 2010C**



3 Marks Questions

23. Using Kirchhoff's rules calculate the current through the 40 Ω and 20 Ω resistors in the following circuit. **Delhi 2019**

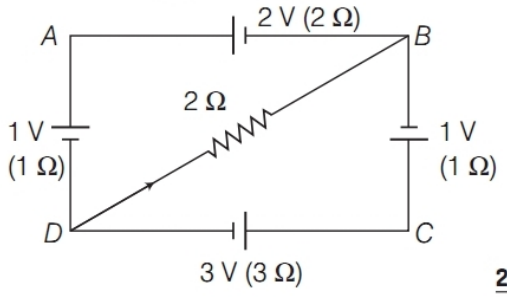


24. Two cells of emfs ε_1 and ε_2 and internal resistances r_1 and r_2 respectively are connected in parallel. Obtain expressions for the equivalent

(i) resistance and

(ii) emf of the combination **2018C**

25. Using Kirchhoff's rules calculate the potential difference between B and D in the circuit diagram as shown in the figure.



2018C

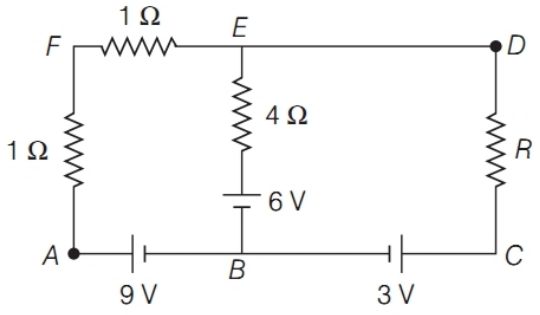
26. A cell of emf E and internal resistance r is connected across a variable load resistor R. Draw the plots of the terminal voltage V *versus* (i) resistance R and (ii) current I.

It is found that when $R = 4\ \Omega$ the current is 1 A and when R is increased to $9\ \Omega$ the current reduces to 0.5 A. Find the values of the emf E and internal resistance r.

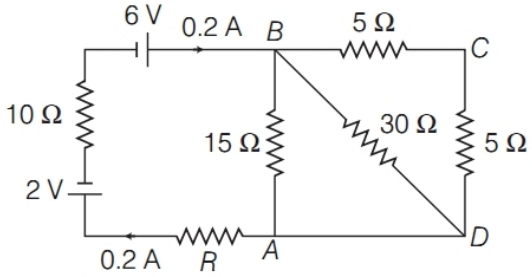
All India 2015

27. Using Kirchhoff's rules, determine the value of unknown resistance R in the circuit, so that no current flows through $4\ \Omega$ resistance. Also, find the potential difference between points A and D.

Delhi 2012

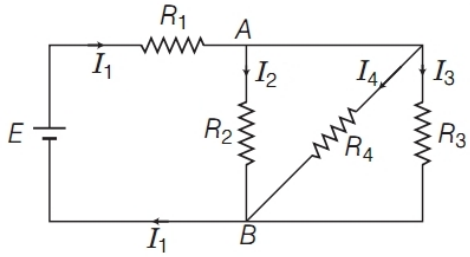


28. Calculate the value of the resistance R in the circuit shown in the figure, so that the current in the circuit is 0.2 A. What would be the potential difference between points A and B? **All India 2012**

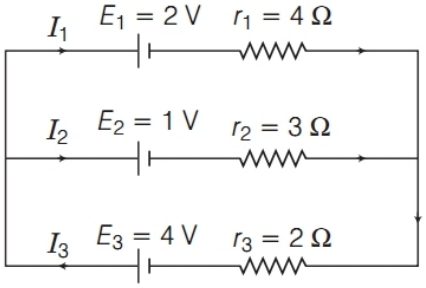


29. In the circuit shown, $R_1 = 4\ \Omega$, $R_2 = R_3 = 15\ \Omega$, $R_4 = 30\ \Omega$ and $E = 10$ V. Calculate the equivalent resistance of the circuit and the current in each resistor.

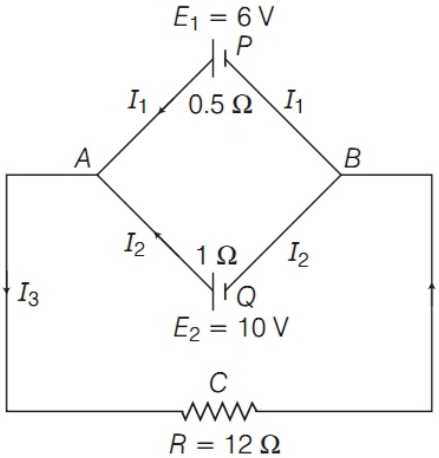
Delhi 2011



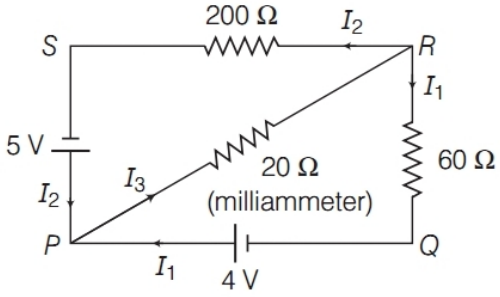
30. State Kirchhoff's rules. Use these rules to write the expressions for the currents I_1, I_2 and I_3 in the circuit diagram shown in figure below. **All India 2010**



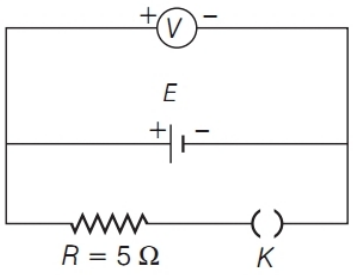
31. State Kirchhoff's rules. Apply Kirchhoff's rules to the loops $ACBPA$ and $ACBQA$ to write the expressions for the currents I_1, I_2 and I_3 in the network. **All India 2010**



32. State Kirchhoff's rules. Apply these rules to the loops *PRSP* and *PRQP* to write the expressions for the currents I_1, I_2 and I_3 in given circuit. **All India 2010**



33. Write any two factors on which internal resistance of a cell depends. The reading on a high resistance voltmeter, when a cell is connected across it, is 2.2 V. When the terminals of the cell are also connected to a resistance of 5 Ω as shown in the circuit, the voltmeter reading drops to 1.8 V. Find the internal resistance of the cell. **All India 2010**



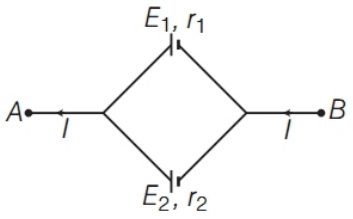
34. (i) State Kirchhoff's rules.

(ii) A battery of 10 V and negligible internal resistance is connected across the diagonally opposite corners of a cubical network consisting of 12 resistors each of 1 Ω resistance. Use Kirchhoff's rules to determine. **All India 2010**

(a) the equivalent resistance of the network and

(b) the total current in the network.

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



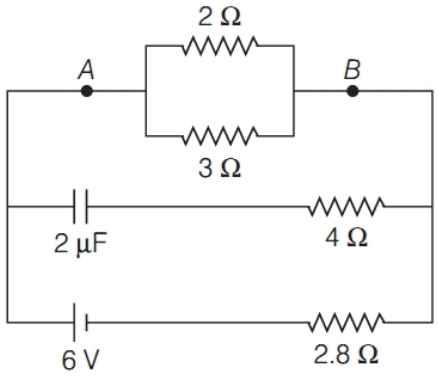
Deduce the expressions for

(i) the equivalent emf of the combination.

(ii) the equivalent resistance of the combination and

(iii) the potential difference between the points *A* and *B*. **Foreign 2010**

36. Calculate the steady current through the 2 Ω resistor in the circuit shown in the figure below. **Foreign 2010**

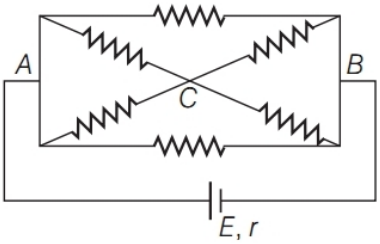


5 Marks Question

37. (i) State the two Kirchhoff's laws. Explain briefly, how these rules are justified?

(ii) The current is drawn from a cell of emf *E* and internal resistance *r* connected to the network of resistors each of resistance *r* as shown in the figure. Obtain the expression for (a) the current draws from the cell and

(b) the power consumed in the network. **Delhi 2017**



Previous Years

Examination Questions

1 Mark Questions

1. Nichrome and copper wires of same length and same radius are connected in series. Current I is passed through them. Which wire gets heated up more? Justify your answer. **All India 2017**

2. A heating element is marked 210 V, 630 W. What is the value of the current drawn by the element when connected to a 210 V DC source? **Delhi 2013**

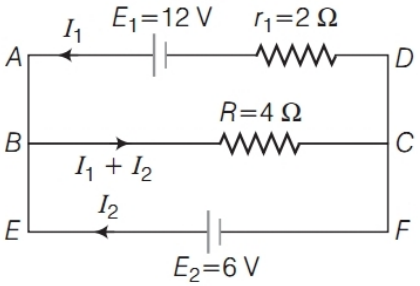
2 Marks Questions

3. Two bulbs are rated (P_1, V) and (P_2, V). If they are connected (i) in series and (ii) in parallel across a supply V, find the power dissipated in the two combinations in terms of P_1 and P_2. **Delhi 2019**

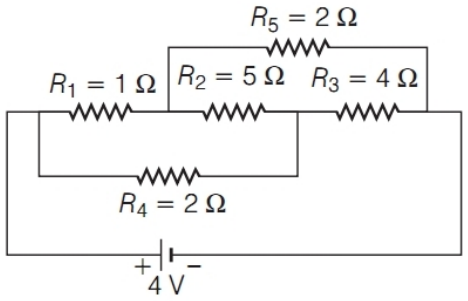
4. Two electric bulbs P and Q have their resistances in the ratio of 1 : 2. They are connected in series across a battery. Find the ratio of the power dissipation in these bulbs. **2018**

5. Use Kirchhoff's rules to obtain the balance conditions in a Wheatstone bridge. **All India 2015**

6. In the electric network shown in the figure, use Kirchhoff's rules to calculate the power consumed by the resistance $R = 4\,\Omega$. **Delhi 2014C**



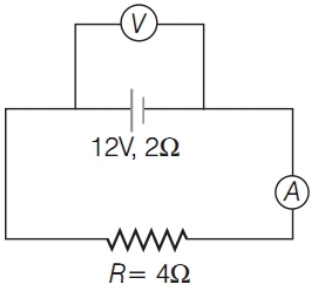
7. Calculate the current drawn from the battery in the given network. **All India 2012C**



3 Marks Questions

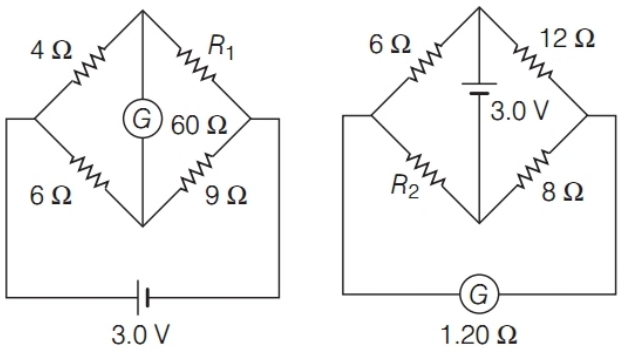
8. (i) The potential difference applied across a given resistor is altered, so that the heat produced per second increases by a factor of 9. By what factor does the applied potential difference change ?

(ii) In the figure shown, an ammeter A and a resistor of 4 Ω are connected to the terminals of the source. The emf of the source is 12 V having an internal resistance of 2 Ω. Calculate the voltmeter and ammeter readings. **All India 2017**



9. Define the current sensitivity of a galvanometer. Write its SI unit. Figure shows two circuits each having a galvanometer and a battery of 3 V.

When the galvanometer in each arrangement do not show any deflection, obtain the ratio R_1/R_2. **All India 2013**



10. Two heating elements of resistances R_1 and R_2 when operated at a constant supply of voltage V, consume powers P_1 and P_2, respectively. Deduce the expressions for the power of their combination when they are in turn, connected in

(i) series and

(ii) parallel across their same voltage supply. **All India 2011**

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