# PHYSICS

## NCERT - NCERT PHYSICS(GUJRATI)

## CURRENT ELECTRICITY

**Example**

**1.** (a) Esttimate the average drift speed of conduction electrons in a copper wite of cross-secttonal area $1.0 \times 10^{-7} m^2$ carrying a current of $1.5 A$. Assume the each copper atom contrbutes

roughly one conduction electron. The density of copper is $9.0 \times 10^3 kg/m^3$, and its atomic mass is $63.5u$. (b) Compare the drift speed obyained above with, (1) thermal speeds of copper atoms at ordinary temperaturtes. (ii) speed of propagation of electric field along the conductor which causes the drift motion.

Watch Video Solution

**2.** (a) the electron drift speed is estimated to be only a few $mms^{-1}$ for currents in the range of a few amperes ? How then is current established

almost the instnat a circuit is closed ?

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

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

(d) 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 ?

(e) Are the paths of electrons straight lines

between successive collisions (witht the positive ions of the metal) in the (i) absence of electric field, (ii) presence of electric field ?

View Text Solution

**3.** An electric toaster uses nichrome for its heating element. When a negllgibly small current pases through it, its resistance at room temperature $(27.0^{\circ}C)$ is found to be $75.3\Omega$. When the toaster is connected to a 230 V supply, the current settles, after a few seconds, to a steady value of $2.68A$. What is the steady temperature of the nichrome

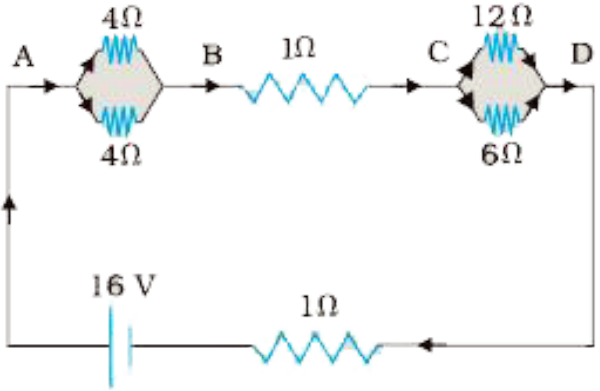
element ? The temperature coefficient of resistance of nichrome averaged over the temperature range involved is $1.70 \times 10^{-4} \circ C^{-1}$.

Watch Video Solution

**4.** The resistance of the platinum wire of a platinum resistance thermometer at the ice point is $5\Omega$ and at steam point ins $5.23\Omega$ When the thermomenter is inserted in a hot bath, the resistance of the platinum wire is $5.795\Omega$. Calculate the temperature of the bath.

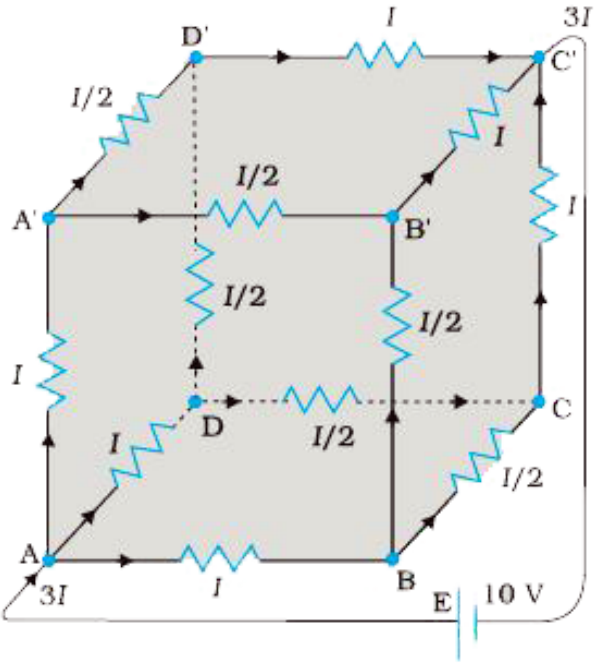
Watch Video Solution

**5.** A network of resistore is connected to a 16 V battery with internal resistance of $1\Omega$, as shown in (a) Compute the equivalent resistance of the network. (b) Obtain the current in each resistor. (c ) obtain the voltage drops $V_{AB}, V_{BC}$ and $V_{CD}$



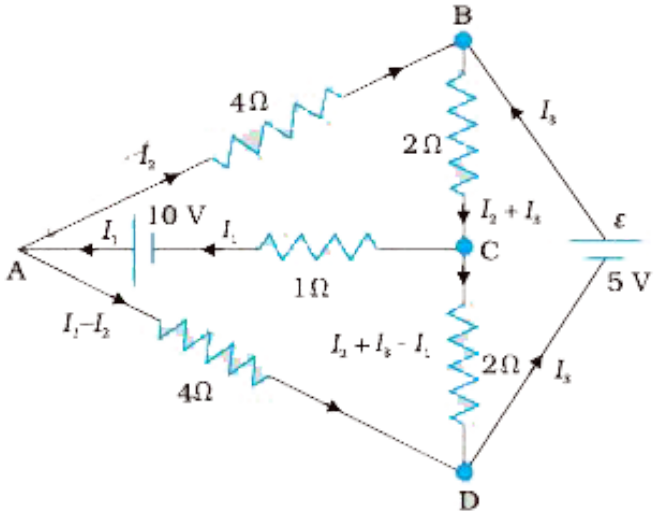

Watch Video Solution

**6.** A bettery of 10 V and negligible internal resistance is connected across the diagonally opposite corners of a cubical network consisting of 12 resistors each of resistance $1\Omega$ Determine the equivalent resistance of the network and the current along each edge of the cube.



Watch Video Solution

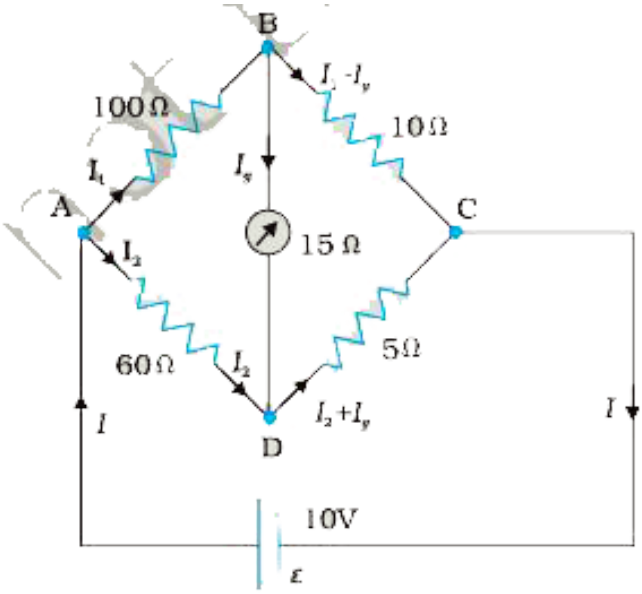
**7.** Determine the current in each brance of the network showin in




Watch Video Solution

**8.** The four arma os a Wheatstone bridge have the following resistances:

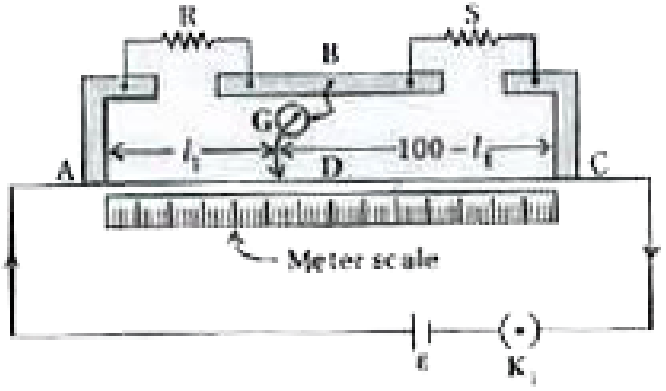
$AB = 100\Omega$, $BC = 10\Omega$, $CD = 5\Omega$ and $DA = 60\Omega$




A galvanometer of $15\Omega$ resistacne is connected across BD. Calculate the current through the galvanometer when a potential difference of 10 V is maintained across AC.

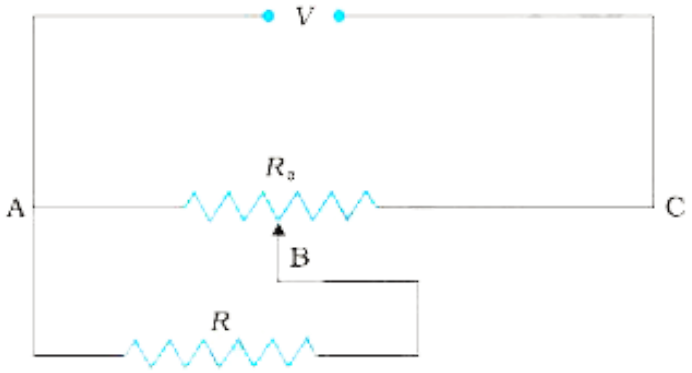
Watch Video Solution

**9.** In a meterbridge, the null point is found at a distance of 33.7cm from A. If a resistance of 12W is connected in parallel with S, the null points occurs at 51.9cm Determine the values of R and S.




Watch Video Solution

**10.** A rsisitance of $R\Omega$ draws current from a potentiometer. Te potentiometer has a total resistance $R_0\Omega$ A voltage V is supplited to the potentiometer. Derive an expression for the voltage across R when the sliding contact is in the middle of the potenttometer.




Watch Video Solution

## Exercises

**1.** The storage battery of a car has an emf of 12 V. If the internal resistance of the battery is $0.4\Omega$ what is the maximum current that can be drawn from the battery ?

Watch Video Solution

**2.** A bettery of emf 10 V and internal resistacne $3\Omega$ is connected to a resistor. If the current in the circuit is $0.5A$, what is the resistance of the

resistor ? What is the terminal voltage of the bettery when the circuit is closed ?

Watch Video Solution

**3.** (a) Three resistor $1\Omega, 2\Omega,$ and $3\Omega$ are combined in series. What is the total resistance of the ombination ?

(b) If the combination is connected to a battery of emf 12 V and negligible internal resistance, obtain the potential drop across each resistor.

Watch Video Solution

**4.** (a) Three resistors $2\Omega 4\Omega$ and $5\Omega$ are combined in parallel. What is the total resistance of the combination ?

(b) If the combination is connected to a bettery of emf 20 V and neglibible internal resistance, determine the current through each resistor, and the total current drawn from the battery.

Watch Video Solution

**5.** At room temperature $(27.0^{\circ}C)$ the resistance of a heating element is $100\Omega$. What is the temperature of the element if the resistance is

found to be $117\Omega$. given that the temperature coefficient of the material of the resistor is $1.70 \times 10^{-4} \circ C^{-1}$.

Watch Video Solution

**6.** A negligibly small current is passed through a wire of length 15 m and uniform across-section $6.0 \times 10^{-7} m^2$, and its resistance is measured to be $5.0\Omega$ What is the resistivity of the material at the temperature of the experiment ?

Watch Video Solution

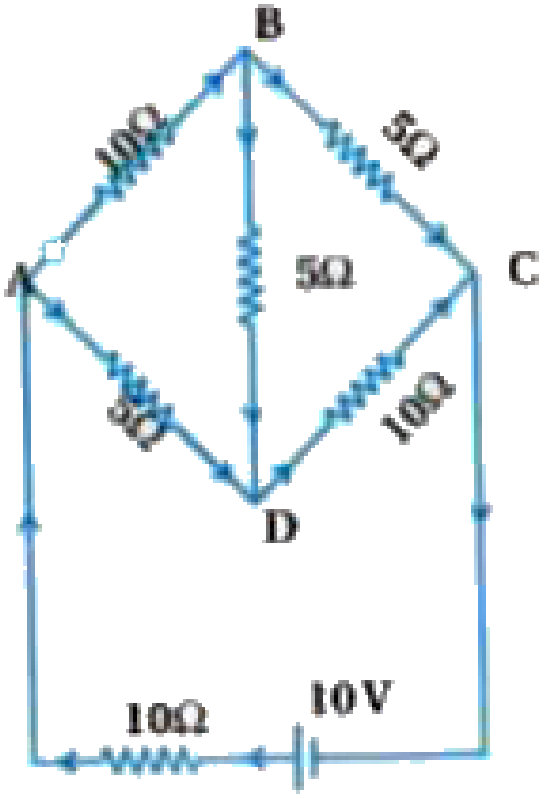
**7.** A silver wire has a resistance of $2.1\Omega at 27.5^\circ C$. and a rsistance of $2.7\Omega at 100^\circ C$. Determine the temperature coefficient of resistivity of silver.

Watch Video Solution

**8.** A heating element using nichrome connected to a 230 V supply draws an initial current of $3.2A$ which settles after a few second to a steady value of $2.8A$. What is the steady temperature of the heating element if the room temperature is $27.0^\circ C$? Tempeerature range involved is $1.70 \times 10^{-4 \circ} C^{-1}$.

Watch Video Solution

**9.** Determine the current in each branch of the given network.



Watch Video Solution

**10.** A storage battery of emf $8.0V$ and internal resistance $0.5\Omega$ is being charged by a 120 V de supply using a series resistor of $15.5\Omega$. What is the terminal voltage of the battery during charging? What is the purpose of having a series resistor in the charging circuit ?

Watch Video Solution

**11.** In a potentiometer arrangement, a cell of emf $1.25V$ fives a balance point at $35.0$ cm length of

the wire. If the cell is replaced by another cell and the balance point shifts to $63.0cm$, what is the emf of the second cell ?

Watch Video Solution

**12.** The number density of free electrons in a copper conductor estimated in is $8.5 \times 10^{28} m^{-3}$. How long does an electron take to drift form one end of a wire $3.0m$ long to its other end? The area of cross-section of the wire is $2.0 \times 10^{-6} m^2$ and it is carrying a current of $3.0$ A.

Watch Video Solution

## Additional Exercises

**1.** The earth's surface has a negative surface charge density of $10^{-9} Cm^{-2}$. The potential difference of 400 kV between the top of the atmosphere and the surface results (due to the low conductivity of the lower atmosphere) in a current of only 1800 A over the entire globe. If there were no mechanism of sustaining atmospheric electric field, how much time (roughly) would be required to neutralise the earth's surface? (This never happens in practice

because there is a mechanism to replenish electric charges. namely tghe coontainual thunderstorms and lighting in different parts of the globe). (Radius of earth $= 6.37 \times 10^6 m.$ )

Watch Video Solution

**2.** (a) Six lead-acid type of secondary cells each of emf $2.0V$ and internal resistacne $0.015\Omega$ are joined in series to provide a supply to a resistance of $8.5\Omega$. What are the current drawn from the suply and its terminal voltage ?

(b) A secondary cell after long use has an emf of

$1.9V$ and a large internal resistance of $380\Omega$. What maximum current can be drawn from the cell? Could the cell drive tghe starting motor of a car ?

Watch Video Solution

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

$(\rho_{AI} = 2.63 \times 10^{-8}\Omega m, \rho_{Cu} = 1.72 \times 10^{-8}\Omega m.$

Relative density of $Al = 2.7 of Cu = 8.9.$ )

Watch Video Solution

**4.** What conclusion can you draw from the follwing observation on a resistor made of alloy manganin ?

| Current A | Voltage V | Current A | Voltage V |
|---|---|---|---|
| 0.2 | 3.94 | 3.0 | 59.2 |
| 0.4 | 7.87 | 4.0 | 78.8 |
| 0.6 | 11.8 | 5.0 | 98.6 |
| 0.8 | 15.7 | 6.0 | 118.5 |
| 1.0 | 19.7 | 7.0 | 138.2 |
| 2.0 | 39.4 | 8.0 | 158.0 |

Watch Video Solution

**5.** Answer the following questions:

(a) A steady current flows in a metallic conductor of non-uniform cross-section. Which of these quantities is constant along the conductor: current, current density electric field, drift speed ?

(b) Is Ohm's law universally applicable for all cnducting elements ? If not, give examples of elements which do not obey Ohm's law.

(c ) A low voltage suply from which one needs high currents must have very low internal resistance.Why

(d) A high tension (HT) supply of say, 6kV must have a very large internal resistance, Why ?

Watch Video Solution

**6.** Choose the correct alternative:

(a) Alloys of metals usually have (greater/less) resistivity than that of their constituent metals.

(b) Alloys usually have much (lower/higher) temperature coefficients of resistance than pure metals.

(c ) The resisitivity of the alloy manganin is nearly independent of/increases rapidly with increase of temperature.

(d) The resistivity of a typical insulator (e.g.,

amber) is greater than that of a metal by a factor of the order of $\left(10^{22} / 10^{23}\right)$.

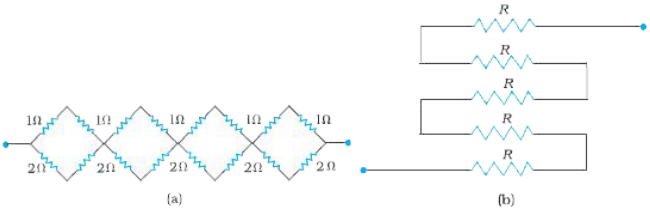
Watch Video Solution

**7.** (a) Given n resistores each of resistance R. how will you combine them to get the (i) maximum (ii) minimum effective resistance?

(b) Given the resistances of $1\Omega$, $2\Omega$, $3\Omega$. how will be combine them to get an equivalent resistance of $(i)(11/3)\Omega(ii)(11/5)\Omega$, $(iii)6\Omega$, $(iv)(6/11)\Omega$ ?

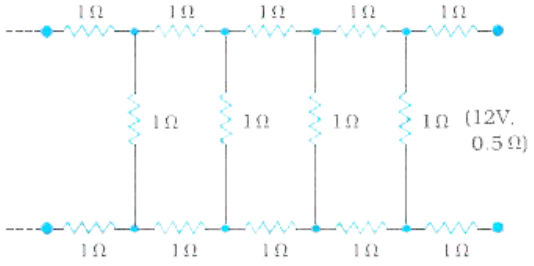
(c ) Determine the equivalent resistance of

networks shown in




Watch Video Solution

**8.** Determine the furrent drawn from a 12 V suly with internal resistacne $0.5\Omega$ by the infinite network shown in Each rsistor has $1\Omega$ resistance.

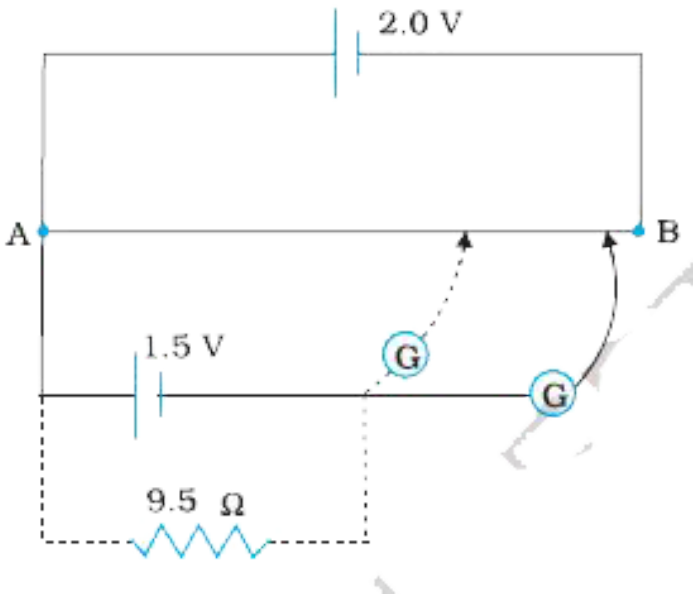



Watch Video Solution

Watch Video Solution

**9.** show a $2.0V$ potentiometer used for the determination of internal resistance of a $1.5V$ cell. The balance point of the cell in open circuit is $76.3$ cm. When a resistor of $9.5\Omega$ is used in the external circuit of the cell, the balance point shifts to $64.8cm$ length of the potentiometer wire.

Determine the internal resistance of the cell.




Watch Video Solution