ELECTRICITY

Matter is generally made of protons, neutrons and electrons. Each proton carries a charge of 1.6×10^{-19} C, and each electron carries an equal negative charge. Neutrons have no charge. This makes the matter neutral.

Sometimes the balance of charges in a body disturbed.

For eg. When a glass rod is rubbed with silk cloth, some electrons are transferred from glass rod to the silk cloth. When we run a comb through dry hair, the electrons transfer to the comb.

Even then the total charge on the two bodies is conserved.

(to remember = only electrons are transferred not protons as they are tightly bound inside the nucleus)

Electrostatic Potential (or potential):

Work done in bringing a unit charge from infinity to a point is called **potential** of that point.

The work done in bringing a unit charge from one point to another is called **potential difference**.

It is denoted by V.

It is a scalar quantity.

Its unit is volt (V).

$$V=\frac{W}{q}$$

$$\Rightarrow \quad 1\text{V}=\frac{1\text{J}}{1\text{C}}$$

If 1 joule of work is done in bringing a 1 coulomb charge from one point to another, potential difference is said to be **1 volt** between the two points.

Potential difference is measured by **voltmeter**.

Voltmeter is connected in **parallel** in the circuit due to its high resistance.

Electric current:

Flow of electrons in a conductor is called **electric current**.

It is denoted by I.

It is a scalar quantity.

Its unit is ampere (A).

$$I = \frac{q}{t}$$

$$\Rightarrow \qquad 1A = \frac{1C}{1s}$$

If 1 coulomb of charge passes through a place in 1s, the current there is **1 ampere**.

The direction of current is opposite to the direction of flow of electrons.

Current is measure by **ammeter**.

Ammeter is connected in **series** in the circuit.

A metal conductor has large number of free electrons in it. These electrons move in random directions and so make average velocity of electrons as zero. As a result there is no net flow of electrons or charge in a particular direction in a metal conductor. When some potential difference is applied across the two ends, the free electrons experience a force and start moving from negative end to the positive end of the conductor. On their way the free electrons suffer lots of collisions. They lost and regained their kinetic energy during these collisions. The process continues till the electrons reach the positive end of the conductor.

The average velocity with which free electrons get drifted towards positive end of the conductor is called **drift velocity**.

The materials which conduct electricity very easily are called **conductors**.

Example: silver (best), copper (second best)

The materials which do not conduct electricity easily are called **insulators**.

Example: wood, rubber

The materials whose conductivity lies between that of conductors and insulators are called **semiconductors**.

Example: silicon, germanium

Ohm's law:

According to his law, "at constant temperature, the current through a metallic element is proportional to the potential difference between the ends"

$$I \propto V$$

or $V \propto I$

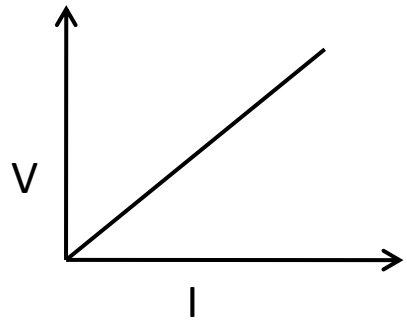
or $V = IR$

or $\frac{V}{I} = R$

or $\frac{V}{I} = a \ \ constant$

where R is constant and is called **resistance**.

Graph between potential difference and current:



Unit of resistance is **ohm** (Ω).

The property of the conductor due to which it opposes the flow of current through it is called **resistance**.

$$R = \frac{V}{I}$$

$$\Rightarrow \qquad 1\Omega = \frac{1V}{1A}$$

If potential difference of 1V is applied across an element and a current of 1A passes through it, the resistance of the element is called **1** Ω .

Resistance of a material depends on the following factors:

(i) on the length of wire (l) : more is the length of wire, more is the resistance

(ii) area of cross-section (A) : more is the area of cross-section, lesser is the resistance

Resistivity:

as we know $R \propto \frac{l}{A}$

$$\Rightarrow \qquad R = \rho \frac{l}{A}$$

here ρ (rho) is constant and is called **resistivity** of the material.

Resistivity of the material is the resistance of a piece of the material per unit cross section per unit length.

Resistivity may also be defined as the resistance of a cubical conductor of side 1 m.

Its unit is Ωm (ohm metre)

Value of resistivity of insulators is very high and that of conductors is very low.

Silver has the least resistivity, then is copper.

Note: In conductors, its value increases with temperature but in case of semiconductors resistivity decreases with rise in temperature. Resistivity of insulators may increase or decrease with temperature (depends on the system).

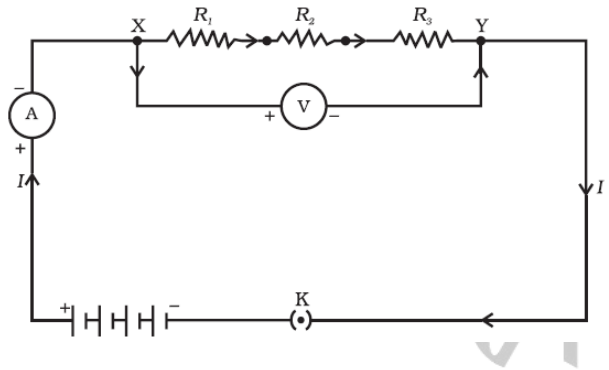
Series and parallel connections of resistances:

1) Series connection:

Consider three resistors of resistances R_1, R_2 and R_3 connected in series.

The free ends are connected to a cell which maintains a potential difference of V.

The current following through a cell is I which will be same in all the resistors.



If V_1, V_2 and V_3 be the potential difference across R_1, R_2 and R_3 respectively then

$$V = V_1 + V_2 + V_3$$

$$\Rightarrow \quad IR = IR_1 + IR_2 + IR_3 \qquad \text{(by ohm's law)}$$

$$\Rightarrow \quad R = R_1 + R_2 + R_3 \qquad \text{(obtained on dividing by } I\text{)}$$

Note:

In series resistance circuit

- the current is same in every resistor.
- the voltage (p.d.) across any resistor is directly proportional to the resistance of that resistor.

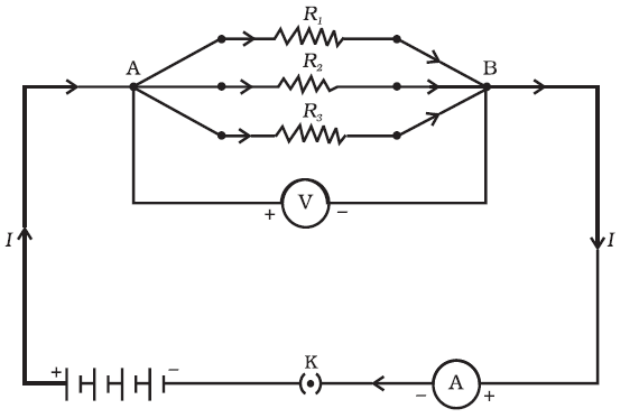
2) Parallel connection:

Consider three resistors of resistances R_1, R_2 and R_3 connected in parallel.

The free ends are connected to a cell which maintains a potential difference of V.

The current following through a cell is I.

The same potential difference V is applied to each resistor.



If I_1, I_2 and I_3 be the current across R_1, R_2 and R_3 respectively then

$$I = I_1 + I_2 + I_3$$

$$\Rightarrow \quad \frac{V}{R} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3} \qquad \text{(by ohm's law)}$$

$$\Rightarrow \quad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \qquad \text{(obtained on dividing by } V\text{)}$$

In parallel resistance circuit

- the potential difference is same in every resistor.
- the current through any resistor is inversely proportional to the resistance of that resistor.

Electric power:

It is the electric work done per unit time.

It is denoted by P.

Its SI unit is watt (W).

$$P = \frac{W}{t}$$

$$\Rightarrow \quad 1\text{W} = \frac{1\text{J}}{1\text{s}}$$

When 1 joule of work is done is 1 second power is said to be **1 watt**.

Commercial unit of power is **horse power** (H.P)

1 H.P. = 746 W

Also $P = VI = I^2R = \frac{V^2}{R}$

Note

- **when current is constant,** $P \propto R$
- **when potential difference is constant,** $P \propto \frac{1}{R}$

Electrical energy:

The electrical energy consumed by an electrical appliance is given by the product of its power and the time for which it is used.

Its SI unit is **joule**.

Its commercial unit is **kWh** (kilowatt hour)

1 unit	=	1 kWh
	=	1 kW × 1 hr
	=	1000 W × 3600 s
	=	3600000 Ws
	=	3.6×10^6 J

Therefore, **1 unit = 1 kWh = 3.6×10^6 J**

Heating effects of electric current:

When a current passes through a wire, some internal energy is produced in the form of heat. This heat produced by the current is given by

$$H = P \times t$$

$$\Rightarrow \quad H = VIt$$

$$\Rightarrow \quad H = I^2Rt \qquad (\because V = IR)$$

$$\therefore \quad H \propto I^2$$

$$H \propto R$$

$$H \propto t$$

If current is doubled, the heat produced will become four times (as $2^2 = 4$),

If resistance is tripled, the heat produced will also be tripled,

If time is quadrupled, the heat produced will also be quadrupled.

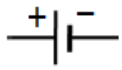
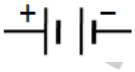
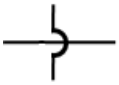
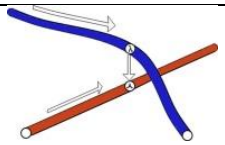
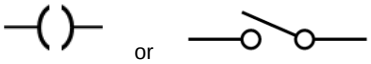
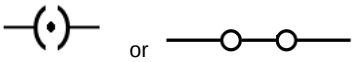
If 'I' is doubled, 'R' is tripled and 't' is quadrupled then, heat produced will get 48 times ($= 2^2 \times 3 \times 4$)

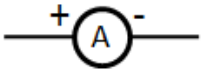
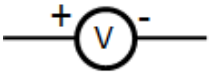
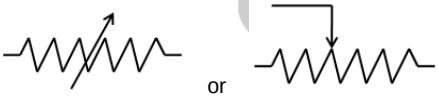
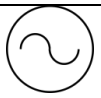
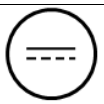
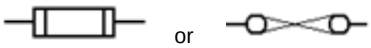
applications:

electric bulbs, room heaters, fuses, electric iron, etc. work on the heating effect of current.

In these appliances, a wire (called heating element) of suitable resistance is connected to power supply. The current passing through the element produces heat which can be used for specific purposes.

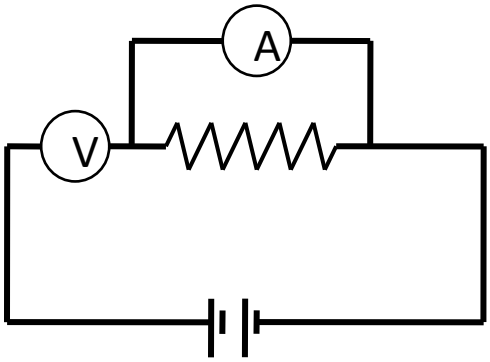
Symbols of some commonly used components in circuit diagrams:

Cell		
Battery		
A wire joint		
wires crossing without joining		
Open switch	 or	
Closed switch	 or	

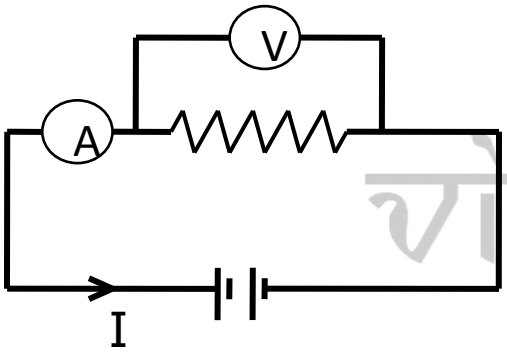
Resistor		
Ammeter		
Voltmeter		
Galvanometer		
electric bulb		
rheostat (variable resistance)	 or	
A.C. source		
D.C. source		
Fuse	 or	

assignment

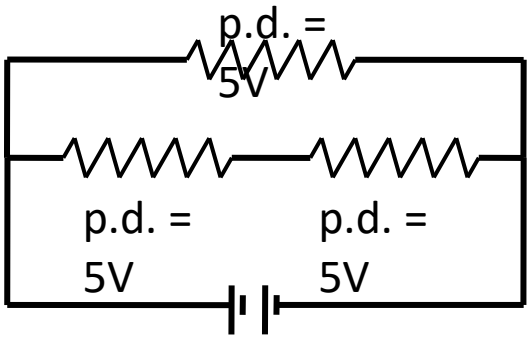
1) Find error(s) in the following:



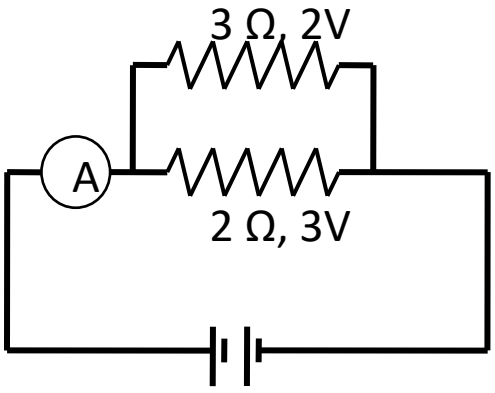
(a)



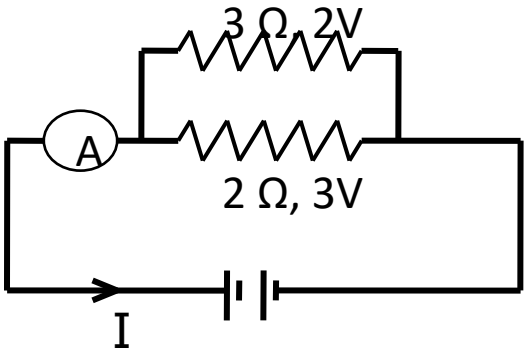
(b)



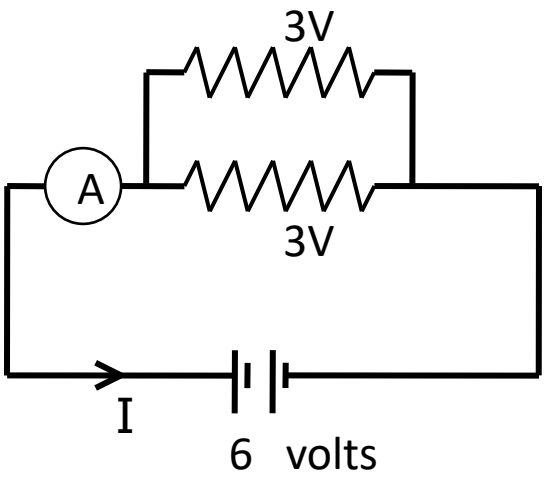
(c)



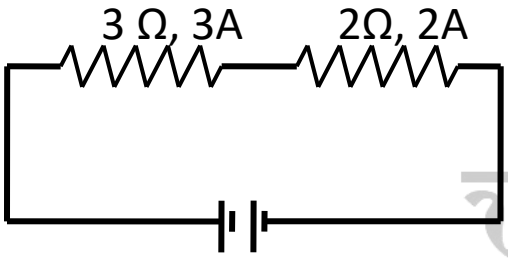
(d)



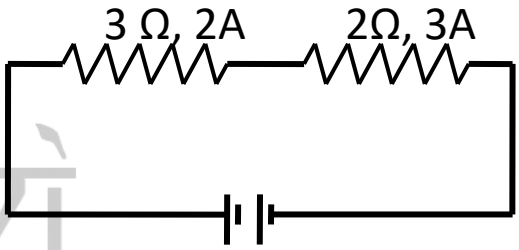
(e)



(f)

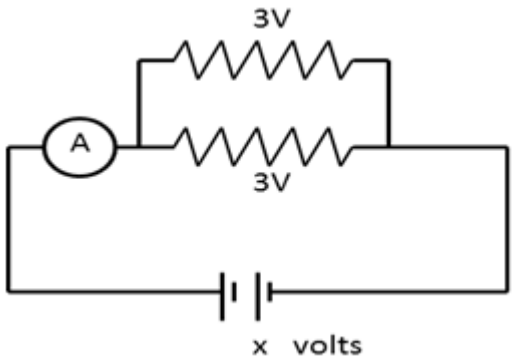


(g)

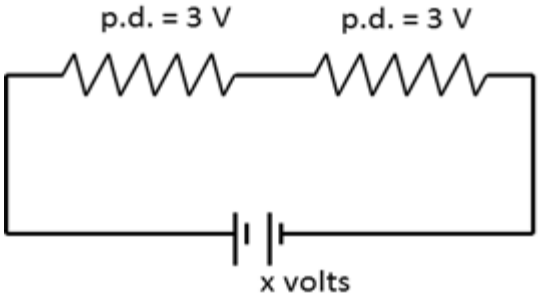


(h)

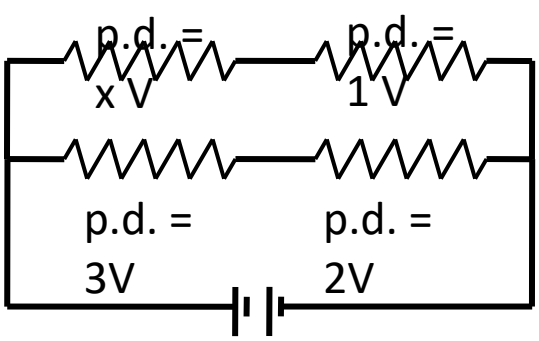
2) Find x:



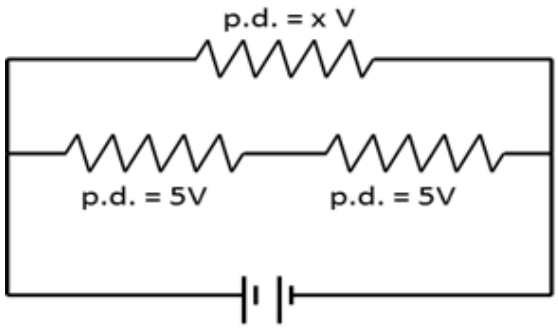
(a)



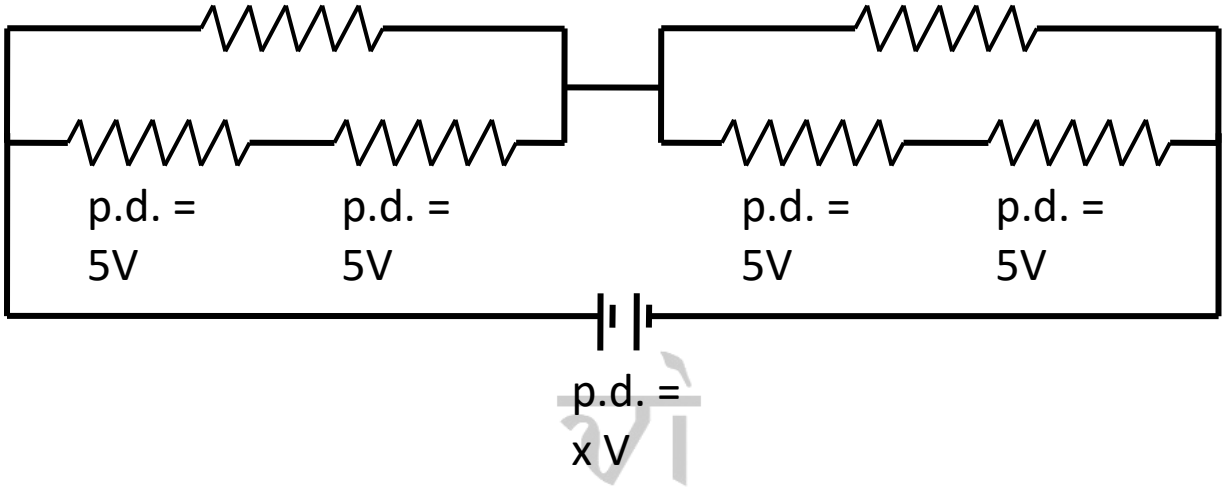
(b)


p.d. = x V
p.d. = 1 V
p.d. = 3V
p.d. = 2V

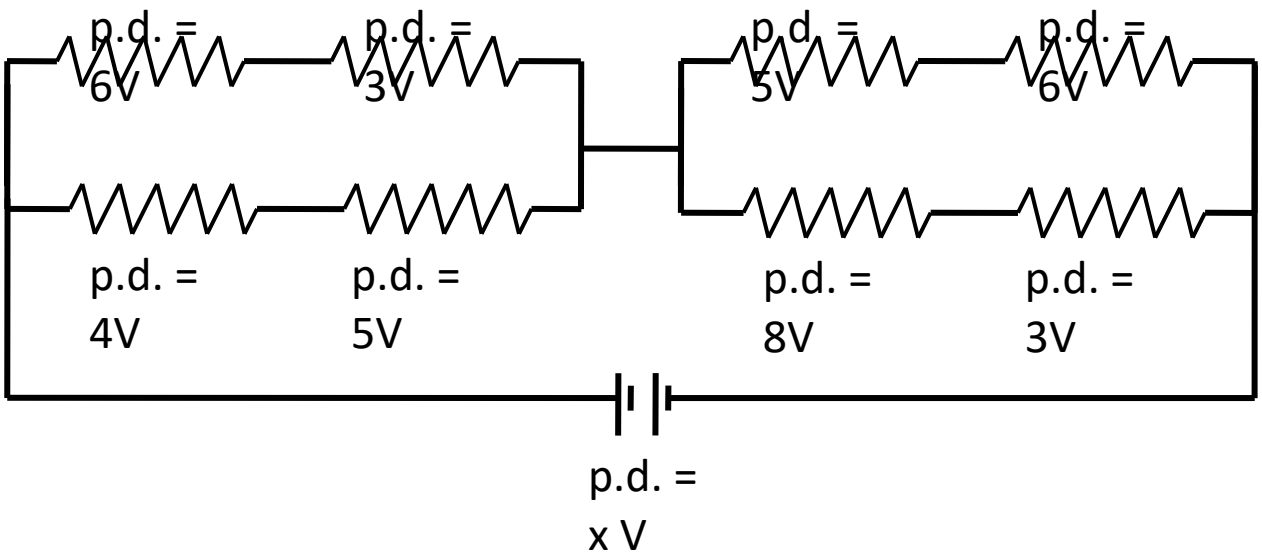
(c)


p.d. = x V
p.d. = 5V
p.d. = 5V

(d)


p.d. = 5V
p.d. = 5V
p.d. = 5V
p.d. = 5V
p.d. = x V

(e)


p.d. = 6V
p.d. = 3V
p.d = 5V
p.d. = 6V
p.d. = 4V
p.d. = 5V
p.d. = 8V
p.d. = 3V
p.d. = x V

(f)

3) Rate of flow of charges is called _____. It is denoted by _____ and its unit is _____. It is measured by _____. This instrument is connected in _____ in the circuit as it has _____ resistance. Direction of his quantity is opposite to the _____ or from _____ terminal to _____. It is equal to ratio of _____ and _____.
When 1 coulomb of charge moves for 1 second, _____ flown is _____.

4) Work done in moving _____ positive charge from infinity to a point is called _____ of that point. Work done in moving _____ positive charge from one point to another point is called _____ between these points. Unit of this quantity is _____. Its symbol is _____ and it is measured by _____. This instrument is connected in _____ due to its _____ resistance.
When _____ work is done in moving 1 C of charge from one point to another, _____ between the two points is said to be _____.

5) _____ effect of current is used in electrical appliances such as iron, toaster, oven, geysers etc. The filament of bulb is made up of _____, it gets very heated and then emits _____. This metal is used it has very _____ melting point and resistance. The bulbs are filled with chemically inactive nitrogen and argon gasses to prolong the life of filament.
A fuse is a safety device that works on _____ effect of current. Fuse is connected in _____ with the device. It consists of a wire made up of a metal with _____ m.p. and _____ resistance.

6) How many electrons constitute 1 coulomb charge?

7) Why copper is used in connecting wires?

8) Define current. What is its unit? Which instrument measures it? How is this instrument connected in circuit and why?

9) Define ampere.

10) Define potential difference. What is its unit? Which instrument measures it? How is this instrument connected in circuit and why?

11) Define volt.

12) Draw a circuit comprising a battery, a key, an ammeter, a voltmeter and a bulb.

13) Name the device which measures the p.d. across a conductor.

14) Name the device which maintains the p.d. across a conductor.

15) When electrons are constantly in motion across a conductor, why there is no current until potential difference is established?

16) Why are copper and aluminium wires usually employed for electricity transmission?

17) On what factor(s) resistivity of a material depends and how?

18) State Ohm's law. When does if fail?

19) Under what conditions ohm's law holds good?

20) How will the resistance R of the conductor be affected when

(a) V is halved

(b) L is halved

(c) A is halved

(d) both L and A are halved?

21) Define resistivity. On what factors does it depend and how?

22) Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Why?

23) Resistivities of A, B, C are $1.6 \times 10^{-8}\ \Omega$ m, $2.8 \times 10^{-8}\ \Omega$ m and $3.6 \times 10^{-7}\ \Omega$ m respectively. Which of these is best conductor of electricity?

24) When are three resistor called to be connected in parallel?

25) When are three resistor called to be connected in series?

26) Why is the series arrangement not used for domestic circuits?

27) Why does the cord of an electric heater not glow while the heating element does?

28) State the characteristics of a metal to be used as heating element.

29) Nichrome and copper wires of same length and same radius are connected in series. Current I is passed through them. Why does nichrome wire get heated first?

30) Why are coils of toasters and electric irons made of an alloy rather than a pure metal?

31) Why is tungsten used almost exclusively for filament of electric lamps?

32) Why are the conductors of electric heating devices, such as bread-toasters and electric irons, made of an alloy rather than pure metal?

33) Is power directly or inversely proportional to resistance?

34) Relate S.I. and commercial units of energy.

35) Which of the following effect can electricity can't produce: lighting, chemical, heating and magnetic effect?

36) When are three resistor called to be connected in parallel?

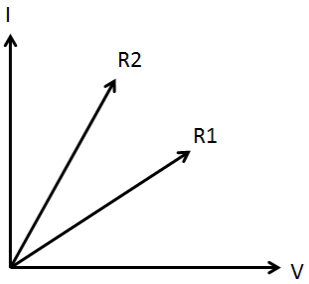
37) Write the function of rheostat, voltameter, voltmeter, ammeter, galvanometer.

38) Which physical quantity is measured in kWh?

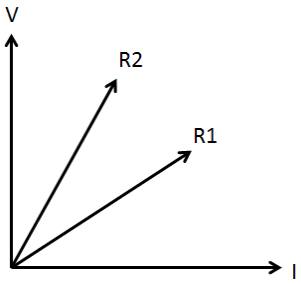
39) Fill in the blanks:

1 A	=	____ μA	1 mA	=	____ A
1 KWh	=	____ J	1 HP	=	____ W
1 nm	=	____ m	1 Mm	=	____m
1 mm	=	____m	1 W	=	____ HP
1 mV	=	____ V	1 C	=	____ electrons
1 HP	=	____ KW	1 Wh	=	____ J

40) Which resistance value is more: R_1 or R_2?

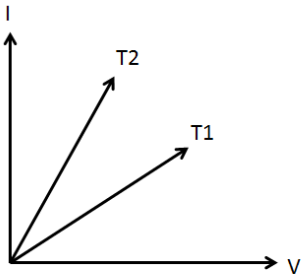


(a)

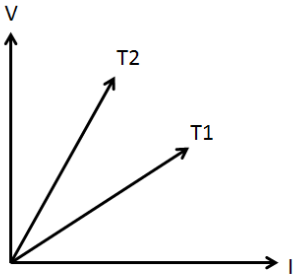


(b)

41) Which temperature is higher: T_1 or T_2?

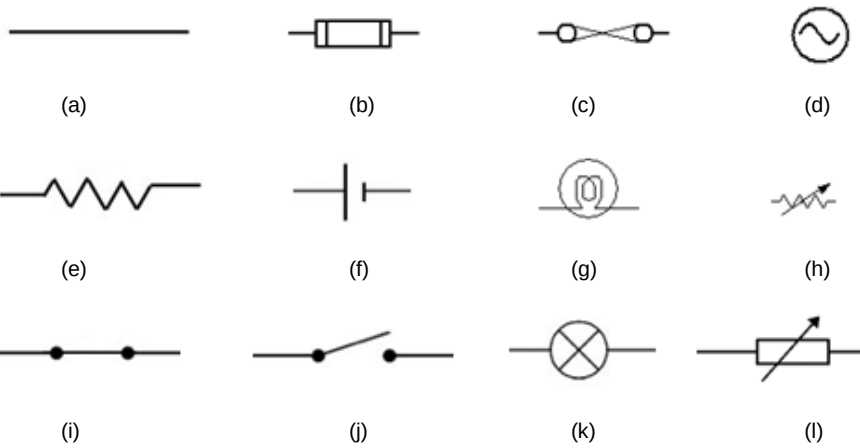


(a)



(b)

42) Identify following symbols:



(a) (b) (c) (d)

(e) (f) (g) (h)

(i) (j) (k) (l)

43) Three resistances of $1\,\Omega$, $2\,\Omega$ and $3\,\Omega$ are connected in parallel. Find the resultant resistance.

44) Connect three resistances of $30\,\Omega$ each to get their resultant equal to

(i) 90 Ω (ii) 10 Ω (iii) 45 Ω (iv) 20 Ω

45) 100 J of heat is produced each second in a $4\,\Omega$ resistance. Find the potential difference across the resistor.

46) A current of 0.5 A is drawn by a filament of an electric bulb for 10 minutes. Find the amount of electric charge that flows through it.

47) Compute the heat generated while transferring 96000 C of charge in 1 hour through a p.d. of 50 V.

48) An electric iron of resistance 20 Ω takes a current of 5 A. Calculate the heat developed in 30 s.

49) 3 V battery is connected across a 5 Ω resistor. Find heat produced by it in 5 seconds.

50) An electric kettle is rated as 500 W, 220 V. It is used for 30 s. Find heat produced.

51) How much energy is given to each coulomb of charge passing through a 6 V battery?

52) How much work is done in moving a charge of 2 C across two points having a potential difference 12 V.

53) How many 176 Ω resistors (in parallel) are required to carry 5 A on the 220 V line?

54) The p.d. between the terminals of an electric heater is 60 V when it draws a current of 4 A from the source, what current will the heater draw if the potential difference is increased to 120 V?

55) 6×10^{20} electrons cross through an area per minute. Find electric current.

56) A 4 V battery is connected to a lamp of resistance 4 Ω. Find current.

57) 10 Ω and 5 Ω resistors are connected in series across a battery of p.d. 7.5 V. Find current in the circuit.

58) An electric bulb is rated 220 V and 100 W. When it is operated on 110V, what will the power consumed?

59) If the resistance of wire of length 1.20 m and diameter 0.4 mm is found to be 2.5 Ω, what is the specific resistance of the material of the wire?

60) The specific resistance of the material of the wire is 44 x 10^{-8} Ω m. If the resistance of the wire is 14 Ω and its diameter is 1 mm, calculate the length of the wire.

61) A wire of resistance of wire is R. it is cut from the mid and the two parts are connected in parallel. What is the new resistance?

62) A wire of resistance R is bent to form a circle. Find resistance across any two diametrically end points.

63) A wire of resistance R is bent to form a square ABCD. Find resistance across

(i) AB (ii) AC (iii) AD

64) A wire of resistance R is bent to form a regular hexagon ABCDEF. Find resistance across

(i) AB (ii) AC (iii) AD (iv) AE (v) AF

65) Length of wire is stretched so that its length gets doubled. What will happen to resistance and resistivity?

66) Length of wire is stretched so that its length gets thrice. What will happen to resistance and resistivity?

67) Two resistances when connected in series give resultant = 90 Ω and when in parallel give resultant = 20 Ω. Find their values.

68) The resistance of two conductors in parallel is 12 Ω and in series is 50 Ω. Find the resistance of each conductor.

69) 4 Ω, 6 Ω and 10 Ω resistors are connected in series across 5 V battery. Find the p.d. across each resistance.

70) 10 Ω and 20 Ω resistors are connected in parallel.

(a) How will a current of 6 A divide in them?

(b) How will a p.d. of 6 V divide in them?

71) 10 Ω and 20 Ω resistors are connected in series.

(a) How will a current of 6 A divide in them?

(b) How will a p.d. of 6 V divide in them?

72) 10 Ω and 5 Ω resistors are connected in parallel and total current in a circuit is 7.5 A. Find p.d. of the battery.}

73) Two resistors of resistances 10 ohms and 20 ohms are connected in parallel. A battery supplies a current of 6 A to the combination. Find the current in each.

74) The electric iron consumes energy at the rate of 840 W when heating is at the maximum rate and 360 W when the heating is minimum. The voltage is 220V. What are the current and the resistance in each case?

75) How much current will an electric bulb draw from a 220 V source, if the resistance of the bulb filament is 1200 Ω ? How much current will an electric heater coil draw from a 200 V source, if the resistance of the heater coil is 100 Ω ?

76) Compare the power used in the 2 Ω resistor in each of the following circuits:

(a) a 6 V battery in series with 1 Ω and 2 Ω resistors, and

(b) a 4 V battery in parallel with 12 Ω and 2 Ω resistors.

77) An electric heater of resistance 8 Ω draws 15 A from the service mains 2 hours. Calculate the rate at which heat is developed in the heater.

78) Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then parallel in a circuit across the same p.d. Find the ratio of heat produced in series and parallel combination.

79) Several electric bulb designed to be used on a 220 V electric supply line, are rated 10 W. How many lamps can be connected in parallel with each other across the two wires of 220 V line if the maximum allowable current is 5 A?

80) A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of 24 Ω resistance, which may be used separately, in series, or in parallel. What are the currents in the three cases?

81) Two lamps, one rated 100 W at 220 V, and the other 60 W at 220 V, are connected in parallel to electric mains supply. What current is drawn from the line if the supply voltage is 220 V?

82) In the given circuit, find

(a) total resistance

(b) total I

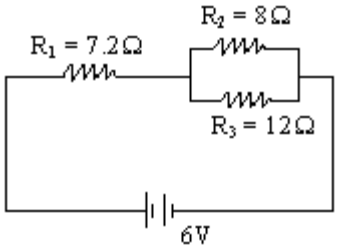
(c) p.d. across R_1.

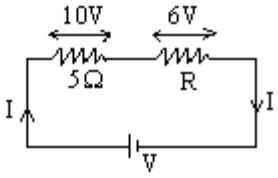
83) Two resistances are connected in series.

(a) What is the current through the $5\,\Omega$ resistance?

(b) What is the current through R?

(c) Find R and V.



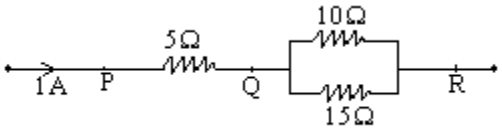


84) Three resistors are connected as shown. A current of 1A flows through $5\,\Omega$.

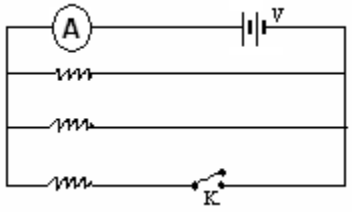
(a) What is the current through other two resistors?

(b) What is the p.d. across PQ and PR?

(c) What is the total resistance?



85) In the following circuit, the cell and the ammeter both have negligible resistance. The resistors are identical. With the switch K open, the ammeter reads 0.6A. What will be the ammeter reads 0.6A. What will be the ammeter reading in the ammeter when the switch is closed?



86) A 50 W fan is used for 20 hours, a 40W tube is used for 6 hours and a T.V. rated 100 W is used for 6 hours daily. Find units of electrical energy consumed in a month of 30 days. Also find its cost at the rate of Rs.5 per unit.

87) A iron of 500 W is used for 30 minutes. Find the cost of electricity consumed at the rate of ₹6 per unit.

88) Find the electricity consumed by a geyser rated 2 KW, 220 V when used for 20 minutes.

89) A room has two tube lights, a fan and a T.V. Each tube light draws 40 W, the fan draws 80 W and the T.V. draws 60 W. on the average the tube light are kept on for 5 hours, fan for 12 hours and T.V. for eight hours a day. The rate of electrical energy is Rs.3.10 per unit. Find the cost of electricity used in 30 days.

90) Consider the following data:

Appliance	**number of appliances**	**wattage**	**average usage time (daily)**
Tube	2	60 W	4 hrs
Fan	1	40 W	20 hrs
LED	1	250 W	2 hrs
AC	1	1.5 KW	8 hrs

Find the cost of using the above appliances for the month of 30 days at Rs. 5 per unit.

91) Consider the following data:

Appliance	**number of appliances**	**wattage**	**average usage time (daily)**
Tube	4	50 W	6 hrs
Fan	2	50 W	20 hrs
LED	2	250 W	4 hrs
AC	1	2 KW	10 hrs
Computer	1	250 W	4 hrs
Iron	1	750 W	40 minutes

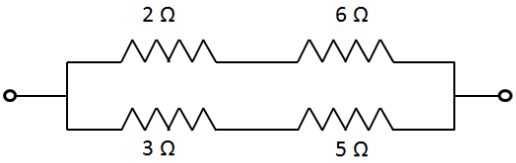
Find the cost of using the above appliances for the month of 30 days at Rs. 5 per unit.

92) Consider the following data:

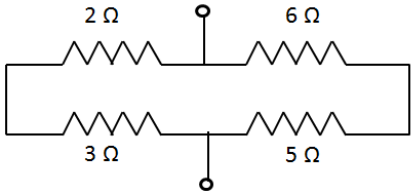
Appliance	**number of appliances**	**wattage**	**average usage time (daily)**
LCD	1	300 W	6 hrs
Fan	2	60 W	20 hrs
Tube	2	60 W	6 hrs
A.C.	1	1.5 KW	5 hrs
Geyser	1	1 KW	30 min.
Iron	1	1 KW	30 min.
Washing machine	1	900 W	30 min.
Oven	1	1 KW	15 hrs
Computer	1	200 W	4 hrs
Refrigerator	1	600 W	20 hrs

Find the cost of using the above appliances for the month of 30 days at Rs. 5 per unit.

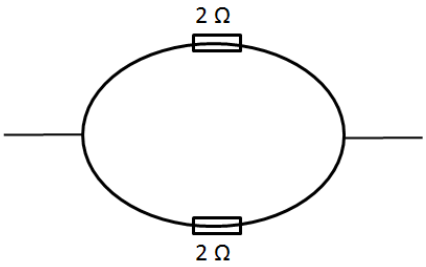
93) Find the effective resistance of the following:


2 Ω
6 Ω
3 Ω
5 Ω

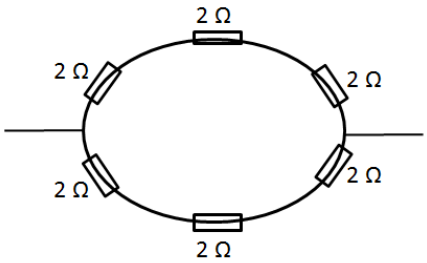
(a)


2 Ω
6 Ω
3 Ω
5 Ω

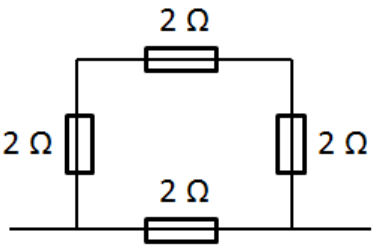
(b)


2 Ω
2 Ω

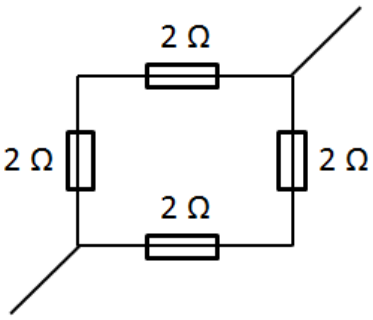
(c)


2 Ω
2 Ω
2 Ω
2 Ω
2 Ω

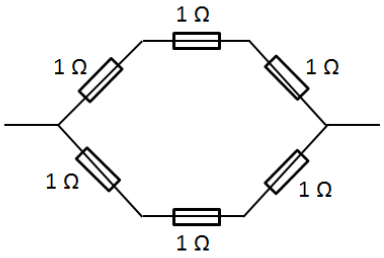
(d)


2 Ω
2 Ω
2 Ω
2 Ω

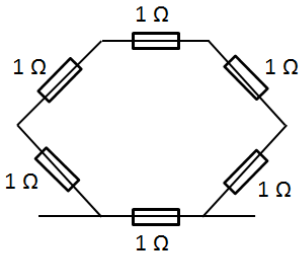
(e)


2 Ω
2 Ω
2 Ω
2 Ω

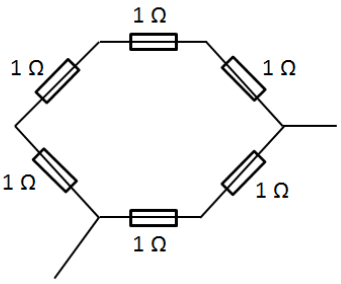
(f)


1 Ω
1 Ω
1 Ω
1 Ω
1 Ω
1 Ω

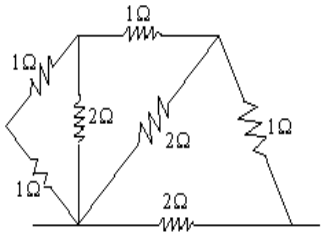
(g)

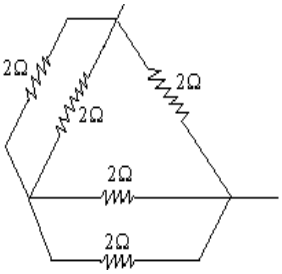

1 Ω
1 Ω
1 Ω
1 Ω
1 Ω
1 Ω

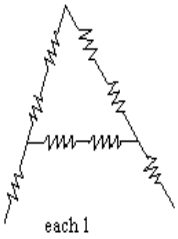
(h)

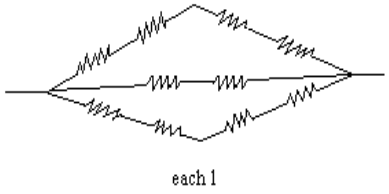

1 Ω
1 Ω
1 Ω
1 Ω
1 Ω
1 Ω

(i)

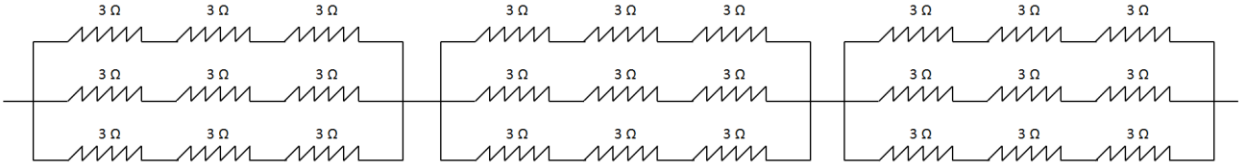

1Ω
1Ω
2Ω
2Ω
1Ω
1Ω
2Ω


2Ω
2Ω
2Ω
2Ω
2Ω

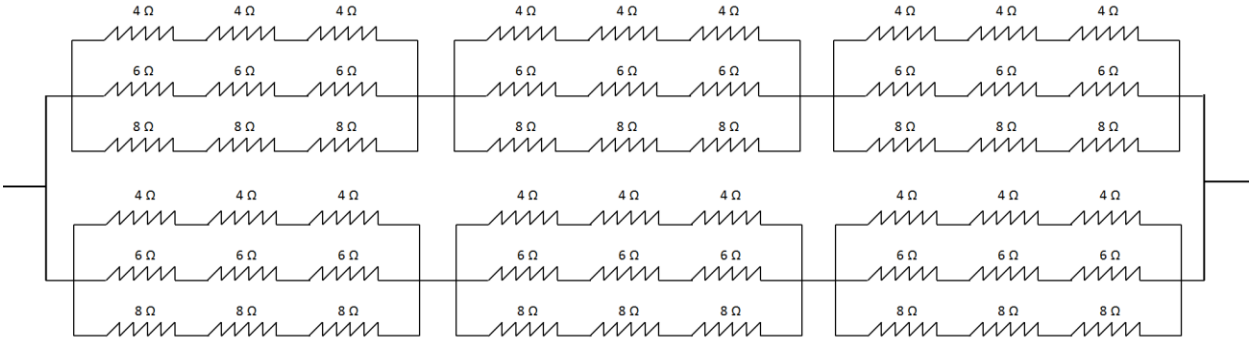

each 1


each 1

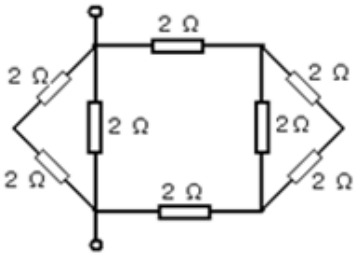
(j) (k) (l) (m)



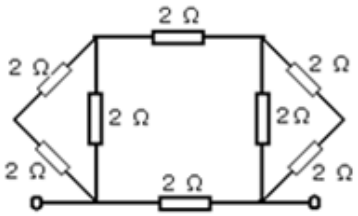
(n)



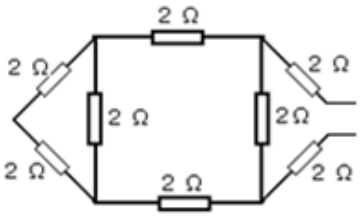
(o)



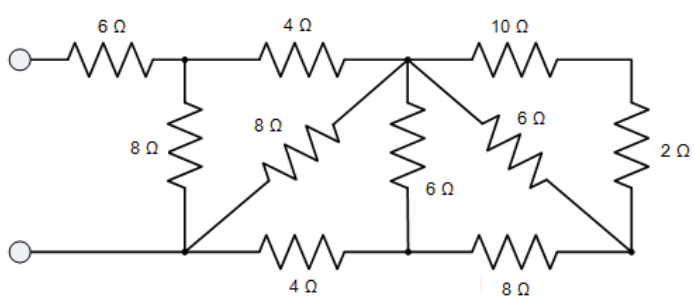
(p)



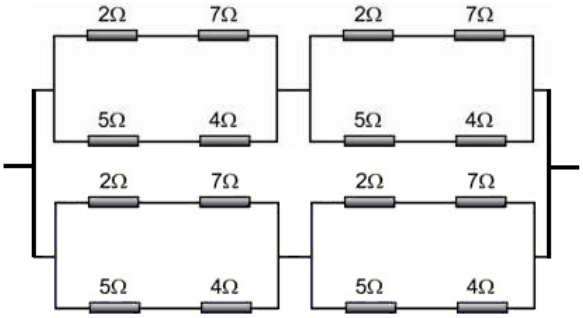
(q)



(r)



(s)



(t)

answers

2) (a) 3 (b) 6 (c) 4 (d) 10

(e) 20 (f) 20 43) 6/11 Ω 45) 20 V

46) 300 C 47) 4.8 MJ 48) 15 KJ 49) 9 J

50) 15 KJ 51) 6 J 52) 24 J 53) 4

54) 8 A 55) 1.6 A 56) 1 A 57) 0.5 A

58) 25 W 59) $2.6 \times 10^{-7}\Omega m$ 60) 25 m 61) R/4

62) R/4 63) (i) 3R/16 (ii) R/4 (iii) 3R/16

64) (i) 5R/36 (ii) 2R/9 (iii) R/4 (iv) 2R/9

(v) 5R/36

65) resistance = 4 times, resistivity = same 66) resistance = 9 times, resistivity = same

67) 30 Ω , 60 Ω 68) 30 Ω , 20 Ω 69) 1V,1.5V,2.5V

70) (a) 4A, 2A (b) 6V, 6V 71) (a) 6A, 6A (b) 2V, 4V

72) 25 V 73) 4A, 2A 74) 57.6 Ω , 134.1 Ω 75) 0.18A, 2.2A

76) (a) 8 W (b) 8 W 77) 1800 W 78) 1:4

79) 110 80) 9.2A, 4.6A, 18.3A 81) 0.73 A 82) 12 Ω , 0.5A, 3.6V

83) 2A, 2A, 3 Ω , 16V 84) (a) 0.4A, 0.6A (b) 5V, 11V 84) 11 Ω

85) 0.9 A 86) 55.2 units, Rs.276 87) Rs.1.50 88) 0.67 kWh

89) Rs.171.12 90) Rs.2067 91) Rs.4005 92) Rs.6250.50

93) (a) 4 Ω (b) 55/16 Ω (c) 1 Ω (d) 3 Ω

(e) 1.5 Ω (f) 2 Ω (g) 1.5 Ω (h) 5/6 Ω

(I) 4/3 Ω (j) 1 Ω (k) 1 Ω (l) 10/3 Ω

(m) 1 Ω (n) 9 Ω (o) 108/13 Ω (p) 16/15 Ω

(q) 1.4 Ω (r) 60/11 Ω (s) 10 Ω (t) 4.5 Ω

sOmEthIng UsELEss cUm IntErEstIng

ammeter

voltmeter

multimeter

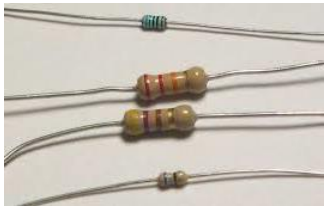
Rheostat

*capacitor (*used to store energy in an electric field*)*

semiconductor

electric eel

(fish which can generate shock up to 600 V)



resistor

diode

(allow electricity to flow in only one direction)

- Electricity travels at the speed of light more than 186,000 miles per second!
- As the temperature decreases, resistance of the conductor also decreases. The temperature, at which resistance of the conductor becomes zero, is called critical temperature. The conductor is known as superconductor at this time.

  These are used in making very strong electromagnets, very high speed computers and for transmission of electric power.
- Rub your feet across carpet and then touch a metal door handle. Then you can get shocked! Lightning works in the same way.
- Ohm-metre is a unit of resistivity;

  Ohm-Meter is an instrument used to measure resistance.
- Current is a scalar quantity as it does not follow the laws of vector addition.
- The current carrying wire is not charged as at any instant number of electrons is equal to the number of protons.
- The devices which do not obey Ohm/s law are called non-ohmic devices.

  Example: vacuum tube, semiconductor diode, liquid electrolyte, transistor.

  In non-ohmic devices, $\frac{V}{I} = R \ \ (but\ not\ constant)$
- In case of silicon, germanium and carbon, when temperature increases, their resistance decreases.
- When we switch ON the lights one after the other, the effective resistance of the circuit goes on decreasing and so main current goes increasing.
- When the motor starter of a car is operated, it draws more current from the battery. The potential difference across the light bulb is lowered and hence the light of a car is dimmed.
- To reduce the brightness of a light bulb, we should decrease the current flowing through the bulb and that can be done by increasing resistance.

- Electro motive force (emf) is the maximum potential difference between two electrodes of the cell when no current is drawn from the cell.

  Internal resistance is the resistance offered by the electrolyte and electrodes of the cell when current flows through it.
- Since electrons are negatively charged, they have a tendency to go to regions of high potential.
- A car battery is of 12 V. 8 simple cells connected in series can give 12 V but such combination is not used as their internal resistance is of the order 10 Ω while resistance of car battery is of the order 0.1 Ω.
- There are some materials of which the resistance becomes exactly zero by decreasing temperatures. These are known as super-conductors. The temperature, at which these become super conductors, is known as transition temperature.
- If you had a light bulb on the moon connected to a switch in your bedroom, it would take only 1.26 seconds for that bulb to light up, 238,857 miles away.
- If you traveled as fast as electricity, (about 300,000 kilometers = 186,411.358 miles per second the speed of light), you could go around the world 8 times in the time it takes to turn on a light switch.
- Metals like copper, silver, iron etc. are conductors as they have large number of free electrons.

  Rubber, glass, wood etc. are insulators as they have almost no free electron.

  In between the two there are materials like silicon and germanium in which number of free electrons is greater than insulators but less than conductors. These are known as semi-conductors.

  Their resistivity decreases as the temperature increases.

  Their resistivity can also be decreased to high extent by adding appropriate impurities in them.

  By controlling the amount of impurity and its distribution, very useful electronic devices are formed from semiconductors which are used in computers, watches, calculators etc.
- Most photocopying machines are based on the properties of electric charges. A photocopying machine has a powerful light source and a system of mirror and lenses which forms an image of the original document on a rollers made of special material. The roller is initially positively charged. The material of the roller has the property of losing its charge when exposed to light. Light reflected from white portions of the original document falls on the roller and these portions of the drum lose their charge. The dark portion of the original does not reflect light, and, therefore the corresponding areas on the roller retain positive charge. For printing, a negatively charge toner (ink) is used. The positive charged areas on the roller attract the negatively charged toner. As the drum rotates, the toner gets transferred to the paper, which passes in contact with the drum. This way, the dark portions on the original document are imaged on the paper.
- **How does a CD store data?**

  A CD writer burns little holes in an aluminum disk (between 2 plastic plates). This causes little bumps to appear on the disc. A CD drive can read the data back out using a laser that reflects on that surface. In a bump the laser will reflect in a different angle then when there isn't a bump. The CD drive detects this and reads a '1' if the laser is not reflected (no bump) and a '0' if the laser is reflected (hits a bump).

  This method of storing data contains a lot of errors, bumps that are read wrong.

That's why a CD contains 2/3 fault checks on the actual data. This means that on a CD you can actually write 2.1 GB of data, but only 700 mb is the data you store because 1.4 gb is used to repair the mistakes in reading.

- **Blu ray disc:**

  Blu-ray Disc (BD) is a digital optical disc data storage format designed to supersede the DVD format. The plastic disc is 120 mm in diameter and 1.2 mm thick, the same size as DVDs and CDs.

  Conventional (pre-BD-XL) Blu-ray Discs contain 25 GB per layer, with dual layer discs (50 GB) being the industry standard for feature-length video discs. Triple layer discs (100 GB) and quadruple layers (128 GB) are available for *BD-XL* re-writer drives. The name *Blu-ray Disc* refers to the blue laser used to read the disc, which allows information to be stored at a greater density than is possible with the longer-wavelength red laser used for DVDs. The major application of Blu-ray Discs is as a medium for video material such as feature films. Besides the hardware specifications, Blu-ray Disc is associated with a set of multimedia formats. Generally, these formats allow for the video and audio to be stored with greater definition than on DVD.

- **Difference between CD, DVD, BD**