

## Chapter: 14

## Current Electricity

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## Objective

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1. The mathematical form of current is:

☐ (A)  $I = VR$

☒ (B)  $t = \frac{q}{t}$

☐ (C)  $I = \frac{t}{q}$

☐ (D)  $I = QR$

2. The unit of current is:

☒ (A) Ampere

☐ (B) Joule

☐ (C) Coulomb

☐ (D) volt

3. If 0.5C charge passes through a wire in 10 seconds, then current will be:

☒ (A) 50 mA

☐ (B) 5mA

☐ (C) 5 A

☐ (D) 20A

4. In an Electric circuit when Electrons move from low to high potential they will:

☐ (A) Lose their identity

☐ (B) Gain energy

☒ (C) Lose energy

☐ (D) Gain potential

5. An electric current in conductors is due to the flow of:

☐ (A) Negative ions

☐ (B) Positive ions

☐ (C) Positive charges

☒ (D) Free electrons

6. One milli ampere is equal to:

☐ (A)  $10^{-2}A$

☐ (B)  $10^{-1}A$

☒ (C)  $10^{-3}A$

☐ (D)  $10^{-12}A$

7. The rate of flow of charges is called:

☐ (A) Coulomb

☐ (B) Volt

☐ (C) Current

☒ (D) Current

8. Electrical potential and e.m.f:

☒ (A) Are the same terms

☐ (B) Positive ions

☐ (C) Are the different terms

☐ (D) Have different units

9. Formula of e.m.f is equal to:

☒ (A)  $E = \frac{W}{Q}$

☐ (B)  $F = mv$

☐ (C)  $W = EQ$

☐ (D)  $W = \frac{E}{Q}$

10. And ideal voltmeter has a resistance:

☒ (A) Very high

☐ (B) low

☐ (C) Very low

☐ (D) Nothing

11. What will be the voltage across the 6 Ohm resistor when 4 Ampere current passes through it:

☐ (A) 36V

☒ (B) 18V

☐ (C) 9V

☐ (D) 2V

12. Mathematical equation of Ohm's law is:

☒ (A)  $V = IR$

☐ (B)  $V = IR^2$

☐ (C)  $V = QT$

☐ (D)  $V = I^2R$

13. SI unit of resistance is:

☐ (A) Farad

☒ (B) Ohm

☐ (C) Volt

☐ (D) Ampere

14. Specific resistance of copper is ....  $\times 10^{-8}\Omega m$ .

☐ (A) 5.25

☐ (B) 2.75

☐ (C) 1.62

☒ (D) 1.69

15. An electric current in conductor is due to the flow of:

☒ (A) Free electrons

☐ (B) Positive charges

☐ (C) Positive ions

☐ (D) Negative ions

16. What happens to the intensity or the brightness of lamps connected in series as more and more lamps are added:

☐ (A) Cannot be change

☐ (B) Remain same

☐ (C) Increase

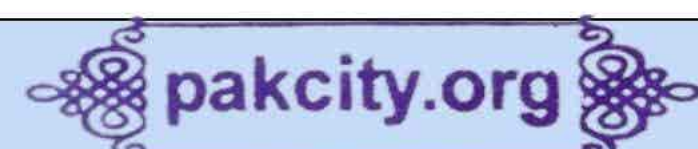
☒ (D) Decrease



17. When resistances are connected in series the current passing through them is:  
 (A) Zero (B) Same (C) Different (D) None of these
18. The SI unit of e.m.f is:  
 (A) JC (B) NC (C) JC<sup>-1</sup> (D) NC<sup>-1</sup>
19. Mathematical form of Joule's law is:  
 (A)  $W = I^2 R^2 T$  (B)  $W = IR^2 T$  (C)  $W = IRT$  (D)  $W = I^2 RT$
20. Electrical Energy is given by:  
 (A)  $Qt$  (B)  $QC$  (C)  $QR$  (D)  $QV$
21. Five joules of work is needed to shift 10C of charge from one place to another. The potential difference between the places is:  
 (A) 0.5V (B) 10V (C) 2V (D) 5V
22. If e.m.f of a battery is 2V, then the energy supplied by battery is ..... when one coulomb of charge flows through the close circuit.  
 (A) 4J (B) 2.8J (C) 5J (D) 2J
23. What is the power rating of a lamp connected to a 12V source when it carries 2.5A:  
 (A) 60W (B) 30W (C) 14.5W (D) 4.8W
24. The unit of electric power is:  
 (A) Volt (B) Joule (C) Ampere (D) Watt
25. The electric power of washing machine in watt is:  
 (A) 800 (B) 750 (C) 100 (D) 50
26. One watt is equal to:  
 (A)  $sJ^{-1}$  (B)  $J^2s$  (C)  $Js$  (D)  $Js^{-1}$
27. 1kWh is equal to: OR 1 kilowatt is equal to:  
 (A) 4.6MJ (B) 3.6Mj (C) 4.6J (D) 3.6kJ
28. When we double the voltage in a simple electric circuit, we double the:  
 (A) Power (B) Both A and C (C) Current (D) Resistance
29. One micro ampere is equal to:  
 (A)  $10^{-12}A$  (B)  $10^{-9}A$  (C)  $10^{-6}A$  (D)  $10^{-3}A$

## Chapter : 14

## Current Electricity



## ★ Subjective ★

Q1: **Define and explain the term electric current.**

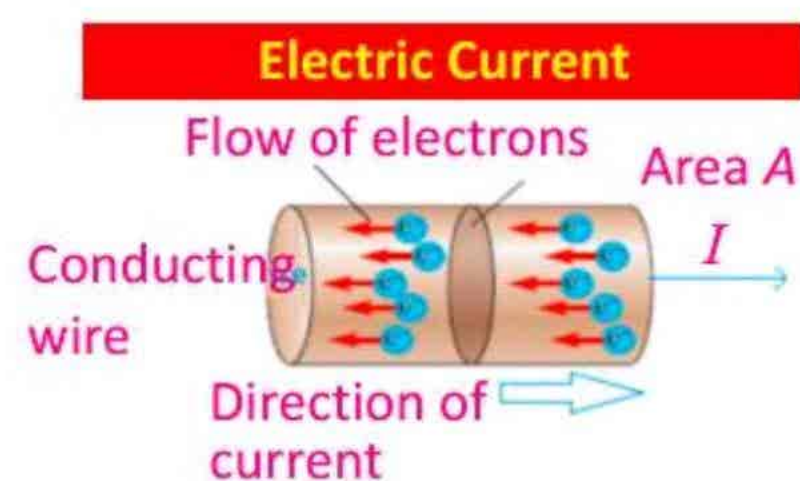
Ans: **Electric Current:**

The rate of flow of electric charge through any cross sectional area is called current. If charge 'Q' is passing through any area in time then current 'I' flowing through it will be:

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

**S.I. unit of Electric Current:**

The S.I. unit of current is ampere (A).



The current is the rate of flow of charge.



**Ampere:**

If one coulomb charge passes through any cross sectional area in one second then current will be equal to one ampere.

Without a battery the net current in a conductor will be zero because number of charges moving rightwards and leftwards will be same. But in the presence of battery, due to potential difference charge carriers move in certain direction and current is produced. It means potential difference is necessary for producing current. The electric current can also be changed in other form of energy, but total number of charge carriers remains same.

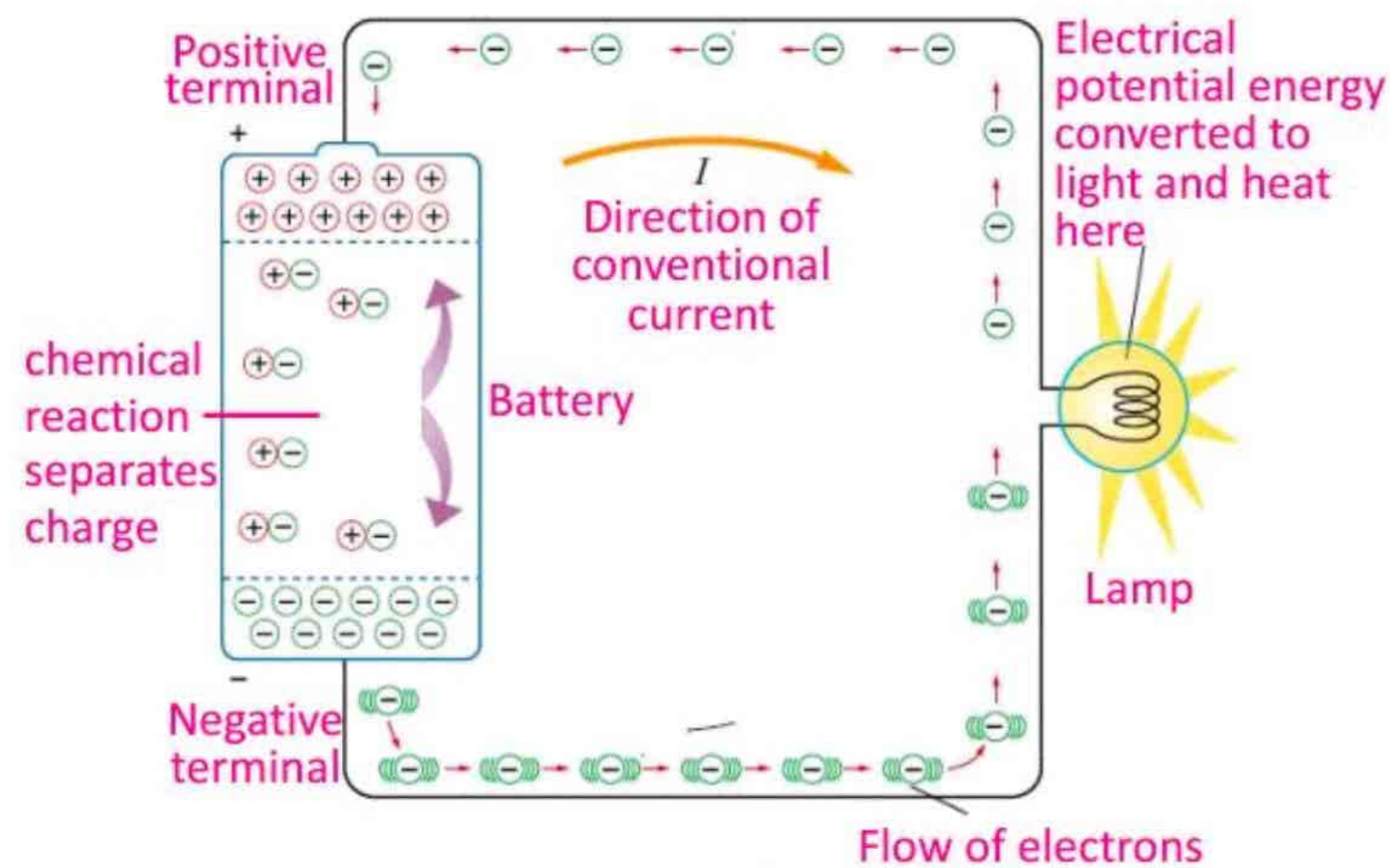


Fig. : Schematic diagram of battery as a current source

Q2: **What is the difference between electric current and conventional current?**

Ans: The difference between electric current and conventional current is:

Electric current	Conventional Current
❖ This current is produced due to flow of free electrons or negative charges.	❖ This current is produced due to flow of positive charges.
❖ Its direction is from negative terminal of the battery to positive terminal of the battery.	❖ Its direction is from positive terminal to negative terminal of the battery.

Q3: **What do we mean by the term e.m.f? Is it really a force? Explain.**

Ans: **Electromotive Force:**

It is the energy supplied by a battery to a unit positive charge when it flows through the closed circuit.

$$E = \frac{W}{Q}$$

Where  $E$  is e.m.f. Thus the  $W$  is energy converted from non-electric form to electric form and  $Q$  is a positive charge.

**Unit of e.m.f:**

Unit of e.m.f is  $JC^{-1}$  which is equal to volt.

Electromotive force is not force but actually a voltage between the terminals of battery even when no current flows in circuit. The e.m.f. represents the energy per unit charge which is available when nonelectrical form of energy is converted into electrical form.

Q4: **How can we differentiate between e.m.f and potential difference?**

Ans: Difference between e.m.f and potential difference:

Electromotive force	Potential Difference
❖ Electromotive force is the potential difference between two terminals of cell.	❖ The difference between potential of two points is called potential difference.
❖ Electromotive force can introduce energy to the system.	❖ It cannot introduce energy to the system. But dissipate energy in the circuit.
❖ It is gain in energy per unit charge.	❖ It is loss in energy per unit charge.



Q5: **Define resistance and its unit.**

Ans: **Resistance:**

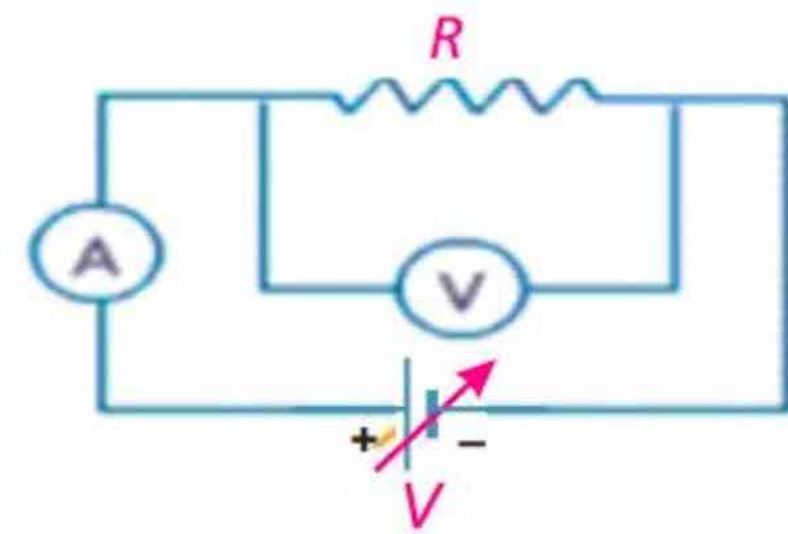
The property of a substance which opposes the flow of current through it is called resistance.

**Unit of e.m.f:**

Its S.I. unit is ohm.

**Ohm:**

If the current of one ampere is flowing through the conductor due to potential difference of one volt then its resistance is one ohm.



Q6: **What is difference between conductors and insulators?**

Ans: The difference between conductors and insulators:

Conductors	Insulators
❖ The substances through which electric current can pass easily are called conductors.	❖ The substances through which electric current cannot pass easily are called insulators.
❖ It has more number of free electrons.	❖ They have no free electrons for the flow of current.
❖ For example metals like silver, copper, Gold etc. are conductors.	❖ For example fur, wood, plastic etc. are insulators.

Q7: **What is difference between DC and AC?**

Ans: Difference between DC and AC:



Direct Current or DC	Alternating Current or AC
❖ The current that does not change its direction of flow and is unidirectional is called direct current.	❖ The current that changes its direction after equal interval of time is called alternating current.
❖ The current derived from a cell or a battery is direct current.	❖ The current supplied to our homes by the power companies is alternating current.
❖ Direct current cannot be transmitted to long distances.	❖ Alternating current can be transmitted to long distances with less power losses.

Q8: **Write down features of parallel combination of resistors.**

Ans: The features of parallel combination of resistors:

- ❖ In parallel combination one end of each resistor is connected to positive terminal while other end of each resistor is connected to negative terminal of the battery, so voltage across each resistor is same.
- ❖ The total current is equal to the sum of the current in various resistors.
- ❖ The equivalent resistance of combination is given by

$$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

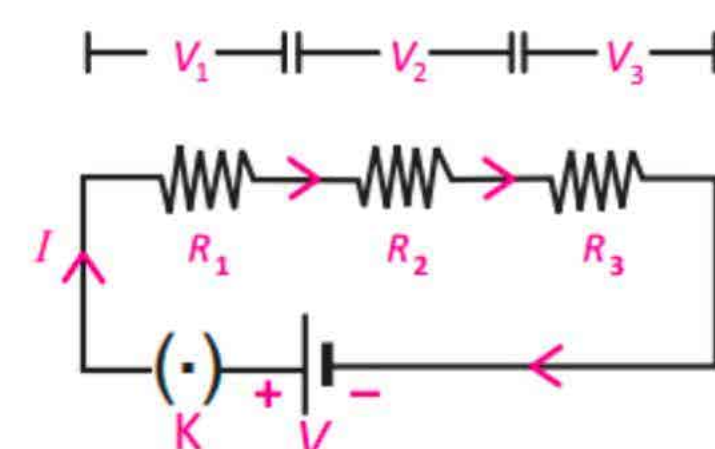


Fig.. Three resistors in series combination

Q9: **What is the difference between current flow and water flow?**

Ans: The flow of charge in a circuit is like the flow of water in a pipe except that a conducting wire is needed in order to have a complete conducting path.

Q10: **If 0.5C charge passes through a wire in 10 seconds, then what will be the value of current?**

Ans:  $Q = 0.5C$

$t = 10s$

$I = ?$

**Solution:**



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

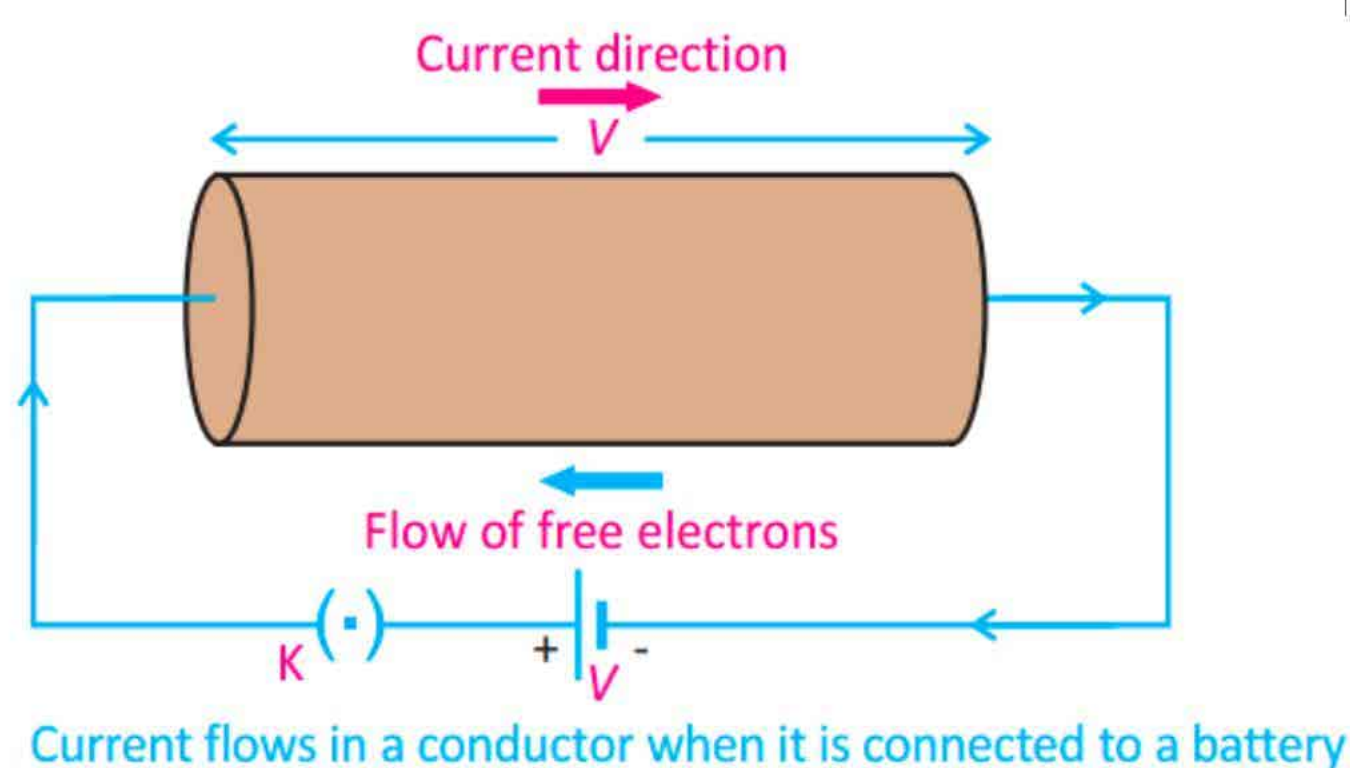
$$I = \frac{0.5C}{10s}$$

$$I = 0.05Cs^{-1}$$

$$I = 0.05A$$

$$I = 50A$$

Total current flow through wire,  $I = 50mA$



**Q11: What is meant by Conventional current? What is the direction of conventional current? Or What do you mean by Conventional current? Or Define Conventional current.**

**Ans:** Current flowing from positive to negative terminal of a battery due to the flow of positive charges is called conventional current.

**Direction:**

Conventional current produces the same effect as the current flowing from negative terminal to the positive terminal due to the flow of negative charges.

**Q12: Write briefly the function of galvanometer.**

**Ans:** Galvanometer is very sensitive Instrument and can detect small current in a circuit. A current of few mille amperes is sufficient to cause full scale deflection in it. Of the connection polarity should keep in mind while use galvanometer. After suitable modification galvanometer can be converted into an ammeter.

**Q13: What is the difference between Galvanometer and Ammeter?**

**Ans:** The difference between Galvanometer and Ammeter is:

Galvanometer	Ammeter
❖ Galvanometer is very sensitive Instrument and can detect small current in a circuit.	❖ A large current of the range such as 1A or 10A can be measured by means of ammeter.
❖ It is connected in series, so the current flowing in the circuit also passes through the galvanometer.	❖ Ammeter is connected in series, so the current flowing in the circuit also passes through the ammeter.

**Q14: What is the difference between cell and battery?**

**Ans:** The difference between cell and battery is:

Cell	Battery
❖ A cell is a single unit at the base voltage.	❖ A battery can be single cell or multiple cells connected together in series or parallel to make the voltage current rating as required.

**Q15: In order to measure current in a circuit, why ammeter is always connected in series?**

**Ans:** Like galvanometer, ammeter is also connected in series, so the current flowing in the circuit also passes through the ammeter.

**Q16: Which instrument is used to measure the current in circuit? How it is connected?**

**Ans:** Ammeter is used for measurement of electric current. It always connected in series while measuring electric current.

**Q17: Define Volt.**

**Ans:** The potential difference between two points will be 1 volt if 1J of energy consumed by 1C charge while flowing between two point.

**Formula:**

$$1V = 1JC^{-1}$$

**Q18: Which are sources of e.m.f? Write names. OR Write names of two sources of E.M.F.**

**Ans:** Battery, dry cells etc. are sources of e.m.f.

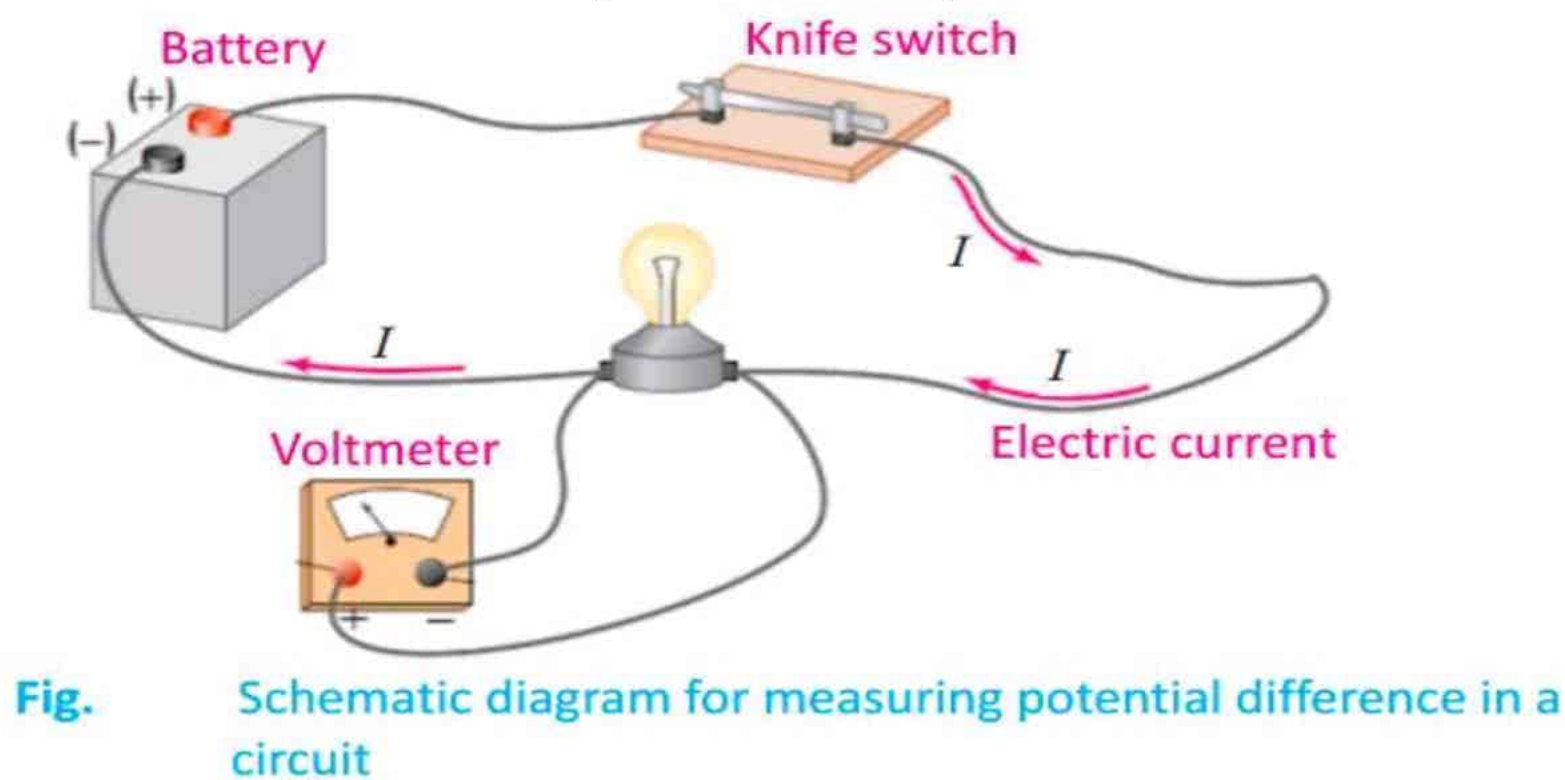


Q19: **What is digital multimeter?**

Ans: A digital multimeter can be used to measure current resistance. And potential difference.

Q20: **How we measure e.m.f of a battery?**

Ans: In order to measure e.m.f of the battery, we connect voltmeter directly with the terminal of the battery.



For your information



A digital multimeter can be used to measure current, resistance and potential difference. Here, the multimeter is in voltmeter mode to measure the potential difference across a battery.

Q21: **State Ohm's law and write its equation.**

Ans: The amount of current passing through a conductor is directly proportional to the potential difference applied across its ends, provided the temperature and the physical state of the conductor do not change.

**Equation:**

$$I \propto V$$

$$V \propto I$$

$$V \propto IR$$

Q22: **What are the limitations of the Ohm's Law?**

Ans: The limitations of the Ohm's Law are:

- ❖ Ohm's law is valid only for metals (specific metals).
- ❖ Ohm's law is valid if the temperature and physical state of metals do not change.

Q23: **Define Ohm. Write its symbol.**

Ans: When a potential difference of one volt is applied across the ends of a conductor and one ampere of current passes through it, thus its resistance will be one ohm. It is represented by  $\Omega$ .

Q24: **What is meant by Ohmic conductors?**

Ans: Materials that obey Ohm's law and hence have a constant resistance over a wide range of voltages are called Ohmic conductors. Most of metals are Ohmic.

Q25: **What are Non-Ohmic conductors?**

Ans: Materials does not obey Ohm's law is called non-Ohmic conductors and the resistance of that material varies at high range of voltages. Thermistor and filament are non-Ohmic.

Q26: **What is meant by thermistor?**

Ans: A type of electrical resistor whose resistance is greatly reduced by heating used for measurements and control. Its resistance decrease when temperature increases.

### Conceptual Question



Q1: **Why in conductors charge is transferred by free electrons rather than by positive charge?**

Ans: As conductor carries a large number of free electrons so the charge in conductor is transferred by free electrons, also physical movement is possible only in case of electrons.

Q2: **What is difference between cell and a battery?**

Ans: A cell is an energy or charge storing device that consists of a single set of plates while battery is an energy storing device which consists of a number of sets of plates connected in series. A cell is usually dry while in battery electrolyte is used.

Q3: **Can current flow in a circuit without potential difference?**



Ans: **No**, current in a circuit cannot flow without a potential difference between ends of battery. According to Ohm's law current passing through the conductor is directly proportional to the potential difference.

Q4: **Two points on an object are at different electric potentials. Does the charge necessarily flow between them?**

Ans: If two points are at different potentials then charge will flow due to potential difference. If there is no potential difference then charge will not flow.

Q5: **In order to measure current in a circuit why is ammeter always connected in series?**

Ans: The resistance of an ammeter is very small due to which it does not affect the circuit current. Also in series combination current across each component of circuit is same so the scale reading of ammeter shows the current across each component.

Q6: **In order to measure voltage in a circuit why is voltmeter always connected in parallel?**

Ans: If voltmeter is connected in parallel then due to high resistance no current passes through it and circuit voltage remains unaffected.

Q7: **How many watt hours are there in 1000 J?**

Ans: Watt hours are there in 1000 J:

$$1 \text{ KWh} = 3.6 \text{ MJ}$$

$$3.6 \times 10^3 \times 10^3 \text{ J} = 1 \text{ KWh}$$

$$1000 \text{ J} = \frac{1}{3.6 \times 10^3} \text{ KWh}$$

$$1000 \text{ J} = \frac{1}{3.6} \text{ Wh}$$

$$1000 \text{ J} = 0.28 \text{ Wh}$$

Q8: **From your experience in watching cars on the roads at night, are automobile headlamps connected in series or in parallel?**

Ans: Headlights of automobiles are always connected in parallel because due to technical fault, if one lamp does not work, the other will work properly. Because in parallel circuit each device receives full battery voltage.

Q9: **A certain flash light can use a 10 ohm bulb or a 5 ohm bulb. Which bulb should be used to get the brighter light? Which bulb will discharge the battery first?**

Ans: According to the relation  $I = V/R$  we can conclude that current and resistance have inverse relation. A flash light with 5 ohm bulb gives bright light and will discharge the battery first as compared to 10 ohm bulb.

Q10: **It is impracticable to connect an electric bulb and an electric heater in series, why?**

Ans: If both heater and bulb are connected in series then equivalent resistance increase and potential difference will drop. Also if one appliance stops working the other will not run.

Q11: **Does fuse in the circuit controls the potential difference or current?**

Ans: A fuse consists of a wire through which current up to certain limit can pass. If the current exceeds the wire melts due to heat and fuse blows out. So the fuse controls the current.

### Additional Question



Q1: **State Joule's law and write down its formula.**

Ans: The amount of heat energy generated in a resistance is due to flow of electric current is equal to product of square of current, resistance and time.

$$W = I^2 R t$$

Q2: **Define kilowatt hour (kWh).**

Ans: It is the amount of energy obtained from a power of one kilowatt in one hour. It is equal to 3.6 MJ.

Q3: **Define resistance and give name of its unit.**



Ans: The property of a substance which opposes the flow of current through it is called resistance.

**Unit:** Its unit is ohm.

Q4: **Define specific resistance or resistivity and write down its formula and unit.**

Ans: The resistance of one meter cube of a substance is called specific resistance.

**Unit:** Its unit is ohm-m.

**Formula:**

$$R = \rho \frac{L}{A}$$

Q5: **Define unit of resistance. OR Define ohm.**

Ans: A material has a resistance of one ohm if there is a current of one ampere flowing through it when the potential difference across it is one volt.

Q6: **What is electromotive force? Write its unit.**

Ans: The energy supplied by the battery to a unit charge when it flows through the closed circuit is called electromotive force.

**Unit:** Its unit is volt.

Q7: **Define electric power? Write down its formula**

Ans: The amount of energy supplied by current in unit time is called electric power.

**Formula:**

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

Q8: **Prove that 1kWh = 3.6 MJ**

Ans: **Prove:**

$$1 \text{ kWh} = 1000 \text{ watt} \times 1 \text{ hour}$$

$$1 \text{ kWh} = 1000 \frac{\text{J}}{\text{sce}} \times 3600 \text{ sec}$$

$$1 \text{ kWh} = 10^3 \times 36 \times 10^2 \text{ J}$$

$$1 \text{ kWh} = 36 \times 10^5 \text{ J}$$

$$1 \text{ kWh} = 36 \times \text{MJ}$$

Q9: **What is circuit breaker? Write its working principle.**

Ans: A safety device used in place of fuse is called circuit breaker. It breaks the electric circuit if current increases beyond the given rating works on the principle of electromagnetism.

Q10: **How ammeter is connected in circuit?**

Ans: In order to measure current in circuit, current passing in circuit also passes through the ammeter.

Q11: **What is difference between earth wire and live wire?**

Ans: Difference between earth wire and live wire is:

Earth Wire	Live Wire
❖ The wire carries no electricity is called earth wire or ground wire.	❖ The wire which is at high potential having voltages 220 v is called live wire.
❖ Its color is green or yellow.	❖ Its color is red or brown.

Q12: **Why does resistance of conductor increases by increasing temperature?**

Ans: When we increase temperature of a conductor the kinetic energy of the free electrons increases. Due to which collision of electron with fixed atom increases, which increases the resistance of conductor.

Q13: **What is difference between fuse and circuit breaker?**

Ans: Difference between fuse and circuit breaker is:

Fuse	Circuit Breaker
❖ A fuse is safety device which is connected with live wire in series.	❖ The circuit breaker acts as a safety device in the same way as a fuse.



Fig. Circuit Breaker

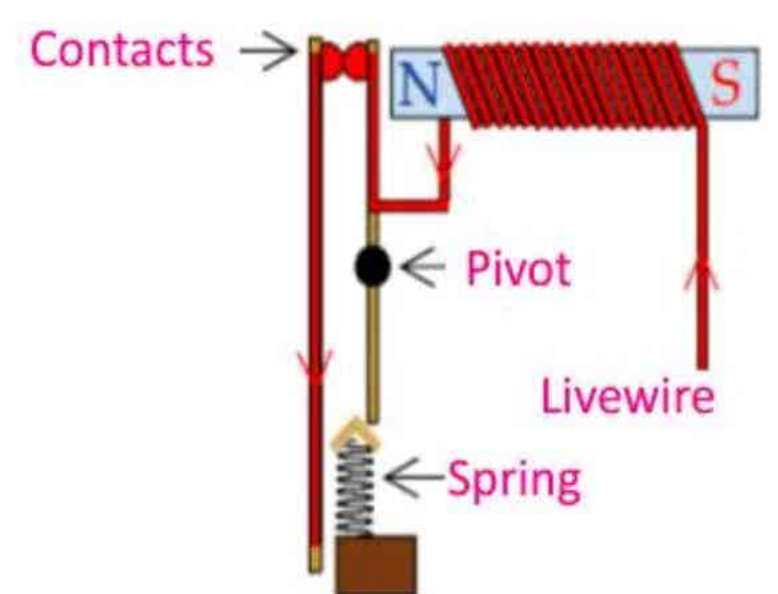


Fig. Working principle of circuit breaker



❖ It consists of a wire which melts due to heat and disconnects the supply.

❖ It disconnects the supply automatically when current exceed from the normal value.

**Q14: What is difference between electric power and kilowatt hour?**

**Ans:** Difference between electric power and kilowatt hour is:

Electric Power	Kilowatt Hour
❖ The amount of energy supplied by electric current in unit time is called electric power.	❖ The amount of energy delivered by a power of one kilowatt in one hour is called kilowatt hour.
❖ $P = \frac{W}{t}$	❖ 1kWh = 3.6 M J

**Q15: What is the function of voltmeter and ammeter?**

**Ans: Voltmeter:**

It is an instrument used to measure potential difference between two points.

**Ammeter:**

Ammeter is an instrument used to measure electric current.

**Q16: Prove that:  $P = I^2R$**

**Ans:** We know that:

$$P = \frac{W}{t} \longrightarrow (1)$$

$$\text{as } W = QV$$

Putting the value of  $W$  in equation (1)

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

$$I = Q/t \text{ or } Q = I \times t$$

$$\text{So, } P = IV$$

$$\text{As, } V = IR$$

$$\text{So, } P = I^2R$$

**Q17: Which devices are used to measure current? Write names.**

**Ans:** Following devices are used to measure current:

- ❖ Galvanometer
- ❖ Ammeter

**Q18: What is difference between live wire and neutral wire?**

**Ans:** The difference between live wire and neutral wire is:

Live Wire	Neutral Wire
❖ The wire which is at high potential having voltages 220 V is called live wire.	❖ The wire which is mentioned at zero potential by connecting it to the earth at the power station itself is called neutral wire.
❖ Its color is red or brown.	❖ ii. Its color is black or blue.

**Q19: What is meant by potential difference?**

**Ans:** Potential difference across the two ends of a conductor causes the dissipation of electrical energy into the other forms of energy as charges flow through the circuit.

**Q20: Give any two uses of fuse.**

**Ans:** Two uses of fuse:

- ❖ It is used to control excess amount of current.
- ❖ It is a safety device which protects electric appliance and person from fatal accidents.

**Q21: Describe two reasons for cables insulation damage.**

**Ans:** Reasons for cables insulation damage:

- ❖ Constant friction removes the insulation from the wire. Too much moisture also damages the insulation. So it is advisable to use a cable with two layers of insulation.

#### Identifying Circuit Components

Wires crossed not joined	
Wires crossed at a junction	
Variable resistor	
Fixed resistor	
Diode	
Earth or ground	
Battery or DC supply	
Capacitor	
Time-varying or AC supply	
Ammeter	
Voltmeter	
Ohmmeter	
Thermistor or temperature-dependent resistor	
Switch	
Lamp/bulb	



- ❖ When live wire come in contact with neutral wire, short circuit occur which, damages the insulation of cable.

## Chapter : 14

## Current Electricity

**Imp.Long Questions**

- Q.1: Derive relation for equivalent resistance of parallel combination of resistors. Also write important features of this combination.
- Q.2: Discuss the main features of series combination of resistors and determine the equivalent resistance.
- Q.3: State and explain Ohm's Law. What are its limitations?
- Q.4: Define specific resistance. On what factor does resistance  $R$  depend? Derive its relation.
- Q.5: State and explain Joule's law.
- Q.6: Explain electricity hazards.
- Q.7: An electric bulb is marked with 220 V, 100 W. Find the resistance of the filament of the bulb. If the bulb is used 5 hours daily, find the energy in kilowatt-hour consumed by the bulb in one month (30 days).
- Q.8: By applying a potential difference of 10 V across a conductor, a current of 1.5 A passes through it. How much energy would be obtained from the current in 2 minutes?
- Q.9: At 100,000  $\Omega$ , how much current flows through your body if you touch the terminals of a 12 V battery? If your skin is wet, so that your resistance is only 1000  $\Omega$ , how much current would you receive from the same battery?
- Q.10: Two resistances of 2 k $\Omega$  and 8 k $\Omega$  are joined in series, if a 10 V battery is connected across the ends of this combination, find the following quantities: (a) The equivalent resistance of the series combination. (b) Current passing through each of the resistances. (c) The potential difference across each resistance.

