Unit 14

CURRENT ELECTRICITY

After studying this unit, the students will be able to:

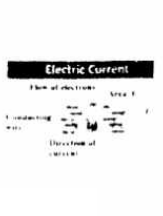
- **a.** Define electric current.
- **b.** Describe the concept of conventional current.
- **c.** Understand the potential difference across a circuit component and name its unit.
- **d.** Describe ohm's law and its limitations.
- **e.** Define resistance and its unit.
- **f.** Calculate the effective resistance of a number of resistances connected in series and also in parallel.
- **g.** Describe the factors affecting the resistances of a metallic conductor.
- **h.** Distinguish between conductors and insulators.
- **i.** Sketch and interpret the v-1 characteristics graph for a metallic conductor, a filament lamp and thermistor.
- **j.** Describe how energy is dissipated in a resistance and explain joule's law.
- **k.** Apply the equation $E=1,Vt=I^2,Rt=V^2t/R$ to solve numerical problem.
- **l.** Calculate the cost of energy when given the cost per kwh.
- **m.** Distinguish between d.c and a.c.
- **n.** Identify circuit components such as switches, resistors, batteries etc..
- **o.** Describe the use of electrical measuring devices like galvanometer, ammeter and voltmeter (construction and working principles not required).
- **p.** Construct simple series (single path) and parallel circuits (multiple paths)
- **q.** Predict the behavior of light bulbs in series and parallel circuit such as for celebration lights.
- **r.** State the function of the live, neutral and earth wires in the domestic main supply.

- **s.** State reason why domestic supplies are connected in parallel.
- **t.** Describe hazards of electricity (damage insulation, overheating of cables, damp conditions).
- **u.** Explain the use of safety measures in household electricity, (fuse, circuit breaker).

Q.1 Define the term electric current? What is conventional current?

Answer

" The rate of flow of electric charge through any cross-sectional area is called current."


Electric Current

Explanation

If the change 'Q' is passing through any area in time then current 'I' flowing through it will be given by:

$$Current=\frac{charge}{time}$$

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

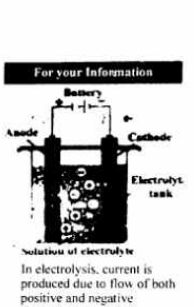
SI unit of current is ampere (A).

1) In metals, the current is produced only due to flow of free electrons i.e. negative charges.

2) In case of electrolyte, its molecules in aqueous solution dissociate among positive and negative ions.

3) Electric current is produced due to the flow of either positive charge or negative charge or both of charges at the same time.

For your Information



In electrolysis, current is produced due to flow of both positive and negative charges. In the electrolyte, positive ion are attracted to the cathode and negative ions are attracts to the anode. This movement of ions within the electrolyte constitutes an electric current within the internal circuit.

Conventional current

Before the idea of free electrons which constitute current in metals, it was thought that current in conductors flows due to the motion of positive charges.

Definitions

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

Explanation

1) We know that when the ends of a copper wire are at different temperatures: heat energy flows from the end of higher temperature to the end of lower temperature.

2) Water in pipe also flows from higher level to lower level.

3) Similarly, when a conductor is connected to a battery, it pushes positive charges to flow current from higher potential to the lower potential as shown in figure 13.2.

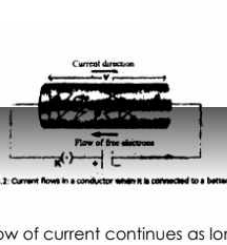


Fig. 14.2: Current flows in a conductor when it is connected to a battery

4) The flow of current continues as long as there is a potential difference.

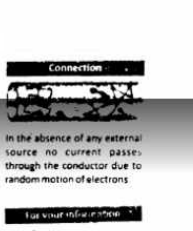
5) Conventional current produces the same effect as the current flowing from negative terminal to the positive terminal due to the flow of negative charges.

Q.2 What is meant by the electric potential of the battery?

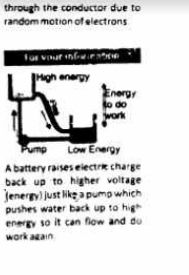
Answer

Electric potential of a battery:

Energy is one of the sources of current. The electromechanical reaction inside a battery separates positive and negative electric charges as shown in the figure 14.1. This separation of charges sets up potential difference between the terminals of the battery.



In the absence of any external source no current passes through the conductor due to random motion of electrons



A battery raises electric charge back up to higher voltage (energy) just like a pump which pushes water back up to high energy so it can flow and do work again.

When we connect a conducting wire across the terminals of the battery, the charges can move from one terminal to the other due to the potential different. The chemical energy of the battery changes to electric potential energy.

The electrical potential energy decreases as the charges move around the circuit. This electrical potential energy can be converted to other useful forms of energy such as heat, light, sound etc.. It is only the energy which changes form but the number of

charge carriers and the change on each carrier always remains the same (i.e. charge carriers are not used up).

Instead of electrical potential energy we use the term electric potential, which is potential energy per unit charge."

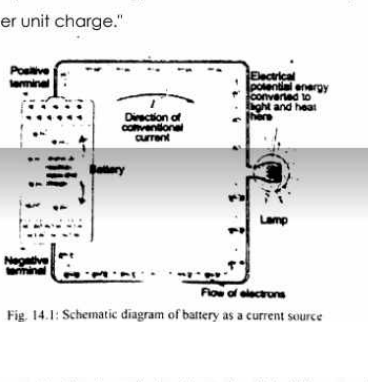

Positive terminal
Direction of conventional current
Battery
Electrical potential energy converted to light and heat here
Lamp
Negative terminal
Flow of electrons

Fig. 14.1: Schematic diagram of battery as a current source

Q.3 What do you mean by the term "electric potential difference"?

Answer

(Electric) potential difference

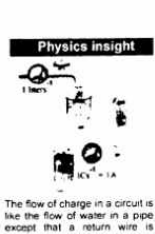
Definition

" potential difference across the two ends of a conductor causes the dissipation of electrical energy into other forms of energy as charges flow through the circuit."

Explanation

When one end 'A' of conductor is connected to the positive terminal and its other end 'B' is connected to the negative terminal of the battery then the potential 'A' becomes higher than the potential of '6' as shown in the figure 14.6.

Physics insight



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

This causes a potential difference between the two ends of the conductor. The flow of current continues as long as there is a potential difference.

The agency which provides the potential difference for the steady flow of current in the copper wire is the battery.

Do you know?
The volt is named after the Italian physicist Alexendro Volta (1745-1827), who developed the first practical electric battery, known as a voltaic pile. Because potential difference is measured in units of volts, it is sometimes referred to as voltage.

As the current flows from higher potential to a lower potential through the conductor, the electrical energy (due to current) is converted into other forms, such as heat and light etc.

When current flows through the conductor, it experiences a resistance in the conductor. The energy supplied by the battery is utilized in overcoming this resistance and is dissipated as heat and other forms of energy.

The dissipation of this energy is accounted for by the potential difference across the two ends of the light bulb.

Unit

SI unit of potential difference is Volt.

Volt

"A potential difference of I V across a bulb means that each coulomb of charge or 1 ampere of current that passes through the bulb consumes I joule of energy."

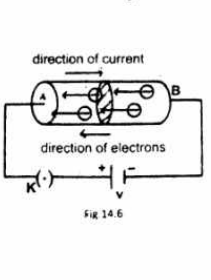


Fig 14.6

Q.4 What do you mean by the term e.m.f? Is it really a force?

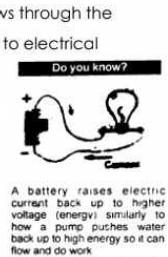
Answer

Electromotive force (e.m.f)

Definition

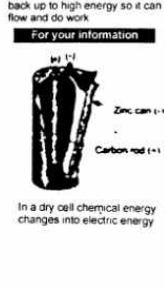
"It is the energy supplied by a battery to a unit charge when it flows through the closed circuit. OR The energy converted from nonelectrical forms to electrical form when one coulomb of positive charge passes through the battery."

Do you know?



A battery raises electric current back up to higher voltage (energy) similarly to how a pump pushes water back up to high energy so it can flow and do work

For your information



In a dry cell chemical energy changes into electric energy

Explanation

A source of electromotive force (e.m.f), converts nonelectrical (chemical, thermal, mechanical etc.) into electrical energy. Examples of sources of e.m.f are batteries, thermocouples and generators. When a conductor is connected to a battery, current flows through it due to potential difference.

For the continuous flow of current through a wire, battery supplies energy to the charges. The positive charges leave the positive terminal of the battery, pass through the conductor and reach the negative terminal of the battery. As a positive charge enters the battery at its lower potential point (negative terminal), the battery must supply energy, 'W' say to the positive

charge to drive it to a point of higher (positive terminal). Such energy supplied 'W' per unit charge is called electromotive force (e.m.f) of the battery.

Thus, $e.m.f=\frac{Energy}{Charge}$

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

Unit:

The unit of e.m.f is joule/coulomb (JC^{-1}), which is volt (V) in SI system.

e.m.f is a force or not:

Electromotive force (emf) is not a force but is an electrical energy supplied by the battery per unit charge.

Q.5 How the current and the potential difference are measured in an electric circuit.

Answer

Measurement of current

To measure the current, we use different electrical instruments. Galvanometer and Ammeter are some examples of current measuring instruments.

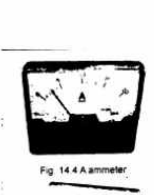


Fig. 14.4 A ammeter

Fig. 14.3 A galvanometer

Galvanometer

Galvanometer is very sensitive instrument and can detect small current in. the circuit as shown in the fig. 14.3. A current of few, milliamperes is sufficient to cause full scale deflection in it. While making the connections polarity of the terminals of the galvanometer should be taken into consideration. Generally, the terminal of the galvanometer with red colour

shows the positive polarity while that of with black colour shows negative polarity. An ideal Galvano meter should have very small resistance to pass the maximum current in the circuit.

Ammeter

After suitable modification galvanometer can be converted into an ammeter. A large current of the range such as I A to 10 A can be measured by means of an ammeter. Ammeter is also connected in series so the current flowing in the circuit also passes through the ammeter as shown in fig. 14.5:

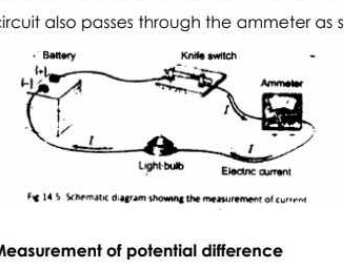


Fig 14.5: Schematic diagram showing the measurement of current

Measurement of potential difference

The potential difference across a circuit component (e.g. light bulb) can be measured by a voltmeter as shown in the figure 14.7. connected, directly across the terminals of the component. The positive terminal of the cell is connected to the positive terminal of the voltmeter and the negative terminal of the cell is connected the negative terminal of the voltmeter. An ideal voltmeter should have very large value of resistance so at noncurrent passes through it.

Fig. 14.3 A voltmeter

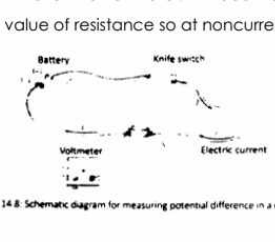


Fig. 14.8: Schematic diagram for measuring potential difference in a circuit.

Voltmeter is always connected in parallel with the device across which the potential difference is to be measured.

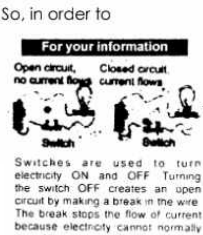
Q.6 Write briefly about the measurement of e.m.f?

Answer

Measurement of e.m.f

In general, e.m.f refers, to the potential difference across the terminals of the battery when it is not driving current in the external circuit. So, in order to measure e.m.f of the battery we connect voltmeter

For your information



Switches are used to turn electricity ON and OFF. Turning the switch OFF creates an open circuit by making a break in the wire. The break stops the flow of current because electricity cannot normally travel through air.

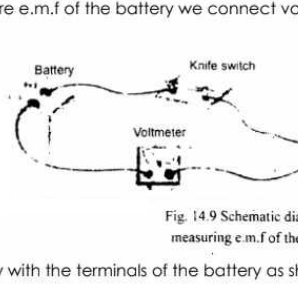


Fig. 14.9 Schematic diagram for measuring e.m.f of the battery

directly with the terminals of the battery as shown in the figure. 14.9.

Q.7 Explain ohm's law?

Answer

Ohm's law (statement)

The amount of current 'I' passing through a conductor is directly proportional to the potential difference V applied across its ends, provided the temperature and the physical state of the conductor does not change, i.e.

$$V\,\alpha\,I$$

Or $V=IR$

Explanation

Take a copper wire of about 50 cm in length and apply a potential difference of 1.5 V from a battery. Measure the current flowing through the wire using an ammeter connected to it in series. Also measure the potential difference across the resistance using a voltmeter connected across it.

For your understanding
1. In order to measure current through resistance, ammeter is always connected in series with the resistance.
2. In order to measure potential difference across the resistance, voltmeter is always connected in parallel with the resistance.

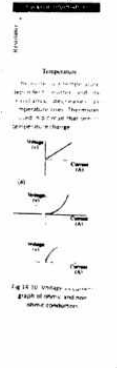
Obtain a set of readings for I and V. by increasing the number of cells. Plot a graph drawn between I and V which is a straight line.

This straight line indicates that voltage V and current I are directly proportional to each other provided the resistance R remains constant.

Resistance

The property of a substance which offers opposition to the flow of current through it is called its resistance.

The SI unit of resistance is ohm.



For your understanding

1. In order to measure current through resistance, ammeter is always connected in series with the resistance.

2. In order to measure potential difference across the resistance, voltmeter is always connected in parallel with the resistance.

Unit of resistance (Ohm)

When a potential difference of one volt is applied across the ends of a conductor and one ampere of current passes through it, then its resistance will be one ohm."

Q.8 Differentiate between ohmic and nonohmic substances?

Answer

Ohmic

Materials that obey ohm's law, and hence have a constant resistance over a wide range of voltages, are said to be ohmic.

Nonohmic

Materials having resistance that changes with voltage or current are nonohmic.

V-I characteristics of ohmic and non ohmic conductors

1) Ohmic conductors have linear current voltage relationship over a large range of applied voltages as shown in the figure 14.10 (a). The straight line shoes a constant ratio between voltage and current. Ohm's law is obeyed. For example, most metals show ohmic behavior.

2) Nonohmic materials have a nonlinear current voltage relationship.

For example, filament lamp, and thermistor, the resistance of filament rises (current decreases) as it gets hotter, which is shown by the radiant getting steeper as shown in the fig. 14.10 (b).

3) A thermistor (a heat sensitive resistor) behaves in the opposite way. Its resistance decreases (current increases) as it gets hotter as shown in the figure 14.10(c).

This is because on heating, more free electrons become available for conduction of current.

Q.9 Explain the term specific resistance (resistivity)?

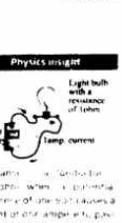
Answer

i) Thick wires have less resistance than thin wires.

ii) Longer wires have more resistance than short wires.

iii) Copper wire has less resistance than steel wire of the same size.

Physics insight



iv) Electrical resistance also depends on temperature.

At a certain temperature and for a particular substance:

1) The resistance 'R' of the wire is directly proportional to the length of the wire i.e.

$R\,\alpha\,L$ ....(1)

2) The resistance 'R' of the wire is inversely proportional to the area of cross section 'A' of the w ire i.e.:

$R\,\alpha\,L/A$..........(2)

Combining equations (1) and (2), we get',

$R\,\alpha\,L/A$

Or $R=\rho\frac{L}{A}$..............(3)

Interesting Information
Diamond does not conduct electricity, because it has no free electrons. However, it is very good at conducting heat because its particles are very firmly bonded together. Jewellers can tell if a diamond is a real diamond or a fake one made from glass, by holding it to their lips. A real diamond feels very cold due to good ability of transferring heat four or five times better than copper.

Where 'p is the constant of proportionality, known as "specific resistance."

Its value depends upon the nature of conductor, i.e. copper, iron, tin and silver would each have different values of 'ρ'.

Unit:

The unit of 'ρ' is ohmmeter (Ωm).

If we put L = 1 m, A = 1 m^2 in equ. (3), we get, $R=\rho$

Q.10 What is the difference between conductors and insulators?

Answer

Conductors

"The substances that have majority of free electrons due to which more electric current can flow are called conductors or electric conductor."

Metals, like silver and copper have excess of free electrons which are not held strongly with any particular atom of metals. When we apply external electric field, these electrons can easily move in a specific direction. This movement of free electrons in a particular direction under the influence of an external field causes the flow of current in metal wires. This hot resistance of conductors increases with increase in temperature. This is due to increase in the number of collisions of electrons with themselves and with the atoms of the metals.

Do you know?
We use hating effect of an electric current for different purposes. For example, when a current flows through the filament of a bulb, it glows white hot and gives out light. Electric heaters have very thin wires that glow red hot when a current flows.

Insulators

"The substance that has rare free electrons and may cause none or negligible flow of current is called insulator."

The electrons in insulators, like rubber, however are not free to move. They are tightly bound inside atoms. Hence current cannot flow through an insulator because there are no free electrons for the flow of current.

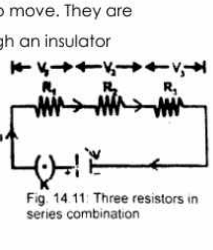


Fig. 14.11: Three resistors in series combination

Insulators have very large value of resistance. Insulators can be easily charged by friction and the induced charge remains static on this surface. Other examples of insulators are glass, wood plastic, fur, silk etc..

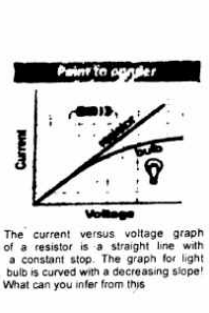
Q.11 Determine the equivalent resistance of series combination of resistors?

Answer

Series combination of resistors

In series combination resistors are connected end to end and electric current has a single path through the circuit. This means that the current passing through each resistor is the same.

Point to ponder



The current versus voltage graph of a resistor is a straight line with a constant slop. The graph for light bulb is curved with a decreasing slope! What can you infer from this

Equivalent resistance of series circuit

The total voltage in a series circuit divides among the individual resistors so the sum of the voltage across the resistance. of each individual resistor is equal to the total voltage supplied by the source.

Thus, we can write as,

$V=V_1+V_2+V_3$ ....(1)

Where 'V' is the voltage across battery and V_1, V_2 ,V_3 are the voltages across resistors R_1, R_2 and R_3 respectively.

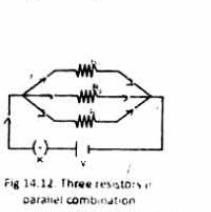
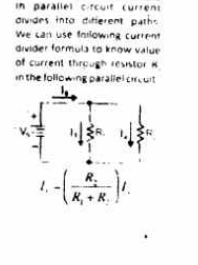


Fig 14.14: Three resistive parallel combination

Parallel circuit and current divider rule



In parallel circuit current divides into different paths. We can use following current divider formula to know value of current through resistor in the following parallel circuit

If is the current passing through each resistor, then from Ohm's Law.

$V=IR_1+IR_2+IR_3$

Or $V=I(R_1+R_2+R_3)$..........(2)

We can replace the combination of resistors with a single resistor called the equivalent resistance R_{eq} such that the same current passes through the circuit. From ohm's law:

$V=IR_{eq}$

Thus, from equ. (2), we have,

$IR_{eq}=I(R_1+R_2+R_3)$

Or $R_{eq}=R_1+R_2+R_3$

Thus, the equivalent resistance of a series combination is equal to the sum of the individual resistances of the combination.

If resistances R_1, R_2, R_3..... R_n, are connected in series, then the equivalent resistance of the combination will be given by:

$R_{eq}=R_1+R_2+R_3+......+R_n$

Q.12 Determine the equivalent resistance of parallel combination of resistors?

Answer

In parallel combination one end of each resistor is connected with positive terminal of battery while the other end of each resistor is connected with the negative terminal of battery as shown in the figure 14.12. Therefore, the voltage is same across each resistor which is equal to the voltage of the battery i.e.,

$V=V_1=V_2=V_3$

Effective resistance of parallel circuit

In parallel circuit, the total current equals the sum of the currents in various resistances i.e.;

$I=I_1+I_2+I_3$..........(1)

Since the voltage across each resistance, 'V' so by ohm's law,

$$I_1=\frac{V}{R_1},I_2=\frac{V}{R_2},I_3=\frac{V}{R_3}$$

Thus, equ. (1) becomes,

$$I=\frac{V}{R_1}+\frac{V}{R_2}+\frac{V}{R_3}$$

Or $I=V\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}\right)$.........(2)

We can replace the combination of resistors with a single resistor called the equivalent resistance Req such that the same current passes through the circuit. From ohm's law, I=V/R_{eq}, thus equ. (2) becomes.

$$\frac{V}{R_{eq}}=V\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}\right)$$

Or $\frac{1}{R_{eq}}=\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}\right)$

Thus, the equivalent resistance of a parallel combination is sum of the reciprocal of the individual resistances. Which is less than the resistance of a one of the combinations.

If resistance R_1,R_2 , R_3,.....R_n are connected in parallel than the equivalent resistance of the combination will be given by

$$\frac{1}{R_{eq}}=\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}+......+\frac{1}{R_n}\right)$$

Q.13 Explain the energy dissipation in a resistance. What is Joule's law?

Answer

Energy dissipation in a resistance

Turbine runs generator to produce electrical 'energy when water falls on it from higher gravitational potential to lower gravitational 'potential.

Similarly, when charge moves from a higher electric to a lower potential, it delivers electric current. Thus, the electric

For your information
Energy saver light bulbs transform much more of the electrical energy into light and much less into wasted heat energy. An energy saver light bulb that uses 11 j of electrical energy each second gives the same amount of light as an "ordinary" incandescent bulb that uses 60 j of electrical energy each second.

current, during which charges continuously move from a higher potential to a lower potential, becomes a continuous source of electric energy.

Consider two points with a potential difference of V volts. If one coulomb of charge passes between these points; the amount of energy delivered by the charge would be V Joule.

Hence, when 'Q' coulomb of charge flows between these two points, then we will get QV joule of energy.

If we represent this energy by W, then, electrical energy supplied by. Q charge, W = QV joule. Now current, when charges Q flow in time T is defined as:

For your information
All electrical appliances have power rating, given in watts or kilowatts. An appliance with a power rating of 1W transfers 1 joule of electrical energy each second. So a 60 W light bulb converts 60 j of electrical energy each second into light energy and heat energy. To find out the total energy an appliance transfers from the mains, we need to know the number of joules transferred each second and the number of seconds for which the appliance in ON.

$I=Q/t$

or $Q=It$

So, the energy supplied by Q charge in t second =W=V x I x t.

This electrical energy can be converted into heat and other forms in the circuit.

From ohm's law, we have V = IR.

So, the energy supplied by the Q charge is

$W=I^2Rt$

Or $=V^2t/R$

This equation is called Joule's law.

Joule's law

The amount of heat generated in a resistance due to flow of charges is equal to the product of square of current I, resistance 'R' and the time duration 't'.

Q.14 What is electrical power? Discuss the unit Kilowatt-hour?

Answer

Electric power

"The amount of energy supplied by current in unit time is known as electric power."

Hence power 'p' can be determined by the formula:

electric power P = Electrical energy /time

Or $P=W/t$

Where 'W' is the electrical energy given by:

$W=QV$

Remember
- To work out the energy transferred, the time must be in seconds and the power in watts.
- To work out the cost, the power must be in kilowatts and the time must be in hours.

Therefore, above equation becomes:

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

Or $P=VI=I^2R$

When current 'I' is passing through a resistor 'R; the electric power that generates heat in the resistance is given by I^2R.

Do you know?
Although the light intensity from a 60 W incandescent light bulb appears to be constant, the current in the bulb fluctuates 50 times each second between -0.71 A and 0.71 A. The light appears to be steady because the fluctuations are too rapid for our eyes to perceive

Unit

The unit of electric power is Watt, which is equal to one joule per second 1 Js^{-1} written on 'W'.

Electric bulbs commonly used in houses consume 25W, 40W, 69W, 75W, and 100W of electric power.

Kilowatt-hour

"The amount of energy delivered by a power of Kilowatt in one hour is called Kilowatt-hour.

One Kilowatt-hour,

1 KWh = 1000 W x I hour

= 1000 W x (3600 s)

= 36 x 10^5 J

= 3.6 MJ.

The energy in Kilowatt-hour can be obtained by the following formula:

The amount of energy is Kilowatt-hour:

=(Watt x time of use in hours) /1000

If the cost of one kilowatt-hour i.e. one unit in known, we can calculate the amount of electricity bill by the following formula:

=(Watt x time of use in hours)/1000

Q.15 What is the difference between D.C and A.C? Discuss the supply to a house and house wiring?

Answer

Direct Current (D.C)

The current derived from a cell or a battery is direct current D.C Since it is unidirectional. The positive and negative terminals of D.C. sources have fixed polarity', therefore, level of D.C remains constant with time as shown in the figure 14.13.

Alternating Current (A.C)

There is also a current which changes its polarity again and again. Such a current that changes direction after equal intervals of time is called alternating current A.C, as shown in the figure 14.14

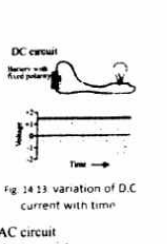


Fig. 14.13: variation of D.C current with time

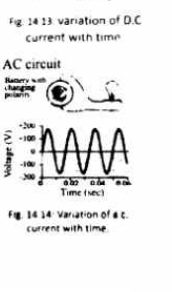


Fig. 14.14: Variation of a.c. current with time.

Time period

The time interval after which the A.C. voltage or current repeats its value is known as its time period. In Pakistan, alternating current oscillates 50 times every second.

Supply to a house

1) The electric power enters our house through three wires. One is called earth wire or ground wire. (E).

This carries no electricity. The earth wire is connected to a large metal plate buried deep in the ground near the house.

2) The other wire is maintained at zero potential by connecting it to the earth at the power station itself and is called neutral wire (N). This wire provides the return path for the current.

3) The third wire is at a high potential and is called live wire (L). The potential difference between the live wire and the neutral wire is 220 V.

All electrical appliances are connected across the neutral and the live wires. The same potential difference is therefore applied to all of them and hence these are connected in parallel to the power source.

House wiring

Figure 14:15 shows the system of house wiring. The wires coming from power station are connected to electricity meter installed in the house. The output power from the electric meter is taken to the main distribution board and then to the domestic electric circuit.

The main box contains fuses of rating about 30A. A separate connection is taken from the live wire of each appliance. The terminal of the appliance is connected to the live wire through a separate fuse and a switch.

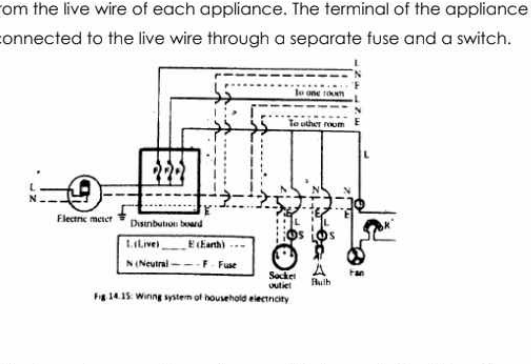


Fig 14.15: Wiring system of household electricity

If the fuse of one appliance burns out, it does not affect the other appliances. In house wiring, all appliances are connected in parallel with each other.

Q.16 Describe briefly the hazards of household electricity?

Answer

Electricity hazards

Major dangers of electricity are electric shock and fire. Some more faults in electrical circuits that may cause electricity hazards are given below.

Insulation damage

All electrical wires are insulated with some plastic cover for the purpose of safety. But when electrical current exceeds the rated current carrying capacity of the conductor, it can produce excess current that can damage insulation due to overheating of cables. This result into a short circuit which can severely damage electrical devices or persons. A short circuit occurs when a circuit with

a very low resistance is formed. The low resistance causes the current to be very large. When appliances are connected in parallel, each additional appliance placed in circuit reduces the equivalent resistance in,' the circuit and increases the current through the wires. This additional current might produce enough thermal energy to melt the wiring's insulation which causes a short circuit, or even starts a fire.

Short circuit can also occur when the live wire and the neutral wires come in direct contact as shown in fig. 14.16.

In order to avoid such situations, the wires carrying electricity should never be naked. Rather it should be covered with good insulator. Such an insulation covered wire is called cable. Constant friction may also remove the insulation from the wire whereas too much moisture also damages the insulation. In such a situation, it is advisable to use a cable with two layers of insulation.

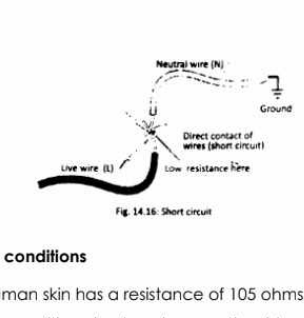


Fig. 14.16: Short circuit

Damp conditions

Dry human skin has a resistance of 105 ohms or more! But under damp conditions (wet environment) resistance of human skin is reduced

drastically to few hundred ohms. Therefore, never operate any electrical appliance with wet hands. Also keeps switches, plugs, sockets and wires dry.

Q.17 What is the use of a fuse in domestic electricity circuits?

Answer

Fuse

A fuse is a safety device that is connected in series with the live wire in the circuit to protect the equipment when excess current flows.

Point to ponder

How many faults can you find after studying this picture accident

It is short and thin piece of metal wire that melts when large current passes through the circuit.

If a large, unsafe current passes through the circuit, the fuse melts and breaks the circuit, before the wires become very hot and cause fire.

Fuses are normally rated as 5A, 10A, 13A, 30A etc. Different types of fuses are shown in the figure 14.17.

The following safety measures should be taken while using fuses in household electrical circuits.

1) Fuses to be used should have slightly more rating than the current which the electrical appliance will draw under normal conditions. For example, for a lightening circuit choose a 5A fuse as the current drawn by each lamp is very small (about 0.4 A for a 100 W lamp).

In such circuit 10 lamps of 100 W can be safely used as the total current drawn is only 4A which can be calculated using the formula, P = VI

2) Fuses should be connected to the live wire so that the appliance will not become live alter the fuses has blown.

3) Switch off the main before changing any fuse.

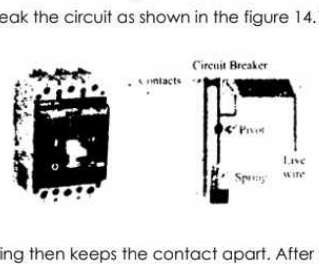
Q.18 What is the use of circuit breaker and earth wire in household circuits?

Answer

Circuit breaker

The circuit breaker as shown in the figure 14.18 acts as a safety device in the same way as a fuse. It disconnects the supply automatically if current exceeds the normal value. When the normal current passes through the live wire the electromagnet is not strong enough to separate the contacts.

If something goes wrong with the appliance and large current flows through the live wire, the electromagnet will attract the iron strip to separate the contacts and break the circuit as shown in the figure 14.19.



The spring then keeps the contact apart. After the fault is repaired, the contacts can then be pushed back together by pressing a button on the outside ale "circuit breaker box.

Earth wire

Sometimes, even the fuse cannot capture the high currents coming from the live wire into the household appliance.

Earthling further protects the user from electric shock by connecting the metal casing of the appliance to earth (a wired connection to the bare ground).

Many electrical appliances have metal cases, including cookers, washing machines and refrigerators. The earth wire provides a safe route for the current to flow through. If the live wire touches the casing as shown in the fig. 14.20. we will get an electric shock if the live wire inside an appliance comes loose and touches the metal casing.

However, the earth terminal is connected to the metal casing, so the current goes through the earth wire instead of passing through our body and causing an electric shock.

A strong current pass through the earth wire because it has a very low resistance. This breaks the fuse and disconnects the appliance.

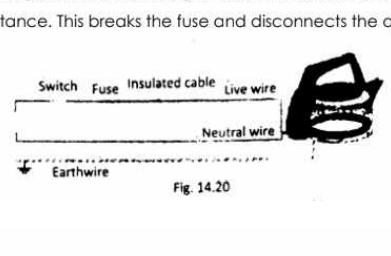


Fig. 14.20

MULTIPLE CHOICE QUESTIONS

Choose the correct answer from the following choices:

i) An electric current in conductors is due to the flow of:

a) positive ions **b)** negative ions

c) positive charges **d)** free electrons

ii) What is the voltage across a 6-n resistor when 3A of' current passes through it?

a) 2V **b)** 9 V

c) 18 V **d)** 36 V

iii) What happens to the intensity or the brightness of the lamps connected in series as more and more lamps are added?

a) increases **b)** decreases

c) remains the same **d)** cannot be predicted

iv) Why should household appliances be connected in parallel with the voltage source?

a) to increase the resistance of the circuit
b) to decrease the resistance of the circuit
c) to provide each appliance the same voltage as the power source
d) to provide each appliance the same current as the power source

v)Electric potential and e.m.f:

a) are the same terms **b)** are the different terms

c) have different units **d)** both b) and c)

vi) When we double the voltage in a simple electric circuit, we double the:

a) current **b)** power

c) resistance **d)** both a) and b)

vii) If we double both the current and the voltage in a circuit • while keeping its resistance constant, the power:

a) remains unchanged **b)** halves

c) doubles **d)** water

viii) What is the power rating of a lamp connected to a 12 V source when it carries 2.5A?

a) 4.8 W **b)** 14.5 W

c) 30 W **d)** 60 W

ix) The combined resistance of two identical resistors, connected in series is 8 a Their combined resistance in a parallel arrangement will be:

a) 2 Ω **b)** 4 Ω

c) 8 Ω **d)** 1 2Ω

ANSWERS

i) d	**ii)** c	**iii)** b	**iv)** c	**v)** a
vi) a	**vii)** c	**viii)** c	**ix)** a	

REVIEW QUESTIONS

14.12 The voltage chosen for the transmission of electrical power over large distance is many times greater than the voltage of the domestic supply. State two reasons why electrical power is transmitted at high voltage?

Answer

1) As we know that, power P = VI, so if We keep the current high the power loss due to high resistance will be more, therefore instead of high current, voltage of transmission in kept high.

2) Voltage is transmitted in the form of electrical energy from the power station to the house hold electrical circuits. Therefore, it is kept lower for domestic supply according to the requirement of the appliance at houses.

14.13 Why the voltage used for the domestic supply much lower than the voltage at which the power is transmitted?

Answer

The voltage transmitted from the power station is transmitted to grid stations and then to local transformers. Then the voltage is distributed to different houses. As the requirement of voltage at houses is much smaller than the

voltage at power station therefore 240V voltage is normally transmitted to houses.

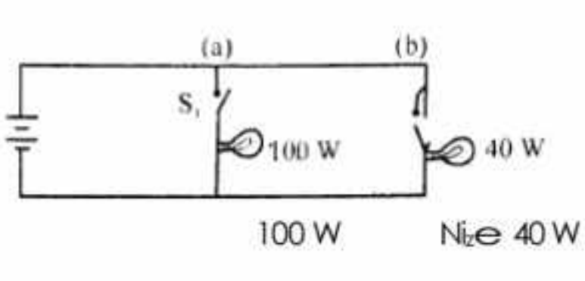
14.16 Design a circuit diagram for a study room that needs the following equipment in parallel:

a) One 100 W lamp operated by one switch;

b) One reading lamp fitted with a 40 W bulb which can be switched ON and OFF from two points.

c) What is the advantage of connecting the equipment in parallel instead of series combination?

Answer



c) Same voltage is gained by all the appliance in parallel with the voltage source.

CONCEPTUAL QUESTIONS

14.1 Why in conductors charge is transferred by free electrons rather than by positive charges?

Answer

In conductors there are majority of free electrons which can easily flow from one place to another place while the positive charges remain stationary at their respective position. That is why charge is transferred by free electron rather than by positive charge.

14.2 What is the difference between a cell and a battery?

Answer

A battery can be re-charged but a cell cannot be re-charged.

14.3 Can current flow in a circuit without potential difference?

Answer

No. To flow the current through a circuit, potential difference is necessary otherwise no current can flow.

14.4 Two points on an object are at difference electric potentials. Does charge necessarily flow between them?

Answer

Yes. The flow the charges between the two points of an object is only possible if there is some potential difference between these points.

14.5 In order to measure current in a circuit why ammeter is always connected in series?

Answer

The resistance of ammeter is kept low so that maximum current can flow through it if it is connected in series in the circuit. In this way an accurate value of current can be measured.

14.6 In order to measure voltage in a circuit voltmeter is always connected in parallel. Discuss.

Answer

The resistance of voltmeter is kept high so that maximum voltage can drop across the resistance if it is connected in parallel to the potential source in the circuit.

14.7 How many watt-hours are there in 1000 joules?

Answer

$$\begin{aligned} &We\ \text{know that, } 1Kwh = 36\times10^5 J \\ &Or \quad 1Wh = 3600J \\ &1J = \frac{1}{3600} Watt-hour \\ &1000J = \frac{1000}{3600} Watt-hour \\ &1000J = 0.28 Watt-hour \end{aligned}$$

14.8 From your experience in watching cars on the roads at night, are automobile head lights connected in series or in parallel?

Answer

Automobile headlights are connected' in parallel with the battery to get maximum voltage. Because the battery is also providing the voltage to the other electricals' parts of the automobile at the same time. In case of series circuit, the head lights may get dim.

14.9 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?

Answer

The flash-light of 10Ω may consume more electrical energy (voltage) and will produce bright light as compared to 5 Ω. The same flash-light may discharge the battery first.

14.10 It is impracticable to connect an electric bulb and an electric heater in series. Why?

Answer

In case of series circuit, voltage is divided depending upon the resistances therefore the electric bulb and electric heater will give divided electrical energy (voltage).

14.11 Does a fuse in a circuit control, the potential difference or the current?

Answer

The fuse in circuit controls only the current therefore it is connected in series with the live wire.

OBJECTIVE TYPE QUESTIONS & ANSWERS

Q2. Give short Answers.

1. What is a wave?

Answer

The wave is a source of transferring energy from one place to another.

2. Differentiate between time period and frequency.

Answer

Time period

The time required by a body to complete one vibration is called its time period. It is denoted by T and measured in second.

Frequency

It is denoted by f and its unit is cycles per second or Hertz (Hz).

3. Give some importance of waves.

Answer

Some importance of waves is:

- Sound waves produce sensation of hearing.
- Heat and light reach us from the sun.
- Broadcasting of radio and television programmes is also in the form of waves.

- Help of waves can detect the defects in the human body.

4. Find the time period of one metre length of simple pendulum on the surface of earth?

Answer

$$l = 1m, g = 10ms^{-2}$$

$$T = 2\pi\sqrt{\frac{l}{g}} = 2\times3.14\sqrt{\frac{1}{10}}$$

$$T = 2\sec$$

5. Find the time period of one metre length of simple pendulum on the surface of moon?

Answer

$$l = 1m, g = 1.6ms^{-2}$$

$$T = 2\pi\sqrt{\frac{l}{g}} = 2\times3.14\sqrt{\frac{1}{10}}$$

$$T = 4.9\sec$$

6. Is there connection between F and x in mass spring system?

Answer

If a force F acts on a body which is displaced through a displacement x. Then according to Hook's law.

$$F \;\alpha\; x$$

$$F = kx$$

Where K is a spring constant

7. Give some characteristics of SHM.

Answer

Some characteristics of SHM are:

- A body executing SHM always vibrates about its position of equilibrium.
- Its acceleration is always directed towards its mean position.
- Its acceleration is directly proportional to its displacement from the mean position.
- Its velocity is maximum at the mean position and zero on the extreme positions.

8. State Hooke's law.

Answer

According to Hooke's law

"The external force acting on the spring is directly proportional to the increase in length of the spring" Mathematically.

$$F \;\alpha\; x$$

$$F = kx$$

Where K is a spring constant.

9. Give relation between the frequency and time period.

Answer

Consider a body, which performed f vibrations in one second.

So, the time period for one vibration = $\frac{1}{f}$

We know that time for one vibration is called time period. It Is denoted by T and is given by:

$$r = \frac{1}{f}$$

Or

$$F = \frac{1}{T}$$

This equation gives the relation between frequency and time period.

10. Explain the relation Fr= -Kx.

Answer

This is the relation for elastic restoring force. The negative sign shows that restoring is always directed towards the mean position or rest. Thus, acceleration is always directed towards the mean position.

11. Write the basic conditions for SHM.

Answer

The conditions for SHM are given as follows:

- The system should have elastic restoring force.
- The system should have inertia.
- The system should be frictionless.

12. Which two forces are acting on the particle when is at the extreme position?

Answer

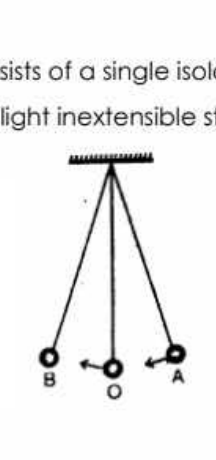
When the particle is at the extreme position, two forces are acting on it.

- The weight mg of the point mass acting vertically downward. '
- The tension T along the string.

13. What is simple pendulum?

Answer

A simple pendulum consists of a single isolated bob suspended from a frictionless support by a light inextensible string.



14. What are factors upon which the time period of simple pendulum depends?

Answer.

The relation for time period of simple pendulum Is given by

$$T = 2\pi\sqrt{\frac{l}{g}}$$

The time period of simple pendulum depends upon:

- The length of the string:

- The value of acceleration due to gravity.
- The time period of simple pendulum is independent of the mass of the bob.

15. Does the time period depends on the amplitude of the pendulum?

Answer

The relation for time period of simple pendulum is given by

$$T = 2\pi\sqrt{\frac{l}{g}}$$

This relation shows that time period of simple pendulum is Independent of the amplitude of the pendulum.

16. Which type of forces comes into play an important role in simple pendulum?

Answer

When a bob of simple pendulum moves to and fro, these forces come into play:

- Weight of the bob.
- Tension in the string.
- Air friction.

17. Give some examples of motion that shows SHM in nature.

Answer

- Motion of the bob of a simple pendulum.
- Motion of stretched string when it is plucked from its mean position.
- Vibratory motion of stretched string of musical instrument.

18. Why does a pendulum lose time in summer and gain time in winter?

Answer

The relation for time period of simple pendulum is given by;

$$T = 2\pi\sqrt{\frac{l}{g}}$$

This relation shows that the time period of a simple pendulum is directly proportional to the square root of the length.

In summer due to increase in temperature the length of simple pendulum increases and the time period of simple pendulum also increases.

In winter due to decrease in length, its time period decreases and hence it gains time.

19. What happens to the frequency of pendulum, as its oscillations die down from large amplitude to small?

Answer

In the oscillations of simple pendulum. The dissipation effect due to frictional forces is present. The amplitude of motion of bob gradually becomes smaller and smaller due to air friction. Hence the friction has also affected in reducing the frequency slightly

20. What is the use of simple pendulum?

Answer

Simple pendulum can be used to determine the value of g because the time period T and the length of the pendulum can be directly measured. If we take proper precautions during the experiment." the accurate value of g can be determined by using Simple pendulum.

21. Do the oceanic waves contain a form of energy?

Answer

Yes. Oceanic waves contain kinetic energy. Sometimes the huge energy of oceanic waves causes the destruction of ships and coastal areas, This, waves energy is also used to produce tidal energy.

22. What is the frequency of seconds pendulum?

Answer

In SHM, the frequency and time period are related as

$$F = \frac{1}{-}$$

As the time period of seconds pendulum is 2 sec. Therefore, its frequency will be

$$F = \frac{1}{2} = 0.5\text{ Hz}$$

23. How with the help of Ripple tank produces straight waves?

Answer

On setting vibrator on the plate starts vibrating and straight waves are generated on the water surface. With the help of light, the image of the water waxes is obtained on the white paper or screen. The crests of the waves appear as bright lines because they behave like, convex lens and they converge the light rays while the troughs of the waves appear as dark lines because they behave like concave lens and they converge the light rays while

the troughs of the waves appear as dark lines because they behave like concave lens and they diverge the light rays.

24. How with the help of ripple tank produces the circular waves?

Answer

It generates circular waves the vibrator bar is raised up and a knob 9 attached to its lowered in such a way that it touches the water surface.

When the vibrator is set on, circular waves are produced.

25. Prove that the product of time period and frequency is unity.

Answer

In SHM, the frequency and time period are related as:

$$F = \frac{1}{T}$$

Or $T \times f = 1$

26. Why the amplitude of simple pendulum is kept small?

Answer

The relation for the time period of simple pendulum is:

$$T = 2\pi\sqrt{\frac{l}{g}}$$

It was assumed that 6 is small then the relation sin $\theta \approx \theta$ holds good. The θ can be small only if amplitude is small. Thus, we must keep the amplitude small.

27. Show that the expression for acceleration of a body executing SHM.

In mass-spring system, the restoring force is given by:

$$F - kx..........(i)$$

If the acceleration a is produced by force F, then according to Newton's second law of motion

$$F = ma..........(ii)$$

By comparing (i) and (ii) then we get

$$ma = -kx$$

$$a = \frac{k}{m}\times x$$

$$a = -(cons\tan t)\times x$$

$$a \;\alpha\; -x$$

Thus, acceleration at any instant of a body executing SHM is directly proportional to the displacement and is always directed towards its mean position.

28.How long must a simple pendulum be in order to have a period 01' one second?

Answer

$$T = 1\sec$$

$$G = 9.8ms^{-2}$$

$$l = ?$$

We know that,

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$T^2 = 4\pi^2 \times \frac{\lambda}{Y}$$

$$l = \frac{g\times T^2}{4\pi^2}$$

$$L = \frac{9.8\times(1)^2}{4\times(3.14)}$$

$$L = 0.25m = 25cm$$

29. Does the acceleration of simple harmonic oscillator remain constant during its motion?

The acceleration of simple harmonic oscillator is:

a = -(constant) x x

a α $-x$

Where x is the displacement from the mean position.

This relation shows that:

- The acceleration is zero at the mean position i.e. x = 0.
- The acceleration is zero at the extreme position.

30. Can we realize an ideal simple pendulum?

Answer

We cannot realize an ideal simple pendulum. An ideal simple pendulum consists of heavy but small metallic bob suspended from a rigid frictionless support by means of long, weightless and inextensible?

31. What happens to the period of simple pendulum if its length is doubled?

Answer

The time period of simple pendulum is given by:

$$T = 2\pi\sqrt{\frac{l}{g}}$$

If its length is doubled, then T' = I.41 T

This shows that the time period of simple pendulum increases 1.41 times, if the length of pendulum is doubled.

32. What will be the time period of simple pendulum at the center of the Earth?

Answer

When the length of pendulum is adjusted such that l =R, the bob will be at the center of the Earth. We know that at this position the value of g is zero i.e. g = 0

$$T = 2\pi\sqrt{\frac{l}{g}}$$

Thus, when length of simple pendulum is adjusted such that the bob is at the centre of the Earth. The time period of the simple pendulum will be infinity.

33. How refraction in wave occurs?

Answer

The refraction in wave occurs due to the change in speed of wave in the other medium.

34. What is vibratory motion? Give some examples.

Answer

Such a type of motion in which a body moves to and fro about a mean position is called Vibratory motion. Some examples of vibratory motion are given as

- Spring-mass system.
- Motion of pendulum.
- Rolling steel ball in a curved dish.

35. Why does the hub of a swinging pendulum comes to rest after sometime?

Answer

The bob of a simple pendulum comes to rest after some time due to following reasons:

- Some energy is lost due to friction in air.
- The energy lost goes into the surrounding air as the heat energy.

36. Why does they vibrating body move away from the mean position?

Answer

During vibratory motion the body experiences restoring force which brings it towards mean position where it has maximum velocity. According to law of inertia the body tries to continue its motion which moves it again away from mean position.

37. Explain the relation between velocity and acceleration of a body performing SHM?

Answer

The velocity and acceleration of a body performing SHM are inversely proportional to each other. At mean position velocity is maximum. Whereas acceleration is minimum.

At the extreme position the velocity is minimum whereas acceleration is maximum.

38. What is second pendulum?

Answer

A second pendulum is a pendulum, which completes one vibration in two seconds.

Thus, the time period of second pendulum is two seconds.

39. Why total energy of vibrating simple pendulum at its mean position is in kinetic energy form?

Answer

Total energy of vibrating simple pendulum at its mean position is in kinetic energy form because at the mean position.

The velocity of pendulum is maximum.

Its height is zero.

Thus, at the mean position vibrating pendulum has.

K.E = maximum and PE = minimum.

40. Define amplitude.

Answer

The maximum displacement on either side of the mean position of an oscillating body is called amplitude.

41. What is wave motion?

Answer

Wave in a medium is due to the generated disturbance which causes' the constituent particles to repeat its to and fro motion about its mean position in equal interval of time, and this disturbance is passed over from one end of the medium to the other.

Example

Waves are produced when one cud of stringy_ is moved up and down.

42. Define spring constant. Give its unit?

Answer

Some energy is lost due to friction in air.

The energy lost goes into the surrounding air as the heat energy.

$$K = \frac{F}{x}$$

Its unit is Nm^{-1}

43. What is SHM?

Answer

The type of vibratory motion in which the acceleration of a body executing SHM is directly proportional to the displacement from the mean position and always directed towards the mean position.

44. What is elastic restoring force?

Answer

It is the force, which brings the body back towards the mean position.

45. Differentiate between mechanical wave and electromagnetic wave?

Answer

Mechanical waves

The waves, which require a material medium for their propagation, are known as mechanical waves.

Example

- Waves generated in rope
- Waves generated in water
- Waves generated in strings

Electromagnetic waves

The waves, which do not require a material medium for their propagation are known as electromagnetic waves.

Example

Heat waves, light waves, x-rays etc..

46. Write the differences between transverse and longitudinal waves?

Answer

No.	Transverse waves	No.	Longitudinal waves
1	In this type of wave, particles of the medium move perpendicular to the direction of propagation of the waves.	1	In this type of wave, particles of the medium move along the direction of propagation of the waves.
2	These waves consist of crests and troughs	2	These waves consist of compressions and rarefactions.
3	The distance between two consecutive crests or troughs is known as one wavelength.	3	The distance between two consecutive compressions or rarefactions, known as one wavelength.

47. Prove that $v = f\lambda$?

Answer

If the speed of wave is v and the time period' of producing wave is T second, then the distance covered by the wave will equal to the wavelength A, i.e.

$$\lambda = vT$$

$$\lambda = v\times\frac{1}{f}$$

$$f\lambda = v$$

$$v = f\lambda$$

48. What is refraction of a wave?

Answer

When waves enter from one medium to another, a part of it is reflected in the same medium while the other- part is transmitted into the other medium, is known as refraction.

49. Define diffraction?

Answer

The bending of waves around the comers or obstacles is called diffraction.

50. What is the condition for diffraction?

Answer

Diffraction of waves can only be observed clearly if the size of the slit or obstacle is equal to the wavelength of the wave.

51. What is interference?

Answer

When panicles of medium are subjected to two or more than two waves simultaneously, then effect being produced is called interference.

Multiple Choice Questions

QI. Each question is followed by friar options encircle the correct option.

1) The unit of current is known as:

a. volt b. ohm
c. ampere d. electron

2) As the temperature of a conductor rises, its resistance:

a. increases b. decreases
c. does not change d. none (a) (b) and (c)

3) When resistances are connected in series, the current passing through them is:

a. different b. zero
c. the same d. not the same

4) The equivalent resistance of a parallel combination is:

a. equal to the sum of all the resistance
b. is greater than the largest resistance of the combination
c. is smaller than the smallest resistance of the combination
d. none of the above

5) In electrolytes, the flow of current is due to:

a. only positive charge b. only negative charge
c. both positive and negative charge d. none of the above

6) Current flows through the filament of bulb due to:

a. free electrons b. protons only
c. neutrons d. x-rays

7) The first battery made in 1800 consisted of:

a. copper plates only b. zinc plates only
c. copper and zinc plates d. copper and zinc plates soaked in saltwater

8) Which statement is not true? In the equation V = IR:

a. R is a proportionality constant
b. the value of R is different for different conductors
c. The value of R is the same for every conductor
d. R is called the resistance of conductor

9) Which is not true?

a. The property which opposes the flow of current through a conductor is called its r
b. 1 mega ohm = I x 10^6 ohm

c. ImA=1x10^3ohm
d. the value of R (resistance) is different for each conductor

10) Which of the following has the lowest specific resistance?

a. copper b. silver
c. aluminium d. platinum

11) The resistance of a wire is ________ to its cross-section area:

a. equal b. inversely proportional
c. directly proportional d. not equal

12) Platinum resistance thermometer is used to measure:

a. the current passing through a conductor
b. the temperature of a conductor
c. the potential difference of a conductor
d. the resistance of a conductor

13) Which is not true for series combination of resistances?

a. $V = V_1 + V_2 + V_3$ b. $V = IR_1 + IR_2 + IR_3$
c. $V = I(R_1 + R_2 + R_3)$ d. $V = \frac{1}{V_1} + \frac{1}{V_2} + \frac{1}{V_3} \cdots\cdots$

14) Which is not true for parallel combination of resistance?

a. $I = I_1 + I_2 + I_3 \cdots\cdots$ b. $I = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$
c. $\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ d. $\frac{1}{R_e}$ - $R_2 + R_3$

15) Which is not true?

a. Galvanometer is used to detect presence of current in a circuit
b. The deflection of needle in galvanometer show presence of current
c. It is connected in series in circuit to detect current
d. Galvanometer is used to detect potential difference

16) The amount of heat generated in a resistance due to flow of electric current is equal to the product of square of current, resistance and time duration. This is called:

a. Joule's Law b. Ohm's Law
c. Graham bell's Law d. Berziulios law

17) The amount of energy supplied by current in unit time is called:

a. ampere b. volt
c. electric power d. ohm

18) Which equation is correct for flow of energy:

a. w=QxR b. w=IxR
c. W = QV d. w=IxRxT

19) To electric appliances in house, we should use:

a. circuit breaker b. a wire of very low resistance
c. many electrical appliance at one switch d. a transformer

20) The wire used in resistance thermometer is usually made of:

a. chromium b. aluminum
c. iron d. platinum

21) The amount of energy supplied by the current in unit time is known as:

a. potential difference b. emf
c. electrical power d. heat energy

22) For calculating the cost of electricity one unit is equal to:

a. 1 KW b. 100 KW
c. 100 kwh d. 1 kwh

23) Current in electrolyte is due to flow of:

a. positive charge b. negative charge
c. both positive and negative charges d. none of these

24) The unit of electrical charge is:

a. coulomb b. ampere
c. ohm d. volt

25) The resistance of a conductor depends upon:

a. length b. area
c. temperature d. all of the above

26) The first battery was made in:

a. 1800 b. 1900
c. 1700 d. 1857

27) The device which converts other forms of energies in electrical energy is called:

a. capacitor b. voltmeter
c. source of emf d. galvanometer

28) Potential difference across a conductor and current passing through it are directly proportional if, which remains constant:

a. temperature b. physical state of conductor

c. both (a) and (b) d. none of these

29) The amount of energy supplied by the battery in pushing one coulomb charge from its negative terminal to its positive terminal through the battery is known as:

a. potential difference b. emf
c. potential energy d. current

30) Which metal has least resistance?

a. aluminium b. copper
c. tungsten d. silver

31) Which metal has maximum resistance?

a. platinum b. copper
c. tungsten d. silver

32) The resistance of one meter cube of a substance is called:

a. resistance b. inductance
c. specific resistance d. conductance

33) When a potential difference is applied across a conductor then the velocity of free electrons is said to be:

a. uniform velocity b. drift velocity
c. average velocity d. variable velocity

34) The unit of temperature coefficient of resistance is:

a. ohm $c^{()-1}$ b. $(c)^{\circ}$
c. $(K)^{-1}$ d. both (b) amid (c)

35) The range of platinum resistance thermometer is:

a. 40 °C to 150 °C b. –110 °C to 76 °C
c. –260 °C to 630 °C d. –180 °C to 1100 °C

36) The equivalent resistance ii serif combination which is equal

a. $R_1 + R_2$ b. $\frac{1}{R_1} + \frac{1}{R_2}$ c. $\frac{R_1 + R_2}{R_1 R_2}$ d. $\frac{R_1 R_2}{R_1 + R_2}$

37) Which of the following remains constant in parallel combination of resistances?

a. I b. V
c. R d. none of these

38) Which of following remains constant in series combination of resistances?

a. I b. V
c. R d. none of these

39) The equivalent resistance f... combination

a. $R_1 + R_2$ b. $\frac{1}{R_1} + \frac{1}{R_2}$ c. $\frac{R_1 + R_2}{R_1 R_2}$ d. both (b) and (c)

40) Three resistances of 100, 200 and 300 are joined in series, their equivalent resistance in ohms is:

a. 0.2 b. 30.15
c. 60 d. 10

41) If the P.D across IOΩ, 20Ω and 30Ω resistors which are in series, is 12 volts, then current passing through each resister is:

a. 5 A b. 0.2 A
c. 12 A d. 10 A

42) Galvanometer is used to detect the presence of:

a. resistance b. voltage
c. current d, power

43) If both the terminals of galvanometer are at same potential, then the deflection in the galvanometer is:

a. maximum b. minimum
c. zero d. between zero and maximum

44) When a small resistance joined in parallel with galvanometer it becomes:

a. ammeter b. voltmeter
c. ohmmeter d. avometer

45) In circuits, ammeters are always joined with resistance in:

a. parallel b. across battery
c. series d. all of these

46) Electrical power is given by:

a. VI b. I^2 R
c. V^2 /R d. all of these

47) The Si unit of electrical power is:

a. Joule x s b. watt
c. Joule d. Kilowatt hour

48) One kilowatt hour is equal to:

a. 1000 J b. 3600 Joule
c. 3.6 x 10^6 J d. 10^3 watt

49) The frequency of alternating current is:

a. 50 Hz b. 2 Hz
c. 5Hz d. 500 Hz

50) Graphically, direct current is represented by:

a. curve b. sine wave
c. cosine wave d. straight line

51) An electric wire covered with insulation is called:

a. wire b. cable
c. rope d. string in parallel

52) The household appliances are connected in parallel with live and neutral wires through a:

a. fuse b. circuit breaker
c. switch d. earth wire

53) Current is flowing in:

a. earth wire b. live wire
c. neutral wire d. shunt wire

54) Fuse is always connected in series in:

a. live wire b. neutral wire
c. earth wire d. shunt wire

55) If the power of a heater is 3000W and voltage is 240V, then the value of fuse used in circuit is

a. 3A b. 5A
c. 20A d.13A

56)The wire connected by the body of an electrical appliance and earth is called:

a. live wire b. earth wire
c. neutral wire d. none of these

57) If 10 ohm, 20 ohm and 30 ohm resistors are joined in parallel to a cell of emf 12 volt, the potential difference of each resister is:

a. 2 volt b. 4 volt
c. 6 volt d. 12 volt

58) If 10 ohm, 20 ohm resisters are join in parallel, equivalent resistance will be:

a. 30 ohm b. 0.15 'ohm
c. 6.67 ohm d. 200 ohm

[redacted]

59) The device which join in parallel in the circuit is:

a. voltmeter b. ammeter
c. galvanometer d. ohm meter

60) When a high resistance join in series with galvanometer it becomes a:

a. ohm meter b. voltmeter
c, ammeter d. s...nometer

ANSWERS

No.	ANS	No.	ANS	No.	ANS	No.	ANS
1	c	2	a	3	c	4	c
5	c	6	a	7	d	8	c
9	c	10	a	11	b	12	b
13	d	14	d	15	d	16	a
17	c	18	c	19	a	20	d
21	c	22	d	23	c	24	a
25	d	26	a	27	c	28	c

[redacted]

esistance