**Fundamental of Electro System**

**Chapter 1**

**Question Answer ( 1 marks each).**

1. Define Electric Charge.

- The electric Charge is the electric property of electron and proton present in an atom.

1. Define Static Electricity.

- The electricity produced due to the change in the number of electrons in a non-conducting body or by rubbing is called Static Electricity.

1. Define Current Electricity (Dynamic Electricity).

-The Form of energy produced due to the continuous flow of electrons through a conductor is called current.

1. Define Hydroelectricity.

-Those source of electricity which is produced from water by converting the kinetic energy of water into electrical energy is called Hydroelectricity.

1. Define Solar Electricity.

-Those Form of electricity which is produced from the sunlight is called solar electricity.

1. List application (uses) of electricity.

-The application of electricity are given below :

i) Entertainment

ii) Health Care

iii) Engineering

iv) Office.

1. How can you use electricity for entertainment.

-Electricity is used to run different electrical devices such as Joystick, computer's mobile phones, etc. These devices is used for entertainment purpose. Without electricity these devices cannot work properly.

1. Define atom.

-An atom is the smallest particles of elements which is indivisible and takes part in chemical reaction as a whole or without division.

1. List components of atom.

- The components of atom are given below:

i) Electron

ii) Proton

iii) Neutron

iv) Isotopes

1. Define (Components of Atom).

- Electrons are the negatively charged sub-atomic particle which are revolving around the nucleus of an atom.

- Protons are the positively charged sub-atomic particles which are present inside the nucleus with neutron.

- Neutron's are the chargeless sub-atomic particles of an atom which is present inside the nucleus of an atom.

-Isotopes are those form of atom which have same number of proton but different number of neutrons.

1. Define atomic nucleus.

- The atomic nucleus is the small, dense region consisting of protons and neutrons of the center of an atom.

1. Define atomic Mass.

- Atomic mass is the sum of protons and neutrons that are present in the nucleus of an atom.

1. Define atomic Weight.

- Atomic weight is the average mass of atoms of an element, calculated using the relative abundance of isotopes in naturally occurring element.

1. Define Free electrons.

- Free electrons are those electrons which is not attached to the nucleus of a atom and are free to move when external energy is applied are called free electrons.

1. Define electric field.

- Electric field is a region around a charge particle or object within a force would be exerted on other charged particles or object.

1. Define electric potential.

- Electric potential is the difference in potential energy per unit charge between two location in the electric field.

1. Define potential difference

- Potential difference between any two points in an electric circuit is defined as the amount of work done in moving unit charge from one point to the other point.

1. Define electrical energy.

- Electrical energy is the form of kinetic energy which is produced by the movement of the electrical charges.

1. State Colomb's law.

- Colomb's law state that the electrical force between two charged objects is directly proportional to the product of quantity of charge on the objects and Inversely propotional to the square of the separation distance between two objects.

1. List limitation of colombs law.

- The limitation of colomb's law are given below:

i) The law is applicable only for the point charges at rest.

ii) Colomb's law can be only applied in those cases where the inverse square law is obeyed.

iii) It is difficult to implement Colomb's law where charges are in orbitary shape because in such cases we cannot determine the distance between the charges.

iv) The law can't be used directly to calculate the charge on the big planets.

**Question Answer ( 2 marks each).**

1. What do you mean by electro statics. Explain.

- Electrostatics is the branch of electro magnetism, which deals with the interaction of electric charges when all the charges are stationary, is called as electrostatics.

1. List types of electricity and explain any one.

- The types of electricity are given below :

i) Static Electricity.

ii) Current Electricity( Dynamic Electricity).

Current is the rate of flow of electrons. It is produced by moving electrons and it is measured in amperes. Unlike static electricity, current electricity must flow through a conductor, usually copper wire. Current with electricity is just like current when you think of a river.

1. List uses of electricity and explain any two.

- The uses of electricity are given below :

i) Entertainment ii) Health Care iii) Engineering

iv) Transport and communication v) Outdoors

vi) Household vii) Commercial viii) Office

ix) Fuel x) Space.

Uses of electricity in commercial places.

For the production of various materials the factory uses heavy machinery which always runs on electricity. Even the magnets which are of a gaint like structures require electricity to keep it charged for lifting heavy metals.

1. Define atom and list its components.

- Atom is the smallest particle of an atom which is indivisible and takes part in chemical reaction as a whole or without division is called its atom. The components of atom are listed below :

i) The Nucleus ii) The Protons iii) The Neutrons

iv) The Electrons v) The Isotopes

1. Define Isotopes and give any one example.

- Isotopes are those form of atoms which have same number of proton but different number of neutrons. For example , Normal hydrogen has 1 proton and 0 neutron: The isotopes of hydrogen are :

i) Protium = 1proton, 1 neutron

ii) Deuterium = 1 proton, 2 neutron

iii) Tritium = 1 proton, 3 neutron.

1. State and explain colomb's law in detail.

**Question Answer ( 4 marks each).**

1. Explain types of electricity in details.

- The types of electricity are given below :

i) Static Electricity

Static electricity is when electrical charges build up on the surface of a material. It is usually caused by rubbing materials together. The result of a build-up of static electricity is that objects may be attracted to each other or may even cause a spark to jump from one to the other. For Example. Rub a baloon on a wool and hold it up to the wall.

ii)Current Electricity

Current is the rate of flow of electrons. It is produced by moving electrons and it is measured in amperes. Unlike static electricity current electricity must flow through a conductor, usually copper wire. Current with electricity is just like current when you think of a river.

1. List uses of electricity and explain any four. Define atom and explain its various components.

- The uses of electricity are given below

i) Entertainment ii) Health Care iii) Engineering

iv) Transport and communication v) Outdoors

vi) Household vii) Commercial viii) Office

ix) Fuel x) Space

Uses of electricity in entertainment.

Today, the modern sources of entertainment starting from listening to music from mp3 players, watching Television, playing movies in DVDs or VCDs or VCRs runs on electricity.

Uses of electricity in Engineering.

Constructions of buildings and structures for the convenience of people require electricity in every step. Building houses, installing gates and windows, welding of materials require current electricity to operate the machines.

Uses of electricity in outdoors.

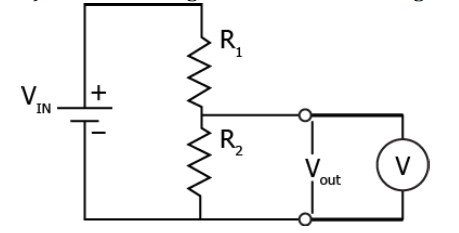
The street light on the road uses electricity to function, even the pool requires electricity to heat the water in colder regions. The lawn mover, which is used to cut grass uses electricity to operate. The water sprinkler for the grass on the lawn uses electricity as well.

Uses of electricity in household.

Starting from toaster to refrigerator, microwave, washing machine, dishwasher, electrical chimney and many more appliances which are simple to use and made for the convenience of day to day activities use electricity to function.

**MULTIPLE CHOICE QUESTIONS**

1. The image shows a circuit diagram. What is being measured using the voltmeter?



a. Current in the circuit b. Voltage in the circuit

c. The voltage across the resistor d. The resistance offered by the resistor

2. The least resistance obtained by using 2 , 4 , 1 and 100 is

a. < 100 b. < 4 c. < 1 d. > 2

3. Work of 14 J is done to move 2 C charge between two points on a conducting wire. What is the potential difference between the two points?

a. 28 V b. 14 V c. 7 V d. 3.5 V

4. A fuse wire repeatedly gets burnt when used with a good heater .It is advised to use a fuse wire of

a. More length b. Less radius

c. Less length d. More radius

5. A circuit has a charge of 2C moving through it in 3 s. Which electrical component in the circuit, if present, will show the current?

a. Voltmeter will show a current of 6 A b. Ammeter will show a current of 0.7 A

c. Rheostat will show a current of 0.7 A d. Resistor will show a current of 0.35 A

6. Electrical resistivity of a given metallic wire depends upon

a. Its length b. Its thickness

c. Its shape d. Nature of the material

7. Two devices are connected between two points, say A an d B, in parallel .The physical quantity that will remain the same between the two points is

a. Current b. Voltage c. Resistance d. None of these

8. Unit of electric power may also be expressed as

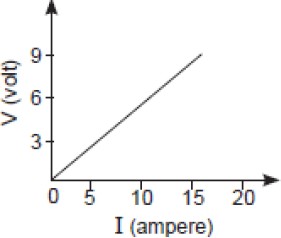
a. Volt-ampere b. Kilowatt -hour c. Watt second d. Joule second

9. What is the relationship between resistance and current?

a. They are directly related to each other

b. They are inversely related to each other

c. The resistance has a greater magnitude than the current

 d. The current has a greater magnitude than the resistance

10. The resistance whose V I graph is given below is

a. 5/3 b. 3/5

c. 5/2 d. 2/5

11. A current of 1 A is drawn by a filament of an electric bulb .The number of electrons passing through a cross -section of the filament in 1 6 seconds would be roughly.

a. 1020 b. 1016 c. 1018 d. 1023

12. How much more heat is produced if the current is doubled?

a. Twice the original amount b. Thrice the original amount

c. Four times the original amount d. Five times the original amount

13. Which of the following represents voltage?

a. Work done / Current Time b. Work done Charge

c. Work done Time / Current d. Work done Charge Time

14. A cooler of 1500 W, 200 volts and a fan of 500 W, 200 volt s are to be used from a household supply .The rating of the fuse to be used is

a. 2.5 A b. 5.0 A c. 7.5 A d. 10 A

15. Which combination of a 2 resistor and 4 resistor offers the least resistance to current in the circuit?

a. Series combination, which results in a net resistance of 2

b. Parallel combination, which results in a net resistance of 2

c. Series combination, which results in a net resistance of 1.5

d. Parallel combination, which results in a net resistance of 0.5

16. In an electrical circuit, two resistors of 2 and 4 , respectively, are connected in series to a 6 V battery .The heat dissipated by the 4 resistor in 5 s will be

a. 5 J b. 10 J c. 20 J d. 30 J

17. In order to reduce electricity consumption at home, what kind of appliance should one purchase?

a. One which draws low power

b. One which produces less heat

c. One which operates at a higher voltage

d. One which draws a high amount of current

18. If n resistors each of resistance R are connected in parallel combination, then their equivalent resistance is

a. /2 b. 2/ c. / d. /

19. Which one among a bar of an alloy of mass 2 kg and a 3 kg iron bar of the same

dimension has greater resistivity?

a. Iron bar because it has a higher mass

b. Alloy bar because it has a lower mass

c. Iron bar because it has the same types of atoms

d. Alloy bar because it has different types of atoms

20. Two resistors connected in series give an equivalent resistance of 10. When connected in parallel, give 2.4 .Then the individual resistance is

a. each of 5 b. 6 and 4 c. 7 and 4 d. 8 and 2

21. A battery of 10 volt carries 20,000 C of charge through a resistance of 20 .The work done in 10 seconds is

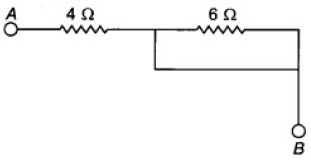
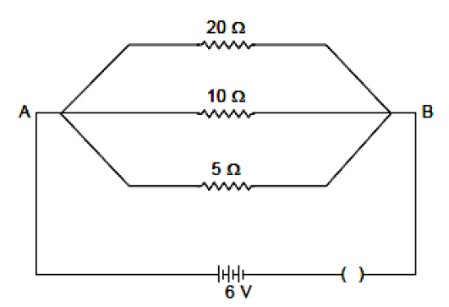
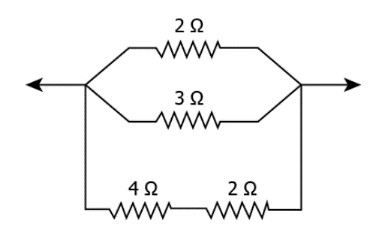
a. 2 103 b. 2 105

c. 2 1044 d. 2 102

22. Two bulbs are rated 40W, 220W and 60W, 220W .The ratio of their resistances will be

a. 4:3 b. 3:4 c. 2:3 d. 3:2

23. The image shows a combination of 4 resistors. What is the net resistance between the two points in the circuit?



a. 0.5 b. 1.0

c. 1.5 d. 2.0

24. If R1 and R2 be the resistance of the filament of 40 W and 60 W, respectively, operating 220 V, then

a. R1 < R2 b. R2 < R1 c. R1 = R2 d. R1 R2

25. An electric toaster has a power rating of 200 W . It operates for 1 hour in the morning and 1 hour in the evening . How much does it cost to operate the toaster for 10 days at Rs .5 per kWh?

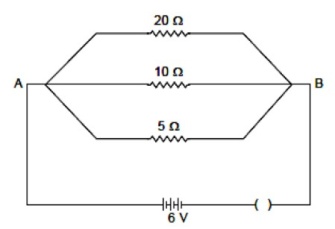
a. Rs.20 b. Rs.400 c. Rs.5000 d. Rs.10000

26. A coil in the heater consumes power P on passing current .If it is cut into halves and joined in parallel, it will consume power

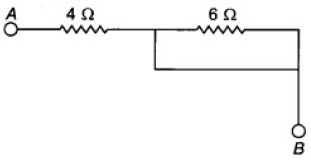
a. P b. P/2

c. 2 P d. 4 P

27. Calculate the current flow through the 10 resistor in the following circuit.

 a. 1.2 A b. 0.6 A

c. 0.2 A d. 2.0 A

28. The effective resistance between A and B is

a. 4 b. 6 c. May be 10 d. Must be 10

**Numerical Problems**

**Problem 1: Determine the electrostatic force between the two charges of magnitude 2 C and -1 C separated by a distance 1m in air.**

**Solution:**

Given that,

The first charge, q1 is +2 C. The second charge, q2 is -1C.

The distance between the two charges, r is 1 m. The value of k is 9 × 109 𝑁𝑚2/ 𝐶2

The formula to calculate electrostatic force between the charges is:

Substitute the given values in the above expression as,

F=

=

**Problem 2: The distance between the two electrons in contact is equal to 1Å. Determine the Coulomb force between them.**

**Solution:**

*The charge on an electron, q is -1.6 × 10-19 C. The distance between the two charges, r is 1 Å.*

*The formula to calculate electrostatic force between the two electrons is:>F = k (q 2 / r2)*

*Substitute the given values in the above expression as, F = (9 × 109 Nm2/ C2) [(-1.6 × 10-19 C)2 / (1 Å)2]*

*=* ***2.3 × 10−8 N***

**Problem 3: When held apart at a certain distance, two spherical conductors B and C with similar radii and carrying equal charges repel each other with a force F. A third spherical conductor, with the same radius as B but no charge, is brought into contact with B, then with C, and ultimately removed from both. What is the new repulsion force between B and C?**

**Solution:**

For the given case,

Initially the electrostatic force on the conductors is defined as:

F = k (q2 / r2) ……(1)

But when a third spherical conductor comes in contact alternately with B and C then removed, so charges on B and C are Q / 2 and 3Q / 4 respectively.p>Therefore, the New force becomes as:

F’ = k [Q / 2) (3Q / 4)/ r2] ……(2)

Comparing equation (1) and (2), we get:

F’ = 38F

**Problem 4: Consider a system of two charges of magnitude 2 × 10-7 C and 4.5**

**× 10-7 C which is acted upon by a force of 0.1 N. What is the distance between the two charges?**

**Solution:**

Given that,

The first charge, q1 is 2 × 10-7 C.

The second charge, q2 is 4.5 × 10-7 C. The force acted upon them, F is 0.1 N.

The formula to calculate electrostatic force between the charges is:

F = k q1q2 / r2

Substitute the given values in the above expression as, 0.1 N = (9 × 109 Nm2/ C2)(2 × 10-7 C)(4.5 × 10-7 C) / (r)2 r = 0.09 m

Hence, the distance between the two charges, r is 0.9 m.

**Problem 5: Determine the magnitude of the two identical charges, when the electrostatic force between these two identical charges is 1000 N and are separated by a distance of 0.1 m.**

**Solution:**

Given that,

The distance between the two charges, r is 0.1 m. he force acted upon them, F is 1000 N.

The formula to calculate electrostatic force between the charges is:

F = k q2 / r2

where q is the charge.

Rearrange the above formula for q as, q2 = Fr2 / k

Substitute the given values in the above expression as, q2 = (1000 N) (0.1 m)2 / (9 × 109 Nm2/ C2)

q = 0.33 × 10-5 C

Hence, the magnitude of the charge is 0.33 × 10-5 C.

**Chapter 2**

**Very Short Answer Question. ( 1 marks each).**

1. Define potential difference.

- Potential difference is the difference in the amount of energy that charge carries (electrons) have between two points in a circuit. Which is measure in volts.

1. Define electric current.

- Electric current is rate of flow of electrons through a conductor.

1. Define electrical resistance.

- The electrical resistance of an object is measure of its opposition to the flow of electric current.

1. Write the formula to calculate resistivity and conductivity. From given V and I

- The formula to calculate resistivity is R = V / I.

- The formula to calculate conductivity is G = I / V.

1. Define capacitors.

- Capacitors is the basic electric components which have ability to store electrical energy in it. It is measured in farad (F).

1. List standards units of capacitance.

- The standard units of capacitance are listed below :

i) Pico Farad (pF) ii) Nano Farad (nF)

iii) Micro Farad (uF) iv) Milli Farad (mF)

v) Kilo Farad (kF)

1. Define inductor.

- An inductor is the basic electric component consisting of a coil o wire which is designed to take the advantage of relationship between magnetism and electricity as a result of electric current passing through it.

1. Define Conductor.

- A conductor is a substance or materials which can pass electricity through them.

1. Define Insulator.

- Insulators are the substance which cannot pass electricity through them.

1. Define Semi Conductor.

- Those substance which allow partially flow of electricity through them are called semi-conductor.

1. List any five example of conductors.

- Any five examples of conductors are :- Gold, Silver , Iron , copper, zinc.

1. List any five example of insulators.

- Any five examples of insulators are :- Glass, Plastic, Rubber, Porcelin, Wood.

1. List sources of electricity.

- The sources of electricity are listed below :

i) Nuclear Power Plant. Ii) Hydro Electricity.

iii) Wind Energy . iv) Thermal Power Project.

1. Define sources of electricity.

- The substance or materials which continuously generates electricity is called sources of electricity.

1. Define nuclear fission and fusion.

- Nuclear fission is the splitting of a heavy nucleus into lighter nuclei.

- Nuclear fusion is the combining of nuclei to form a bigger and heavier nucleus.

1. List uses of resistors.

- The uses of resistors are listed below :

i) Circuit functions

ii) Heating

iii) Frequency and Timing

iv) LEDs and transistors.

1. List factors that affect the resistance of conductor.

- The factors that affect the resistance of conductor are given below :

i) Length of materials.

ii) Cross Sectional area of materials.

iii) Nature of materials.

iv) Temperature of materials.

**Short Question Answer**

1. Define capacitors and list SI unit of capacitance.

- Capacitors is the basic electric component which have ability to store electrical energy in it. Its SI unit is farad.

1. List any five examples of conductors and insulators each.

- Any five examples of conductors are given below :

i) Gold ii) Silver iii) Aluminium iv) Copper v) Zinc

- Any five examples of insulators are given below :

i) Plastic ii) Rubber iii) Glass iv) Porcelian v) Woods.

1. List sources of electricity and explain any three.

- The sources of electricity are listed below:

i) Hydro Electrical Energy.

ii) Nuclear Fission and Fusion.

iii) Wind or Electrical Energy.

iv) Thermal Power.

v) Solar Energy.

i) Hydro Electrical Energy

Hydroelectric Energy also called Hydroelectric power or hydroelectricity, is a form of energy that harness the power of water in motion- such as water flowing over a waterfall- to generate electricity. People have used this force for Over two thousand years ago, people in Greece used flowing water to turn the wheel of their mill to ground wheat into flour.

ii) Nuclear fission and fusion.

Fission occurs when a neutron slams into a larger atom, forcing it to excite and split into two smaller atoms - also known as fission products. Fusion occurs when two atoms slam together to form a heavier atom, like when two hydrogen atoms fuse to form on helium atom.

iii) Wind as electrical Energy.

Wind is used to produce electricity using the kinetic energy created by air in motion. This is transformed into electrical energy using wind turbines or wind energy conversion systems.

1. List uses of resistor and explain any three.

- The uses of resistor are given below :

i) Circuit functions

ii) Heating

iii) Dividing Voltage.

iv) LEDs and transistors.

v) Frequency And Timing

i) Resistor usage in circuit functions.

There are various types of resistors that work according to the usage range. In that, we can set the resistance by using a knob kind of features.

ii) Resistor usage in heating purpose.

Because of the nature of generating heat when conducting current, resistors are used in a heater, toaster, microwave, electric stove and many stove heating appliances.

iii) Resistor usage for dividing voltage.

Dividing the voltage works some components need to work in a much lesser voltage than the supplied input voltage.

1. List important properties of insulators.

- The important properties of insulators are given below :

i) They have high resistivity.

ii) They have high DI Electric Strength.

iii) They have high relative permittivity.

iv) They have high electrical dissipation.

1. List factor affecting the resistance of conductor and explain any two.

- The factor affecting the resistance of conductors are listed below :

i) Cross-Sectional area of wire.

ii) Length of wire.

iii) Temperature

iv) Nature of materials.

**Long Question Answer**

1. Explain factors affecting the resistance of conductor.

- The resistance of a conductor depends upon Temperature, Nature of materials, cross-sectional area of wire and length of wire. The resistance of a conductor is high in more length of wire but it has low resistance when the length of wire is decreases. Similarly, The resistance of wire is decreases. Similarly, The resistance of a conductor is increased when the temperature is increased. Some materials have different resistance some materials have different resistance such as copper have low resistance than aluminium.

1. Classified the objects on the basis of resistance or conductance.

- The classification of the objects on the basis of resistance or conductance are given below :

i) Conductor

Those substance or materials which allow electrons to flow through them are called conductor.

ii) Insulators

Those substances or materials which do not allow electrons to flow through them are called Insulators.

iii) Semi-Conductors

Those substance or materials which allow partially flow of electrons is called semi-conductors.

1. Explain uses of resistor.

- Resistor is used in different electric devices such as torch light, charger, heater, radios, etc. Because of the nature of generating heat when conducting current, it is used in different electric heater. Resistors is also used to identify the level of battery. It also works as a voltage divider.

1. Define resistor. Mention its unit and explain uses of resistor.

- Resistor is an electric components which oppose the flow of electrons. It is represented by R and it is measured in ohm. The resistance R of an object is defined as the ration of voltage V across it to current I through it.

**MULTIPLE CHOICE QUESTION**

1. Resistance can be described as the:

A. opposition to current flow B. resist rate of the voltage

C. current acceptability of a voltage D. opposition to voltage flow

2. The resistance of a material is most commonly determined by four factors -length, cross -sectional area, type of material and:

A. voltage B. temperature C. current D. type of supply

3. The resistance of a conductor is proportional to its:

A. cross -sectional area B. area

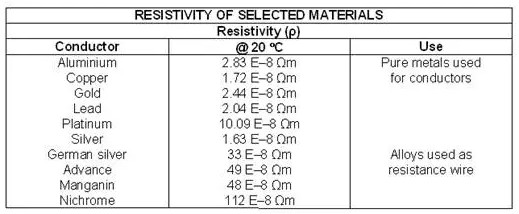
C. length D. current

4. The resistance of a conductor is inversely proportional to its:

A. length B. the supply voltage

C. the type of supply D. cross -sectional area

5. Look at the following table:



The above table gives the resistivity of some common materials used in the electrical industry. The best conductor shown on the table is:

A. silver B. gold C. Nichrome D. copper

6. Resistivity of a material is defined as the:

A. amount of opposition to a flow of resistance through 1 meter cube of the material

B. resistance between the opposite faces of a 1 meter cube at a specified temperature

C. resistance of 100 meters of 1.5 mm2 copper cable at a specified temperature

D. resistance between two faces of a 1 mm2 block of that material at 20 C

7. The following formula can be used to determine the resistance of a length of conduct or. =/. In the formula the symbol stands for the:

A. cross -sectional area of the conductor in 2

B. product of the length of the conductor in meters

C. resistivity of the material on ohm -meters

D. resistance of the conductor ohms per meter

8. The temperature coefficient of resistance of a material is defined as the change in:

A. temperature per degree per ohm

B. resistance per ohm per degree Celsius

C. cross -sectional area per meter per degree Celsius

D. length per meter per ohm resistance

9. For some materials, an increase in temperature causes an increase in resistance; these materials are said to have a:

A. standard temperature coefficient B. negative temperature coefficient

C. positive temperature coefficient D. ambien t temperature coefficient

10. The temperature coefficient of resistance is defined as the change in:

A. temperature per degree per ohm resistance

B. the coefficient of current allowed through a resistance

C. the resistance of a voltage path per change in current in amperes

D. resistance per ohm per degree change in temperature

11. Which process explains the energy extraction from a sea wave?

A. using the kinetic energy of the waves to produce electricity

B. using the thermal energy of the waves to produce electricity

C. using chemical energy of the waves to generate electricity

D. using electrical energy of the waves to generate electricity

12. Why is wind energy considered a conventional source of energy?

A. as it can rotate a windmill

B. as it can help in lifting water

C. as it is readily available and used for a long time

D. as it produced due to uneven heating of the Earth

13. A student studies that biogas contains a large amount of methane which can be used as a fuel for vario us uses. It burns without releasing smoke and leaving no residue like ash in other fossil fuels. Should biomass be considered a good or bad source of energy?

A. bad, as it does not release smoke B. good, as it produces methane gas

C. bad, as it burn s without releasing smoke

D. good, as it does not cause any harm to the environment

14. A student wants to extract energy from fossil fuels. Which process would help him to extract the energy from fossil fuel?

A. burning B. crystallization C. condensation D. distillation

15. Which of these processes explains the extraction of energy from wind to generate energy for a water -lifting pump?

A. conversion of mechanical energy of wind into kinetic energy

B. conversion of the kinetic energy of wind into mechanical energy

C. conversion of mechanical energy of wind into potential energy

D. conversion of the potential energy of wind into mechanical energy

16. Why is biogas considered a good source of energy?

A. as it produces ashes B. as it produces methane

C. as it burns without releasing smoke D. as it decomposes in the absence of oxygen

17. Rajeev studies that due to gravitational pull, the level of water in the sea rises and falls. With the advancement of technology, the generation of electricity has been made possible. This type of energy is known as tidal energy. Should tidal energy be considered a conventional or nonconventional source of energy?

A. conventional, as it uses water as the source of energy

B. non -conventional, as gravitational energy is converted to electrical energy

C. conventional, as the resulting product is electricity which can be used as fuel

D. non -conventional, as the extraction of this energy is possible with advances in technology

18. A student studies th at the efficiency of fuel can be increased using new technologies. How do increased efficiency benefit humans and the environment?

A. production of fuel will increase B. cost of fuel production will decrease

C. Amount of fuel in reservoirs will increase D. pollution and consumption will decrease

19. Thermal power plant is considered a bad source of energy. Why?

A. as it uses very less amount of fossil fuels

B. as the burning of fossil fuel releases harmful gases

C. as electricity is harmful and pollutes the environment

D. as thermal power plants produce less amount of electricity

20. Rihaan can use any source of energy for cooking, but he wants to avoid the production of smoke from the source. Which of these sources should he use for cooking?

A. coal B. electricity C. petroleum D. wood

21. Which of the following processes explains the working of a geothermal power plant?

A. use of potential energy to produce electricity

B. use of thermal energy to produce electricity

C. use of kinetic energy to produce electricity

D. use of tidal energy to produce electricity

22. Should hydropower plants be considered a good or bad source of energy?

A. good, as it uses releases oxides of carbon

B. bad, as it uses water as a source of energy

C. good, as it does not pollute the atmosphere

D. bad, as no ashes are produced while burning fossil fuels

23. Which of these processes explains the extraction of the suns energy to generate energy to light a bulb?

A. conversion of electric energy into solar energy

B. conversion of solar energy into electric energy

C. conversion of solar energy into kinetic energy

D. conversion of kinetic energy into solar energy

24. Which of these characteristics can help us recognize a good source of fuel?

A. physic al state

B. availability in all regions

C. cost -effective for all countries

D. produces a large amount of energy

25. A student studies that energy can be produced by splitting a heavy atom when bombarded with low -energy neutrons. This can be done in a nuclear reactor which is designed for the generation of power. This form of energy is known as nuclear energy. He also studies that nuclear energy is considered a non -conventional source of energy. Why is it considered a non -conventional source of energy?

A. as it splits a heavy atom to produce energy

B. as a low -energy neutron is involved in the process

C. as it is used for the production of energy

D. as energy can be extracted only through a nuclear reactor

**Chapter 3**

**Short Question Answer**

1. Define Electric Circuit.

- Electric circuit is a path through which electric current flows which can also be a closed path and open path.

1. List different types of Electric Circuit.

- The different types of electric circuit are listed below :

i) Series Circuit ii) Parallel Circuit

iii) Series-Parallel Circuit iv) Star- Delta Circuit

v) Resistive Circuit vi) Inductive circuit

vii) Capacitive circuit viii) Resistive, inductive

ix) Active circuit x) Passive circuit

xi) Open Circuit xii) Short Circuit

xiii) Closed Circuit.

1. Define Series Circuit.

- Those types of circuit which have only one path for the flow of electrons is called series circuit.

1. Define Parallel Circuit.

- These types of circuit which have two or more conducting path for the flow of electrons is called parallel circuit.

1. Define Open Circuit.

- Those type of circuit in which there is no return channel for current to flow is called open circuit.

1. Define Short Circuit.

- These types of circuit which has a return channel for current to flow in it and voltage tends to infinity, current tends to zero is called short circuit.

1. Define Closed Circuit.

- Closed circuit is the term used when a load in a circuit functions on it own.

1. Define Domestic Electric Circuit.

- Those type of circuit which is used in our homes to run different electrical devices is called domestic electric circuit.

1. List the different types of wires in domestic circuit.

- The different types of wires in domestic circuit are :-

i) Earth Wire ii) Live Wire iii) Neutral Wire

1. Write some precaution that should follow while using electric circuit.

- Some precaution that should follow while using electric circuit are listed below :-

i) Always use good quality wires which have proper insulation and thickness.

ii) The connections of the wires should be tight and completely insulated.

iii) We should always switch off the main supply before starting any repair work of the electric circuit.

iv) We should not touch bare electric wires with wet hands.

1. State Ohms law.

- Ohm's law states that " When the physical conditions and temperature remain constant voltage across a conductor is directly proportional to the current flowing through it.

1. List the limitation of ohm's law.

- The limitation of ohm's law are listed below :-

i) Ohm's law is not applicable for unilateral electrical elements like diodes and transistors as they allow the current to flow through in one direction only.

ii) Ohm's law is only applicable in metallic conductors. So it won't work in the case of non-metallic conductors.

iii) If I is the current for a certain V, then reversing the direction of V keeping it's magnitude fixed, does not produce a current of same magnitudes as in the opposite direction.

1. List the application of Ohm's law in Daily Life.

- The application of ohm's law are listed below :-

i) In electric fuses.

ii) To know power consumption.

iii) To control the speed of the fans in our houses.

iv) For deciding the size of resistors.

1. State and explain Kirchhoff's Current Law.

- Kirchhof's current law states that for a parallel path the total current entering a circuits junction is exactly equal to the total current leaving the same junction.

This idea by kirchhoff's is commonly known as the conservation of charge as the current is conserved around the junction with no loss of current.

Here in this simple junction example the current It leaving the junction is the algebraic sum of the two currents I1 and i2 entering the same junction that is It = I1 + I2.

1. State and explain Kirchhoff's Voltage law.

- Kirchhoff's voltage law states that the algebraic sum of all the potential differences around the lop must be equal to zero, Note that the term " Algebric sum" means to take into account the polarities and signs of the sources and voltage drops around the loop.

This idea by kirchhof's is commonly known as the conservation of energy, as moving around a closed loop, or circuit, you will end up back to where you started in the circuit and therefore back to the same initial potential with no loss of voltage drops around the loop must be equal to any voltage sources met along the way.

**Multiple Choice Question**

1. If a current of 5 Amperes flows through the conductor. The number of electrons per second will is

A. 1.6 1019 B.3.12 1019 C. 4 1019 D. 7.68 1020

2. Ohms law is true for

A. Metallic conductors at low temperature

B. Metallic conductors at high temperature

C. For electrolytes, when current passes through them

D. For diode when current flows

3. An example of non-ohmic resistance is

A. Diode B. Tungsten wire C. Carbon resistance D. Copper wire

4. In a conductor, if 6 -coulomb charge flows for 2 seconds. The value of electric current will be

A. 3 ampere B. 3 volts C. 2 amperes D. 2 volts

5. An EMF source of 8.0 V is connected to a purely resistive electrical appliance. An electric current of 2.0 A flows through it. What is the resistance offered by the electrical appliances?

A. 4 ohm B. 6 ohm C. 2 ohm D. 3 ohm

6. A potential difference of 10 V is applied across a conductor whose resistance is 2.5 ohm. What is the value of current flowing through it?

A. 4 amperes B. 2 amperes C. 6 amperes D. 10 amperes

7. If the conductor resistance is 50 ohm and the current passing through it is 5 A. What is the value of potential difference?

A. 150 V B. 250 V C. 50 V D. 15 V

8. When the length of the conductor is doubled and the area of cross-section remains the same then its resistance

A. Remains the same B. Will be doubled

C. Will become half D. Will increase by four times

9. The current passing through a resistor in a circuit is 1 A when the voltage across the same resistor is 10 V. What is the value of current when the voltage across the resistor is 8 V

A. 0.8 A B. 8 A C. 80 A D. 18 A

10. Two resistors R1 and R2 with resistance 5 ohms and 10 ohms respectively are connected in series. The voltage across R1 is 4 V. What will be t he value of current across R2.

A. 0.8 A B. 8 A C. 80 A D. 18 A

11.Calculate the voltage across the 5ohm resistor Resistors in series

A. 12 V B. 2 V C. 10 V D. 0 V

12. Which basic law should be followed to analyze the circuit?

A. Newton law B. Faradays law C. Amperes law D. Kirchoff's law

13. Calculate the value of V1 and V2 calculating V1 and V2

A. 4V, 6V B. 5V,6V C. 6V, 7V D. 7V, 8V

14. In Kirchhoffs first law i = 0 at the junction is based on the conservation of

A. Energy B. Charge C. Momentum D. Speed

15. In the circuit shown below what will be the reading in the voltmeter to find the reading in voltmeter

A. 2 V B. 1 V C. 0.5 V D. Zero

16. What is the relation between currents in the figure below Circuit

A. i2 = i1 + i3 + i4 +i5 B. i2 i1 = i3 i4 +i5

C. i3 +i4 =i1+i2+i5 D. I1+i5 =i2+i3+i4

17. The algebraic sum of voltages around any closed path in a network is equal to

A. Infinity B. 1 C. 0 D. Negative polarity

18. Kirchhoffs Current Law is based on

A. The charge can be accumulated at the node

B. Charge cannot be accumulated at the node

C. Energy is stored at the node

D. Depending on the circuit charge can be accumulated at the circuit

19. The terminal potential difference will be greater than its e mf when it is

A. In open circuit B. Being charged

C. Being charged or discharged D. Being discharged

20. When the cells are connected in parallel, then

A. The current increases B. The current decreases

C. The EMF increases D. The EMF decreases

**Numerical Problems**

###### **Example (1): An electronic device has a resistance of 20 ohms and a current of 15 A. What is the voltage across the device?**

Solution:

Resistance (R)=20 ohms

Current (I)= 15 A

resistance, current, and voltage are related together by Ohm's law as 𝑉 = 𝐼𝑅 Thus, the voltage of the device is obtained as V= IxR

=15x20

=30 v

Thus, the voltage across the device = 300V

###### **Example (2): a 3*−*V potential difference is applied across a 6*Ω* resistor. What is the current that flows into the resistor?**

**Solution**:

Voltage (V)= 3V Resistance (R)= 6 ohms

Ohm's law states the potential difference across a resistor is resistance times current so we get

I =

I =

=0.5

Thus, the current that flows into the resistor= 0.5A

###### **Example (3): A current of 0.2A passes through a 1.4k*Ω* resistor. What is the voltage across it?**

**Solution**:

Current (I)= 0.2A

Resistance (R) = 1.4kΩ = 1.4x1000Ω = 1400Ω

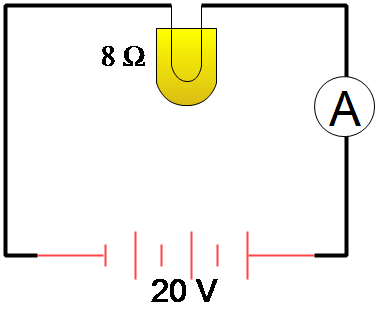
using Ohm's law, 𝑉 = 𝐼𝑅

we have V=0.2X1400

= 280V

Thus, the voltage across the device = 280V

**Example (4): In the circuit shown below, how much current does the ammeter show?**



**Solution**:

Voltage (V)= 20V Resistance (R)= 8Ω

The current passes through it relates to the resistance and voltage drop using Ohm's law

I =

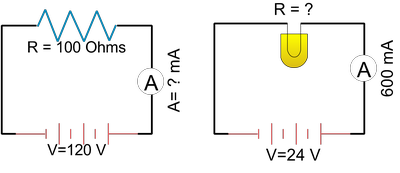
I =

=1.25A

Thus, the current that shows in ammeter = 1.25A

###### **Example 5: In the following circuits, find the unknowns.**

**Solution**:



For first figure Voltage (V)= 120V

Resistance (R)= 100Ω

I =

I =

=1.2A

Thus, the current that shows in ammeter = 1.2A

For second figure

Voltage (V) = 24V

Current (I)= 600mA

=0.6A

From ohm’s law

V=IR

R =

R =

=40 Ω

Thus, the resistance of circuit = 40 Ω

###### **Problem (6): In a circuit, we replace the previous 1.5-volt battery with a 3-volt new one. What happens to this circuit?**

**Solution**: Ohm's law tells us that when more voltage establishes across a circuit, then a higher current would flow through the resistors in a circuit like electric heaters, light bulbs, and so on.

More current can cause damage or failure to the household appliances. For example, a light bulb with resistance R=1.5Ω draws a current of with a 1.5 volts battery and a current with replacement new one. In these cases, the light bulb will most likely burn out.

###### **Problem (7): In a circuit, a 10*Ω* resistor is removed and replaced by a 20*Ω* resistor. What happens to the current in the circuit.**

**Solution**: Since nothing said about the voltage drop across the circuit, we assume it

is constant say, 𝑉 = 120𝑉. Therefore, using Ohm's law formula, I = V/R Current

𝐼 = V/R =120/10 = 12

flows through the 10 Ω resistor and current

𝐼 = 𝑉 = 120 = 6𝐴 flows through the 20 Ω resistor

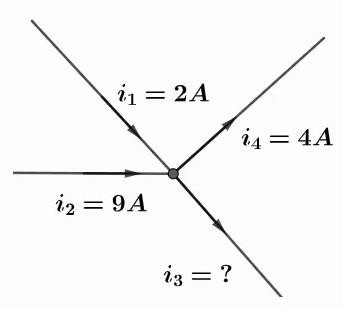
𝑅 20

We can see that for the same voltage, doubling the resistances results in decreasing, more precisely halving the currents.

#### KIRCHHOFF’S LAW

###### **Example 1 : Find current i3 at the node shown below.**

**Solution**:

Currents i1 and i2 are flowing into the node and currents i3 and i4 are flowing out of the node. Apply Kirchhoff's law of current at the given node.

i1+i2 = i3+i4

Substitute the known quantities 2+9=i3+4

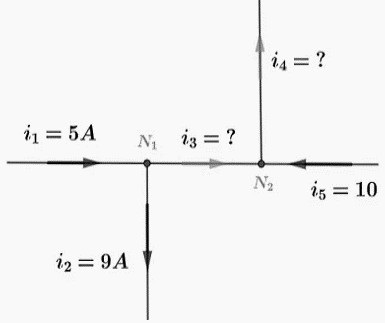
Solve for i3

i3=7 A

**Example 2 : Find currents i3 and i4 at the nodes N1 and N2 shown below.**

**Solution**:

We are not given any information whether i3 and i4 flow into or out of the nodes. We assume i3 flowing out of node N1 and i4 flowing out of node N2 as shown below and use Kirchhoff's current law.



Kirchhoff's current law example 2 solution At node N1, i1 flows into N1 and i2 and i3 flow out of N1, hence

i1 = i2 + i3

Substitute by known quantities 5 = 9 + i3

Solve for i3

i3=−4

Because i3 is negative, i3 flows into node N1

At node N2, i3 and i5 flows into N2 and i4 flows out of N2, hence i3+i5 = i4

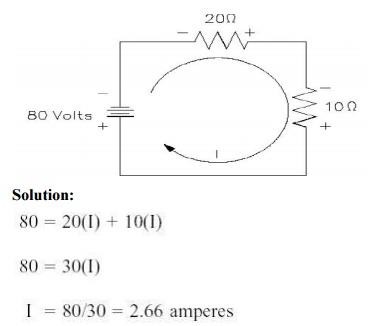
Substitute by known quantities

−4+10 = i4

Solve for i4 i4=6

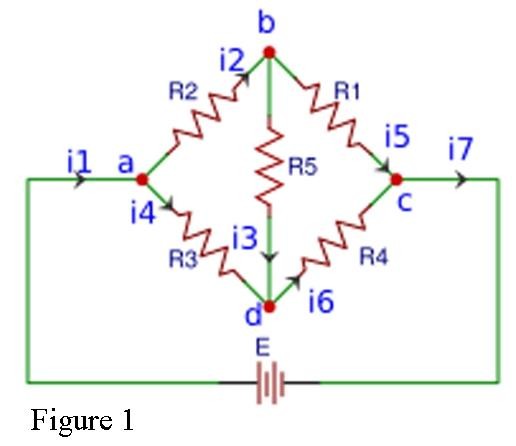
Because i4 is positive it therefore flows out of node N2

###### **Example 3 : Find the current in a circuit using Kirchhoff's voltage law**



**Example 4 : Find the magnitude and direction of the unknown currents in figure 1. Given i1 = 10A, i2 = 6A, i5 = 4A.**

**Solution.**



By observing, it is evident that i1 = i7

Therefore, i7 = 10A

At node “a”, from KCL,

i1 = i2 + i4 10 = 6 + i4 Or, i4 = 4A

At node “b”, utilizing KCL,

i2 = i3 + i5

Or, i3 = i2 – i5 = 6 – 4 = 2A i.e., i3 = 2A

Similarly, at node “C”,

i7 = i5 + i6

giving i6 = i7 – i5 = 10 – 4 = 6A. Therefore, i-6 = 6A.

Then, all the unknown currents of the problem being determined, the branch currents become

i\_1 = i\_7 = 10A; i\_2 = 6A;

i\_3 = 2A; i\_4 = 4A; i\_5 = 4A;

i\_6 = 6A

###### 

###### **Example 5: Using KVL and KCL find the branch currents in the given circuit**

In this question, we have been asked to find the current in each of the branch. We have already been given two loops in the question with their direction, so we will move according to them

In loop 1, using KVL we get 2I1+2(I1−I2)=4−6

4I1−2I2=−2 (1)

In loop 2, using KVL we get

4I2+2(I2−I1)=−2−4

6I2−2I1=−6 (2)

On solving both equation (1) and equation (2), we get

I1=−1.2A I2=−1.4A

Here the negative sign indicates that the direction that we have chosen as positive is wrong and current moves in opposite direction as of what we have selected Hence, Instead of anti-clockwise direction the current moves in clockwise direction. Hence, the correct answer to our question is

I1=1.2A I2=1.4A

**Chapter 4**

**Very short question answer ( 1 marks each)**

1. Define electrical power.

- Electrical power is the rate per unit time, at which electrical energy is transferred by an electric circuit.

1. List types of component in electric circuit.

- The types of component in electric circuit are listed below : -

i) Active Components.

ii) Passive Components.

1. Define Watt.

- One watt is the rate at which work is done when a current of one ampere, I of current flows through a network which has an electrical potential difference of one Volt.

1. List multiples and submultiples of watt.

- The multiples of watt are listed below :

i) kilo Watts (kw)

ii) Mega Watts ( mw)

- The submultiple of watt are listed below

i) Femto watts (fw)

ii) Pico watts (pw)

iii) nano watts(nw)

iv) micro watts ( mw)

v Milli watts (mw)

1. Write the formulas used for calculating electric power.

- The formulas used for calculating electrical power are listed below :

i) W = VI

ii) W = I2R

iii) W = V2/R

1. Define electrical energy.

- Electrical energy is the energy derived from electrical potential energy or kinetic energy of the charged particles.

1. List uses of electrical energy.

- The uses of electrical energy are listed below :

i) Electric motors, movers, generators and storage batteries etc.

ii) Transportation, Vehicles, Electric Transaction, plane and communication.

iii) Escalators, elevators and electronic ladders.

iv) Lightining, heating and cooling i.e. air conditioning, welding and molding, etc.

v) Construction, manufacturing, healthcare, engineering, entertainment, electronics appliances, computers, machinery and much more

1. List sources of electrical energy.

- The sources of electrical energy are listed below :

i) Hydroelectricity.

ii) Sun heat and light energy.

iii) Wind Power and energy.

iv) Nuclear energy.

vi) Lightining as transient energy.

**Long question and answer ( 4 marks each)**

1. Write sources and application of electrical energy in details.

- The sources of electrical energy are given below :

i) Hydroelectric and Water heat energy.

ii) Sun heat and light energy

iii) Wind power and energy.

iv) Nuclear energy

v) Fossil fuels, biofuel, biomass, etc.

vi) Lightining as Transient energy.

- The application of electrical energy are listed below :

i) Electric motor, movers, generators, and storage batteries, etc.

ii) Transportation, vehicles, electric transaction, plans and communication.

iii) Escalators, elevators and electronic ladder.

iv) lightining, heating and cooling i.e air conditioning, welding and molding, etc.

1. Explain different components of electric circuit with example.

- The components in an electric circuit can be divided into two categories.

i) Active devices ( power sources)

if the charges are moved by and exterior force through the device in the direction from the lower electric potential to the higher, so positive charge moves from the negative to the positive terminals.

ii) Passive Devices.

When electric charges move through a potential difference from a higher to a lower voltage, that is when conventional current moves from the positive terminal to the negative terminal, work is done by the charges on the device. The potential energy of the charges due to the voltage between the terminals is converted to the kinetic energy in the devices.

**Multiple Choice Question**

1. Electric power is represented by formula

\*A. =2 B. =2 C. =2 D. =22

2. Which if the following is not unit of electric power?

A. volt -ampere B. joule/sec C. watt \*D. joule-ampere

3. The energy consumed by electric appliance of power 1 kW 1 hr is..

A. 360 B. 36103 \*C. 3.6 106 D. 36106

4. Electric geyser is used for 2 hours has power of 1200 watt, energy spent by geyser is .

A. 2.0 unit \*B. 2.4 unit C. 2.8 unit D. 3.2 unit

5. A Windmill has to generate..power so the potential difference maintained by it can be 220 V and should able to produce current of 2 A per unit time.

A. 0.44 Kw B. 0.40 kW C. 0.36 kW D. 0.32 kW

6. The cost of electric energy for the month of February if TV set of power 650 watt works for 3 hours daily. The cost per unit is Rs.7.50/ -

\*A. 409.5 Rs. B. 309.5 Rs. C. 209.5 Rs. D. 209.5 Rs.

7. An electric motor is of 1.5 hp connected for supply of 220 V, then current drawn by electric motor is

A. 2 A B. 3 A C. 4 A \*D. 5 A

8. Three resistors of values 100 , 200 and 300 are connected in parallel across cell which provides the power of 500 watt, amount of current through the circuit is.

A. 1.5 A B. 2.0 A C. 2.5 A \*D. 3.0 A

9. Three resistors of 25 are connected in circuit with p.d. 12 V, the total power of circuit will be

A. 1.8 A \*B. 1.9 A C. 2.0 A D. 2.1 A

10. If appliances of power 500 watt, 650 watt and 850 watt are connected in parallel , the total power consumed by them is.

A. 1 kW B. 1.5 kW \*C. 2.0 kW D. 0

11. Potential difference of 220 volt connected across resistor of resistance R. The power consumed in the circuit is 1 kW, then R=?

\*A. 48 B. 50 C. 52 D. 54

12. An electric iron of 600 watt works on 220 volt supply, current drawn by iron is

\*A. 2.3 A B. 2.5 A C. 2.7 A D. 2.9 A

13. Solar panel fixed on the roof of school building is able to produce energy of 1.8 kW.h per day; the power generated by solar panel in the mo nth of April is

A. 18 kW B. 36 kW \*C. 54 kW D. 72 kW

14. A wire of resistance 2 k connected across battery of pd 220 V, power consumed and current in circuit will be..

A. 24.2 W,10 mA \*B. 24.2 W,12 mA C. 48.4 W,10 mA D. 48.4 W,12 mA

15. For maximum power consumption, resistors of resistance R should be connected in

A. series \*B. parallel C. both a or b D. none of these

**Numerical Problems**

1. **A 220 V – 5 A electric lamp is used for 30 minutes. How much energy does it equire**

**Solution :**

Voltage (V) = 220 Volt

Electric current (I) = 5 Ampere

Time (t) = 30 minutes = 30 x 60 seconds = 1800 seconds Electric power (P) :

P = V I

= (220 Volt)(5 Ampere)

= 1100 Volt Ampere

= 1100 Watt

= 1100 Joule/second

Electric energy = Electric power x time

= (1100 Joule/second)(1800 second) Electric energy = 1,980,000 Joule

= 1,980 kiloJoule

1. **A 220 V – 60 W solder is used for 4 minutes. How much energy does it require. Solution :**

Power (P) = 60 Watt = 60 Joule/second Voltage (V) = 220 Volt

Time (t) = 4 minutes = 4 x 60 seconds = 240 seconds Wanted: Electric power

220 Volt – 60 Watt means the electric solder works well if the potential difference or voltage is 220 volts and has a power of 60 Watt = 60 Joule/second, means that electric solder using the energy of 60 Joules per second.

Electric energy = electric power x time interval

= (60 Joule/second)(240 second)

= 14,400 Joule.

1. **The energy used by the iron for 1 minute is 33 kJ, at a voltage of 220 volts. How large the current is in the iron.**

**SOLUTION:**

Time interval (t) = 1 minute = 60 seconds Energy (W) = 33 kiloJoule = 33,000 Joule

Voltage (V) = 220 Volt Wanted : Electric current (I)

Electrical power is the electrical energy used during a certain time interval. P = W / t

= 33,000 Joule / 60 seconds P = 550 Watt

Electric current :

I = P / V

= 550 / 220

= 2.5 Ampere

1. **Someone watches TV on average 6 hours each day. The TV is connected to a 220 Volt voltage so that the electric current flows through the TV is 0.5 Amperes. If the electric company charges $0.092 per kWh, then the cost of using electric energy for TV for 1 month (30 days) is…**

**Solution :**

Time interval = 6 hours x 30 = 180 hours Voltage (V) = 220 Volt

Electric current (I) = 0.5 Ampere Wanted : The cost per month Power of TV :

P = V I

= (220 Volt)(0.5 Ampere)

= 110 Volt Ampere

= 110 Watt

Electric energy = electric power x time interval Electric energy of TV = 110 Watt x 180 hours

= 19800 Watt hours

= 19.8 kilo Watt hours

= 19.8 kilo Watt hours

= 19.8 kWh

The cost of using electric energy for TV during 1 month :

=19.8 kWh x $ 0.092 / kWh

= $ 1.8216

1. **In a house there are 4 lamps 20 Watt, 2 lamps 10 Watt, 3 lamps 40 Watt, are used 5 hours every day. If the electric company charge 0.092 per kWh, then the cost of using electric energy during 1 month (30 days) is ….**

**Solution :**

4 lamps 20 Watt = 4 x 20 Watt = 80 Watt

1. lamps 10 Watt = 2 x 10 Watt = 20 Watt
2. lamps 40 Watt = 3 x 40 Watt = 120 Watt

Total power (W) = 80 Watt + 20 Watt + 120 Watt = 220 Watt Time interval (t) = 5 hours x 30 = 150 hours

Wanted : The cost of using electric energy during 1 month (30 days) Electric energy = electric power x time interval

= 220 Watt x 150 hours

= 33,000 Watt hour

= 33 kilo Watt hour

= 33 kilo Watt hour

= 33 kWh

The cost of using electric energy during 1 month (30 days)

=(33 kWh) ( 0.092 / kWh)

= $ 3.036

**6: Find the power dissipated in a conductor with a 10V potential difference and a current of 5A.**

**Answer:**

It is known that the power dissipated in the conductor is given by, P = VI

P = VI

Given:

V = 10

I = 5

P = VI

P = (10)\*(5)

P = 50 W

**7: Find the power dissipated in a conductor with a 5V potential difference and a current of 2A.**

**Answer:**

It is known that the power dissipated in the conductor is given by, P = VI

Given:

V = 5

I = 2

P = VI

P = 5 \* 2

P = 10 W

**8: An electric heater is connected to a battery of 5V potential difference. The heater has a total resistance of 50 ohms. Find the power dissipated by the electric heater.**

**Answer:**

It is known that the power dissipated in the conductor is given by,

𝑃 = 𝑉2/𝑅

Given:

V = 5

R = 50

𝑃 = 𝑉2/𝑅

⇒ 𝑃 = (52)/(50)

⇒ P = 0.5 W

**9: An electric fan is connected to a battery of 20V potential difference. Assume that the fan has a total resistance of 15 ohms. Find the power dissipated by the electric fan.**

**Answer:**

It is known that the power dissipated in the conductor is given by,

𝑃 = 𝑉2/𝑅

Given:

V = 20

R = 15

𝑃 = 𝑉2/𝑅

⇒ 𝑃 = (202)/(15)

⇒ P = 400/15

⇒ P = 26.67 W

**10: An electrical appliance is connected to a battery due to which a current of 5A flows through it. The appliance has a total resistance of 10 ohms. Find the power dissipated by the appliance.**

**Answer:**

It is known that the power dissipated in the conductor is given by,

𝑃 = 𝐼2𝑅

Given:

I = 5

R = 10

𝑃 = 𝐼2𝑅

⇒ 𝑃 = (52)(10)

⇒ P = (25)(10)

⇒ P = 250 W

**11: An electrical appliance is connected to a battery due to which a current of 10A flows through it. The appliance has a total resistance of 20 ohms. Find the power dissipated by the appliance.**

**Answer:**

It is known that the power dissipated in the conductor is given by,

𝑃 = 𝐼2𝑅

Given:

I = 10

R = 20

P = 𝐼2𝑅

P = 100 \* 20

P = 2000W

**Chapter 5**

1. Define cell.

- An electrical cell is an electrical power supply which converts the stored chemical energy into electrical potential energy, allowing positive charge to flow from positive terminal to the negative one through an external circuit.

1. Define battery. List types of battery.

- A battery is an electro chemical device that can store energy in the form of chemical energy. The types of battery are listed below :

i) Primary batteries.

ii) Secondary batteries.

1. List types of primary and secondary battery.

- The types of primary batteries are listed below :

i) Alkaline battery.

ii) Button Cell Battery.

- The type of secondary batteries are listed below :

i) Lead-acid batteries.

ii) Nickel-cadmium batteries

iii) Nickel-Metal hydride batteries.

iv) Lithium-ion batteries.

1. Define electric cell.

- An electric cell is an electric power supply which converts the store chemical energy into electrical energy.

1. Define Galvanic cell.

- An electromechanical cell that converts the chemical energy of spontaneous redox reactions into electrical energy is known as galvanic cell or a voltaic cell.

1. List application of primary and secondary cell.

- The application of primary cell are listed below :

i) They can be used in clock and toys.

ii) It can be used in small household devices.

iii) It can be used in personal computers.

1. List application of reserve cell, fuel cell.

- The application of reserve cell or battery are listed below :

i) It is used in devices for sensing time and pressure.

ii) They are largely used in weapons systems.

iii) They are also used in our car batteries and other vehicles.

1. List advantages of battery over other power sources.

- The advantage of battery over other power sources are listed below:

i) Specific Energy Capacity

ii) Power bandwidth

iii) Responsiveness

iv) Environment

v) Installation.

1. List drawbacks of battery.

- The drawbacks of battery are listed below :

i) Charge Time.

ii) Operation Cost.

iii) Energy Storage Capacity.

1. List the factors for choosing right battery according to your application.

- The factors for choosing right battery according to my application are listed below :-

i) Primary or secondary battery.

ii) Temperature range.

iii) Durability.

iv) Energy Density.

v) Safety.

1. Define Capacitor.

- Capacitor is an electrical component with a two-terminal that may store energy in the form of an electric charge.

1. List standard unit of capacitor.

- The standard unit of capacitor are listed below :

1uF = 10-6F,

1nF = 10-9F,

1pF = 10-12F, and so on.

1. List Characteristics of capacitor.

- The characteristics of capacitor are listed below :

i) Nominal Capacitance (c)

ii) Working Voltage (WV).

iii) Tolerance

iv) Leakage current.

V) Working Temperature.

vi) Temperature Coefficient (TC)

vii) Polarization.

viii) Equivalent Series Resistance (ESR).

1. List the factor affecting capacitance of capacitor.

- The factor affecting the capacitance of capacitor are listed below :

i) Plate Area

ii) Plate Spacing

iii) Dielectric Materials.

1. Explain primary battery and secondary battery in details.

- There are mainly two types of battery they are:

i) Primary Batteries.

The batteries made for one time use only and unable to recharge are called primary batteries. This type of battery is thrown away after use. It is also known as non-rechargeable batteries. It's a very simple and convenient source of power for portable devices like a watch, camera, torch, etc.

ii) Secondary batteries.

The battery which is made for reusable purpose by recharging are called secondary batteries. They are also called rechargeable batteries. They have the same electrochemical reaction as alkaline batteries but the electrochemical reaction can be reversed. This type of battery is used for portable devices like mobile phones, laptops, electric vehicles, etc. Also, a rechargeable battery is used with an inverter which stores power to supply our household devices.

1. Differentiate between cell and battery.

-The differentiate between cell and battery are listed below:

|  |  |  |  |
| --- | --- | --- | --- |
| S.N | Cell | S.N | Battery |
| 1 | A cell is the single unit device which converts chemical energy into electric energy. | 1. | A battery usually consists of group of cells. |
| 2 | Depending upon the types of electrolyte used a cell is either reserve, wet or dry types. | 2 | A battery is either primary battery or secondary battery meaning it is rechargeable or non-rechargeable |
| 3 | A cell is usually light and compact as it has a single unit. | 3 | Battery normally consists of several cells thus giving it a bigger size and is bulky. |
| 4 | A cell supplies power for a shorter period of time. | 4 | A battery can supply power for long durations. |
| 5 | A cell is mostly for lighter tasks which requires less energy. | 5 | A battery is mostly used for heavy duty tasks. |

1. Explain types of cells in details.

- There are mainly two types of cell they are primary and secondary cell. Non-rechargeable batteries also known as primary batteries or primary cell. Primary batteries are those which cannot be used again once their stored energy is being used fully. There batteries cannot restore energy by any external sources.

Rechargeable batteries are also known as secondary cell. It can be use again and again by plugging them into charge and get multiple uses before the battery needs to be replaced. The initial cost of rechargeable batteries is commonly more than disposable batteries but the total cost of ownership and environmental impact of these batteries are lower because they can be recharged inexpensively many times before they need to replace it.

1. Explain primary cell in details.

- None rechargeable batteries also known as primary batteries or primary cell. Primary batteries are those which cannot be used again once their stored energy is being used fully. These batteries cannot restore energy by any external source. This is the reason primary cells are also called disposable batteries. There are different types of primary cells they are:-

i) Zinc Carbon Battery

ii) Alkaline Battery

iii) Lithium cells

iv) Silver Oxide Cells

v) Zinc Air cells.

1. Differentiate between primary cell and secondary cell.

- The differentiate between primary cell and secondary cell are listed below :

|  |  |  |  |
| --- | --- | --- | --- |
| S.N | Primary Cell | S.N | Secondary Cell |
| 1 | Suitable for portable application due to light weight and smaller design. | 1 | Not suitable for portable devices. |
| 2 | Good Charge retention. | 2 | Inferior charge retention. |
| 3 | Not suitable for high cost application. | 3 | Highly recommended for backup and high cost applications. |
| 4 | Limited to specific applications. | 4 | Highly versatile and therefore has large spectrum of application. |
| 5 | Low initial cost. | 5 | Higher initial cost. |

1. Explain reserved cell and fuel cell in detail.

- The reserved batteries or cell are also known as stand-by battery. The electrolyte remains inactive in solid until the melting point is reached. As soon as the melting point is reached, ionic conduction begins and battery is activated.

There are four categories of reserve cell they are water activated batteries, heat activated batteries, electrolyte activated battery and gas activated batteries.

Fuel cell is a type of cell in which active materials are fed from outside source fuel cells are capable of producing electrical energy as long as active proton exchange membranges uses hydrogen and oxygen gas as fuel.

1. Explain advantage and drawbacks of battery.

- The energy storage capacity of battery is very less as compared to fossil fuel. It is capable of handling small and large loads more effectively due to high power bandwidth. It is able to deliver power over short notice. This means that warm up is required as in case of combustion engines. The batteries are easy to use.

But it has some disadvantages also, it takes hours to get recharged again for use. Price and weight of large batteries make it impractical for the reliable usage and large vehicles. The energy storage capacity of batteries is low.

1. Explain the factor for choosing right battery according to the application.

-There are many factors included for choosing right battery according to our application. If we want to use battery for longer duration without charging it, we can use secondary battery. We can use primary batteries in disposable kinds of devices. Choosing a right battery with right temperature helps us to reduce the risk of thermal runaway. We can also choose battery according to their energy density, safety and durability. Energy density refers to the total amount of energy stored in the battery per unit volume.

1. Explain types of combination of cell in details.

- The types of combination of cell are series combination and parallel combination. In series connection of cells one positive terminal of each cell is connected to other netative terminal of cell. In parallel combination of cells cells are connected in parallel such that cathode or anode meet at a point.

1. Explain working of capacitor in details.

- Capacitor is made of two parallel layer. One plate is attached to the positive end and the second plate is connected to the negative end when a DC voltage source is placed across the capacitor plate I becomes positive in relation to plate II when the battery's voltage is applied across the capacitor. The current tries to pass through the capacitor from its positive plate to its negative plate in the steady-state condition. However, due to the separation of them with an insulating layer, it is unable to flow. In Capacitor, an electric field appears between the parallel plates. The positive charge is collected on the plate connected to the positive terminal of the battery, while the negative charge is collected on the plate connected to the negative terminal of battery. After a certain point, the capacitor's capacitance with respect to this voltage allows it to collect the maximum amount of charge. The capacitor's charging time is defined as the time it takes to charge the capacitor.

1. Explain characteristics of capacitor.

- The different characteristic of capacitor are listed below :

i) Nominal Capacitance

Capacitance refers to the amount of electrical energy a capacitor can store within it electromagnetic field. The value is represented in the unit farad, including pico-farad (pF), nano-farad (nF) and micro-farads (uF).

ii) Working Voltage.

The working voltage is the maximum amount of voltage a capacitor can receive continuously without damage or failure.

iii) Tolerance

The capacitance value listed for a capacitor can sometimes vary more or less. The value can only vary by a certain range to be accepted, which is its tolerance.

iv) Leakage current

A capacitor contains a non- conductive material known as a dielectric. The dielectric will typically allows a small amount of electricity through, referred amount of electricity through, referred to as leaking.

v) Working Temperature (T)

Temperature affects a capacitors ability to store electrical energy. For example, extremely high temperature can cause a liquid electrolyte in an electrolytic converter to evaporate and change the capacitance.

vi) Temperature Coefficient.

The temperature coefficient measure the change in capacitance that could occur within a particular temperature range.

vii) Polarization

This refers to the change of the plates within a capacitor. In most capacitors there is a positive end and a negative end, similar to a battery.

viii) Equivalent series Resistance

This is a term for the total resistance of every part of a capacitor that resists, rather than conducts electric current.

1. Explain factor affecting capacitance of capacitor.

- The factor affecting capacitance of capacitor are listed below :

i) Plate Area

All other factors being equal, greater plate area gives greater capacitance. Less plate area gives less capacitance.

ii) Plate Spacing

All other factors being equal, further plate spacing gives less capacitance closer plate spacing gives greater capacitance.

iii) Dielectric materials.

All other factors being equal, greater permittivity of the dielectric gives greater capacitance, less permittivity of the dielectric gives less capacitance.

1. Explain connection of capacitor.

- There are mainly two types of connection of capacitors. They are :

i) Series Connection

In this combination of connection one end of a capacitor is connected to the other opposite end of second capacitor. In this combination of capacitor voltage is not increased.

ii) Parallel Connection

In this combination of capacitor, same poles of different capacitor are connected in one point and another end is connected to other single point. It increases the voltage.

**Multiple Choice Question**

1. The capacity of a battery is expressed in terms of

A. Current rating B. Voltage rating

C. Ampere hour rating D. None of the above

2. The storage battery generally used in electric power station is

A. Nickel -cadmium battery B. Zinc carbon battery

C. Lead -acid battery D. None of the above

3. Trickle charger of a storage battery helps to

A. Maintain proper electrolyte level B. Increase its reverse capacity

C. Prevents ulphation ` D. Keep it fresh and fully charged

4. On over charging a battery

A. It will bring about chemical change in active materials

B. It will increase the capacity of the battery

C. It will raise the specific gravity of the electrolyte

D. None of t he above

5. Battery charging equipment is generally installed

A. In well ventilated location B. In clean and dry place

C. As near as practical to the battery being charged

D. In location having all above features

6. Batteries are charged by

A. Rectifiers B. Engine generator sets

C. Motor generator sets D. Any of the above

7. Battery container should be acid resistance therefore it is made up of

A. Glass B. Plastic C. Wood D. All of the above

8. Following will happen if battery charging rate i s too high

A. Excessive gassing will occur B. Temperature rise will occur

C. Bulging and buckling of plates we occur D. All of the above

9. Local action in a battery is indicated by

A. Excessive gassing under load conditions

B. Excessive drop in the specific gravity of electrolyte even when the sale is on open circuit

C. Both A and B

D. None of the above

10. The following indicate that battery on charge has attained full charge

A. Colour of electrode B. Gassing

C. Specific gravity D. All of the above

11. To prevent local action in battery, only ............is used in electrolytes

A. Pump water B. Distilled water

C. Tap water D. Both A and C

12. Ampere hour capacity of an industrial battery is based on ..........hours discharge rate

A. 8 B. 12 C. 16 D. 24

13. A battery of six cells will show a drop of ........volts from fully charged state to fully discharged state

A. 1 B. 1.5 C. 2.4 D. 2.9

14. Which of the following battery is used for aircraft?

A. Lead acid battery B. Nickel -iron battery

C. Dry cell battery D. Silver oxide battery

15. When two batteries are connected in parallel, it should be ensured that

A. They have same EMF B. They have same make

C. They have same ampere hour capacity D. They have identical internal resistance

16. If a battery is to be charged at a much higher rate as compared to normal charging rate, the charging should be restricted to

A. 95% of the capacity of battery B. 80% of the capacity of battery

C. 55% of the capacity of battery D. 35% of t he capacity of battery

17. A floating battery is one

A. Which gets charged and discharged simultaneously

B. Which supplies current intermittently and also during off cycle gets charged

C. In which battery voltage is equal to charger voltage

D. In which the current in the circuit is fully supplied by the battery

18. The terminal voltage when the battery is being charged decreases with

A. Increasing temperature B. Increasing charging rate

C. Increasing stage of charge D. All of the above

19. Which test is used to ascertain whether the battery plates are defective or not ?

A. Open volt test B. Cadmium test

C. High discharge test D. Specific gravity test

20. The electrode for a battery must be

A. A semi conductor B. An insulator

C. A good conductor of electricity D. A bad conductor of electricity

21. Cells are connected in series in order to

A. Increase the voltage rating B. Increase the current rating

C. Increase the life of the cells D. None of the above

22. Five 2 V cells are connected in parallel. The output voltage is

A. 1 V B. 1.5 V C. 1.75 V D. 2 V

23. A dead storage battery can be revived by

A. Adding distilled water B. Adding so -called battery restorer

C. A dose of H2SO4 D. None of the above

24. The open circuit voltage of any storage cell depends wholly upon

A. Its chemical constituents B. On the strength of its electrolyte

C. Its temperature D. All of the above

25. Each cell has a vent cap

A. To allow gases out when the cell is on charge

B. To add water to the cell if needed

C. To check the level of electrolyte

D. To do all above functions

26. Cell short circuit results in

A. Low specific gravity electrolyte B. Abnormal high -temperature

C. Reduced gassing on charge D. All of the above

27. A capacitor consists of two conducting surfaces called plates, separated by an

insulating material called the:

A. dielectric B. conductor C. electrode D. Dielectric

28. Capacitance is the measure of the ability of a capacitor to:

A. conduct a direct current B. hold an electric charge

C. store current in a magnetic field D. repel dynamic eddy currents

29. A farad is the capacity of a capacitor that stores a charge of one coulomb at a potential difference of:

A. one farad B. one ampere C. one volt D. one ohm

30. The charge on a capacitor can be determined using the formula:

A. Q = VC B. Q = V/C C. = 2 D. = 2

31. A 15 uF capacitor has been charged to a potential difference of 240 V. The charge on the capacitor will be:

A. 3,600 C B. 0.003 6 C C. 0.0015 C D. 0.024 C

32 The capacitance of a capacitor varies according to three physical parameters. These are, the effective area of the plates, the distance between the plates and the:

A. cross -sectional area of the plates B. supply voltage characteristic

C. permittivity of the dielectric D. type of connecting lead used

33. For a capacitor consisting of two parallel plates, the capacitance can be found from the following equation:

In the formula symbol A stands for:

A. cross -sectional distance between the plates

B. distance between the plates in meters

C. absolute permittivity of the dielectric

D. area of the plates in square meters

34. The dielectric constant signifies the degree to which capacitance can be increased by replacing the:

A. air between the plates with a dielectric B. air between the plates with a vacuum

C. insulation between the plates with air D. vacuum between the plates with air

35. For a capacitor, the voltage per unit thickness necessary to cause breakdown is called the:

A. dielectric constant of the capacitor

B. dielectric strength of the insulating material

C. capacitance of the insulating material

D. electrostatic current limit of the capacitor

36. When capacitors are connected in series the total capacitance will be:

A. more than the value of any one of the capacitors

B. the same value as the largest one of the capacitors

C. less than the value of any one of the capacitors

D. the same value as the smallest one of the capacitors

37. Look at the following diagram, A 10 uF and a 22 uF capacitor have been connected in series as shown in the above diagram. The total resulting capacitance will be approximately:

A. 32 uF B. 220 uF

C. 2.2 Uf D. 6.9 uF

38. Placing two or more capacitors in parallel has the same effect as:

A. increasing the distance between the plates

B. increasing the area of the plates

C. increasing the dielectric strength of the capacitors

D. decreasing the size of the connecting leads

39 Look at the following diagram, Two capacitors have been connected in parallel as shown. The total capacitance will be:

A. 726 uF B. 72.6 uF

C. 55 uF D. 13.2 uF

40. When a capacitor is connected to DC supply a charging current will flow. This current:

A. flows through the capacitors electrostatic field

B. will flow through the dielectric on each half cycle

C. flows through the insulating material in the circuit

D. does not flow through the capacitor

**Numerical Problems**

**Question 1: Batteries of 10V and 5 V are connected in series such that their emf’s point in the same direction. Find the equivalent resistance for the system.**

Solution :

The formula for equivalent series emf is given by,

Eeq = E1 + E2 + …

Given : E1 = 10,

E2 = 5

Substituting these values in the equation, E = E1 + E2

⇒ E = 10 + 5

⇒ E = 15 V

**Question 2: Batteries of 3, 5, and 10 ohms are connected in series such that their emf’s point in the same direction. Find the equivalent resistance for the system.**

**Solution :**

The formula for equivalent series emf is given by,

Eeq = E1 + E2 + …

Given: E1 = 3,

Substituting these values in the equation, E = E1 + E2 + E3

⇒ E = 3 + 5 + 10

⇒ E = 18 V

**Question 3: Batteries of 10V and 5 V are connected in series such that their emf’s point in the same direction. The internal resistances of the batteries are 2 and 10 ohms respectively. Find the equivalent resistance for the system.**

**Solution :**

The formula for equivalent series emf is given by, Eeq = E1+ E2 + …

Given: E1 = 10,

E2 = 5,

Substituting these values in the equation, E = E1 + E2

⇒ E = 10 + 5

⇒ E = 15 V

Equivalent resistance is also given by a similar equation, req = r1 + r2

Given r1 = 2, r2 = 10

substituting these values in the equation, req = r1 + r2

⇒ r = 2 + 10

⇒ r = 12 ohms

**Question 4: Three batteries of internal resistances 2, 2, and 4 ohms are connected in parallel. Find the equivalent resistance for the system.**

**Solution:**

The formula for equivalent resistance is given by,

1/r = 1/r1 + 1/r2 + 1/r3

Given: R1 = 2Ω,

R2 = 2Ω and R3 = 4Ω

Substituting these values in the equation,

1/r = 1/2 + 1/2 + 1/4

1/r = 4/5

R = 5/4 ohm

**Question 5: Three batteries of internal resistances 5, 5 ohm, and 10, 10 V are connected in parallel. Find the equivalent resistance and emf for the system.**

**Solution:**

The formula for equivalent resistance is given by,

Given: R1 = 5, R2 = 5

Substituting these values in the equation,

⇒

⇒

⇒ R=2.5 Ω

The equivalent emf is given by,

⇒

⇒

⇒ Eeq = 10 V

**Question 1: Three capacitors of 3pF, 5pF, and 10pF are connected in parallel. Find the equivalent capacitance for the system.**

## Capacitor

**Solution**

The formula for series capacitance is given by,

C = C1 + C2 + C3

Given:

C1 = 3pF,

C2 = 5pF and

C3 = 10pF

Substituting these values in the equation,

C = C1 + C2 + C3

⇒ C = 3 + 5 + 10

⇒ C = 18pF

**Question 2: Three capacitors of 2pF, 2pF, and 4pF are connected in series. Find the equivalent capacitance for the system.**

**Solution**

The formula for parallel capacitance is given by,

Given:

C1 = 2pF,

C2 = 2pF and

C3 = 4pF

Substituting these values in the equation,

⇒

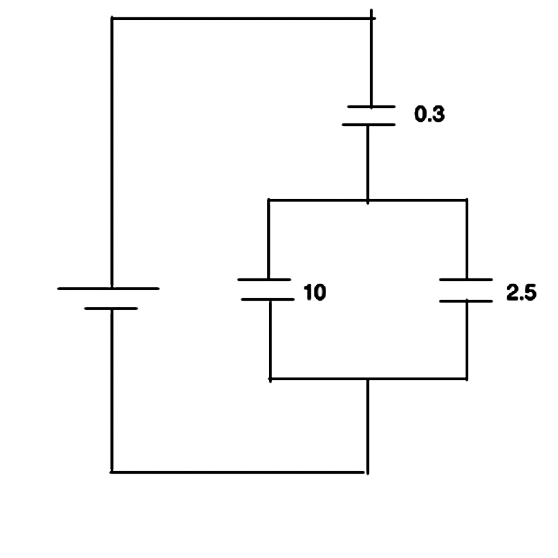
⇒

⇒

⇒ C = 4/5pF

**Question 3: Find the equivalent capacitance for the system shown in the figure below.**

**Solution**

The formula for parallel capacitance is given by,

and the formula for series capacitance is given by,

C = C1 + C2 + C3 + ….

This is combination of both parallel and series capacitances.

Given:

C1=0.3 μF

C2= 10 μF

C3=0.2 μF

C2 and C3 are in parallel so

Substituting these values in the equation,

⇒ = 10 + 2.5

⇒ = 12.5

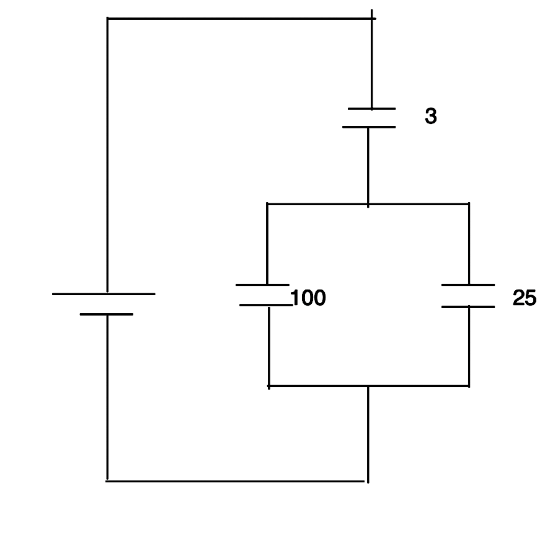
and C1 are in series

Substituting these values in the equation,

⇒ C = 0.29

**Question 4: Find the equivalent capacitance for the system shown in the figure below.**

**Solution**

The formula for parallel capacitance is given by,

and the formula for series capacitance is given by,

C = C1 + C2 + C3 + ….

This is combination of both parallel and series capacitances.

Given:

C1=3 μF

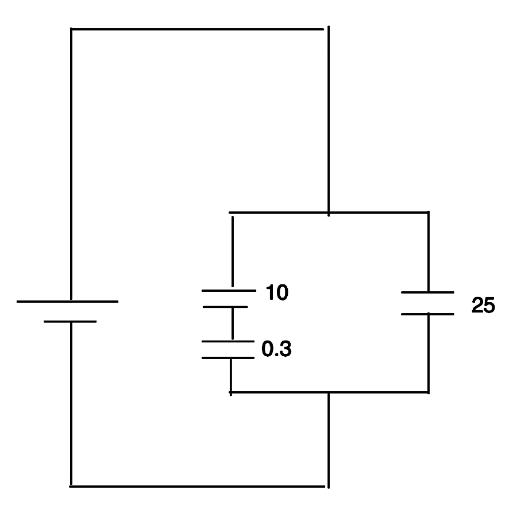
C2= 100 μF

C3=25 μF

C2 and C3 are in parallel so

Substituting these values in the equation,

⇒ = 100 + 25

⇒ = 125

and C1 are in series

Substituting these values in the equation,

⇒ C = 0.29

**Question 5: Find the equivalent capacitance for the system shown in the figure below.**

**Solution**

The formula for parallel capacitance is given by,

and the formula for series capacitance is given by,

C = C1 + C2 + C3 + ….

This is combination of both parallel and series capacitances.

Given:

C1=10 μF

C2= 0.3 μF

C3=25 μF

C1 and C2 are in series so

substituting these values in the equation,

μF

and C3 are in parallel so

substituting these values in the equation,

C = + C3

⇒ C = 2.91 + 25

⇒ C = 27.91 μF

**Chapter 6**

**A. Very Short Question Answer**

1. Define magnet.

- An object which is capable of producing magnetic field and attracting unlike poles and repelling like poles is called magnets.

1. What are temporary magnets ?

- Those types of magnet who loose magnetic property after magnetic field is removed is called temporary magnets.

1. What are permanent magnets ?

- Permanent magnets are those magnets who do not loose their magnetic property when they are magnetized once.

1. Define electro magnets.

- Electro magnets is the type of temporary magnet which acts as magnet until electric current is supplied through the coil of magnet.

1. Define magnetic field.

- The field where the magnet attract or repels magnetic materials such as iron, steel, etc. is called magnetic field.

1. Define magnetic induction.

- The process by which a magnetic substance acquires magnetic properties temporarily due to the presence of magnet close to it, is known as magnetic induction.

1. Define magnetic flux.

- Magnetic flux is a measurement of the total magnetic field which passes through a given area.

1. Define electromagnetic force.

- The amount of magnetizing force (how much force it has to magnetize, magnetic materials such as iron, steel, etc) is called electromagnetic force or magnetic field strength.

1. How are the electro magnetic waves travels ?

- Electro magnetic waves can travel through air, solid objects and even space. It is produced when electric field couples with a magnetic field. Magnetic couples with a magnetic field. Magnetic and electric fields of an electromagnetic wave are perpendicular to each other and to the direction of the waves.

**B. Short question answer**

1. What are the properties of magnet ?

- The properties of magnet are given below :-

i) Magnetic poles always exists in pairs.

ii) Like poles repel while unlike poles attract.

iii) The magnetic force between the two magnets is greater when the distance between these magnets are lesser.

iv) When magnet is suspended freely in mid-air, it always rest towards north and south.

1. Explain characteristics of magnet.

- magnet shows different property like attractive property, directive property, pair property, etc. Attractive property proves that the magnetic strength at the ends of the poles is strong. Directive property helps to understand which pole of the magnet in mid-air. When like poles met at a point it tries to repel with each other and attracts when they met at different poles. Pair property describes that the magnetic pole of magnet cannot be separated

1. What are the uses of magnet ?

- The uses of magnet are listed below :-

i) It is used in speakers and microphones for producing sound.

ii) It is used to convert electrical energy into kinetic energy or vice-versa for example. Motors, generators, etc.

1. Explain types of magnetic materials

- The types of magnetic materials are explained below : -

i) Diamagnetic materials

diamagnetic materials are also known as non- magnetic materials these materials cannot be magnetized when placed in a magnetic field.

ii) Paramagnetic materials.

It is the type of magnetic materials that get weakly magnetized in the presence of the external magnetic field. In the presence of an external magnetic field, these substances tend to move from a region of a weak to a strong magnetic field.

iii) Ferromagnetic materials.

Ferromagnetic materials are those materials which exhibit a spontaneous net magnetization at the atomic level, even in the absence of an external magnetic field. When placed in an external magnetic field, ferromagnetic materials are strongly magnetized in the direction of the field.

1. Explain magnetic effect of current in a conductor.

- A straight current carrying conductor has a magnetic field in the shape of concentric circles around it. Magnetic field lines can visualize the magnetic field of a straight current carrying conductor. The direction of a magnetic field produced due to a current carrying conductor relies upon the same direction in which the current is flowing. The direction of the magnetic field gets reversed if the direction of electric current changes.

1. Explain about magnetic field produced in solenoid due to flow of current.

- The magnetic field produced by the current carrying solenoid is similar to a bar magnet. The magnetic field produced inside a solenoid is parallel which is similar to a bar magnet. One solenoid end behaves as a south pole, and the other end behaves as a north pole. The strong magnetic force produced by a solenoid can be used to magnetize a piece of magnetic materials. The magnet so formed is known as an electromagnet.

1. Explain faraday's first law of electromagnetism in detail.

- Faraday concluded that an E.M.F is induced when the magnetic flux across the coil changes with time. Therefore, faraday's first law of electromagnetic induction states that, "whenever a conductor is placed in a varying magnetic field, an electromotive force is induced, if the conductor circuit is closed, a current is induced, which is called induced current.

1. Explain lenz's law.

- lenz's law states that ' The polarity of induced E.M.F is such that it tends to produce a current which opposes the change in magnetic flux that produced it. " The negative sign in the formula represents this effect. Thus, the negative sign indicates that the direction of the induced E.M.F and the change in the direction of magnetic fields have opposite signs.

1. What are the application of faraday's law.

- The application of faraday's law are given below : -

i) Electrical equipment like transformers works on the basis of faraday's law.

ii) Induction cooker works on the basis of mutual induction, which is based on the principle of faraday's law.

iii) By inducing an E.M.F into an electromagnetic flowmeter, the velocity of the fluids is recorded.

iv) Electric guitar and electric violin are musical instruments that find an application of faraday's law.

**C. Long Question Answer**

1. Explain types of magnets in detail.

- There are three types of magnet. They are :-

i) Permanent magnet

Permanent magnets are those magnets that are commonly used. They are known as permanent magnets because they do not loose their magnetic property once they are magnetized. For example :- Ceramic or ferrite, Alnico, Samarium Cobalt, Neodymium Iron Boron.

ii) Temporary Magnet

Temporary magnet can be magnetized in the presence of a magnetic field. When the magnetic field is removed, these materials loose their magnetic property. Iron nails and paper-clips are examples of the temporary magnet.

iii) Electromagnets

Electromagnets consist of a coil of wire wrapped around the metal core made from ion. When this materials is exposed to an electric current, the magnetic field is generated making the materials behave like a magnet. The strength of the magnetic field can be controlled by controlling the electric current.

1. Explain types of materials on the basis of magnetic properties.

- The types of materials on the basis of magnetic properties are explained below :-

i) Diamagnetic materials

diamagnetic materials are also known as non-magnetic materials. These materials cannot be magnetized when placed in a magnetic field. Moreover, magnetic dipoles contained in diamagnetic substance tends to align in the opposite direction of the applied field.

ii) Paramagnetic Materials

It is the type of magnetic materials that get weakly magnetized in the presence of the external magnetic field. In the presence of an external magnetic field, these substance tends to move from a region of a weak to a strong magnetic field.

iii) Ferromagnetic materials.

Ferromagnetic materials are those materials which exhibit a spontaneous net magnetism at the atomic level, even in the absence of an external magnetic field, when placed in an external magnetic fields, ferromagnetic materials are strongly magnetized in the direction of the field.

1. Explain the steps followed to magnetize ferromagnetic materials.

- Heating ferromagnetic materials higher than its curie temperature. Then, allowing it to cool in a magnetic field and hammering it as it cools. This method is the most effective method used to create permanent magnets. Storking: An existing magnet is moved repeatedly from one end of the material to the other in the same direction Alternatively, two magnets are moved outwards from the centre of a third electric current: The magnetic field produced by passing an electric current through a coil can arrange domains of ferromagnetic materials. Placing ferromagnetic materials in an external magnetic field will result in retaining some of the magnetism even after the removal. In addition, vibration can be used to increase the effect.

1. Explain magnetic effect of current in a conductor.

- A straight current carrying conductor has a magnetic field in the shape of concentric circles around it. Magnetic field lines can visualize the magnetic field of a straight current-carrying conductor. This direction of a magnetic field produced due to a current carrying conductor relies upon the same direction in which the current is flowing. The direction of the magnetic field gets reversed if the direction of electric current changes. Suppose a straight current carrying conductor is hung vertically, and an electric current is flowing from north to south i.e. from up to down. In this situation, the direction of the magnetic field will be clockwise. And if the same current is flowing from south to north through the same conductor, the direction of the magnetic field will be anti-clockwise. The direction of the magnetic field in electric current through a straight conductor can be represented by using the Right - Hand Thumb Rule.

1. Explain about magnetic field produced in solenoid due to flow of current.

- A solenoid is a tightly wound helical-coil of wire whose diameter is smaller than its length. The magnetic field produced by the current-carrying solenoid is similar to a bar magnet. The magnetic field produced inside a solenoid is parallel which is similar to a bar magnet. One solenoid end behaves as a south pole, and the other end behaves as a north pole. The strong magnetic force produced by a solenoid can be used to magnetize a piece of magnetic material. The magnet so formed is known as an electromagnet.

1. Explain principle of electromagnetism in detail.

- Electromagnetism is a branch of physics involving the study of the electromagnetic force, a type of physical interaction that occurs between electrically charged particles. The electromagnetic force governs all chemical processes which arise from interactions between the electrons of neighboring atoms. Electromagnetism is very widely used in modern technology, and electromagnetic theory in the basis of electric power engineering and electronics including digital technology. Electromagnetism is a process where a magnetic field is created by introducing the current in the conductor. When a conductor is electrically charged it generates magnetic lines. For example, if current i.e, positive charges move in a wire, it produces the magnetic field along the wire, and the direction of magnetic lines and forces can be determined using Right - Hand Rule Refer to the image for a detailed explanation.

1. Explain Faradays law in detail.

- According to faraday's law the relative motion between the magnetic field and conductor, the flux linkage charges and this change in flux includes a voltage across the coil. Faradays law of electromagnetic induction, also known as faraday's law, is the basic law of electromagnetism which helps us predict how a magnetic field would interact with an electric circuit to produce an electromotive force (E.M.F0. This phenomenon is known as electromagnetic induction. Faraday's law or the law of electromagnetic induction is the observation or results of experiments conducted by faraday.

**Multiple Choice Question**

1. Magnetic force acting on a unit positive charge moving perpendicular to the magnetic field with a unit velocity is called

A. Magnetic flux B. Magnetic field intensity

C. Magnetic induction D. Self -inductance

2. A current carrying conductor is placed in a uniform magnetic field parallel to it. The magnetic force experienced by the conductor is

A. F=1/B B. F=1/Bsin C. F/0 D. F=1/Bcos

3. What is the value of the current in a wire of 10cm long at the right angle to a uniform magnetic field of 0.5 Weber/m2 when the force acting on the wire is 5N?

A. 1A B. 10A C. 100A D. 1000A

4. When a particle of charge q and mass m enters into a uniform magnetic field B moving with a velocity v perpendicular to the direction for the field it describes a circular path of radius

A. R=qB/mV B. R=mV/qB C. R=qmV/B D. R=qmB/V

5. A particle of mass m and charge Q moving with velocity V enters the region of a uniform magnetic field at right angle to the direction of its motion. How does its kinetic energy get affected?

A. Its kinetic energy will be affected B. Its kinetic energy wont be affected

C. Its all energy wont be affected D. Its kinetic force wont be affected

6. Two parallel wires carrying currents in the opposite directions

A. Repel each other

B. Attract each other

C. Have no effect upon each other

D. They cancel out their individual magnetic fields

7. A magnetic compass will be deflected if it is kept near a

A. Charge in motion B. Charge at rest

C. Both D. None

8. A magnetic field

A. Always exerts a force on a charged particle

B. Never exerts a force on a charged particles

C. Exerts a force if the charged particle is moving in the direction of the magnetic

field lines

D. Exerts a force if the charged particle is moving perpendicular to the magnetic

field lines

9. A moving coil galvanometer of resistance 100 gives half scale deflection for a current of 20mA. What will be the potential difference across it?

A. 4 volt B. 5 volt C. 2 volt D. 0.4 volt

10. Which one of the following material is most suitable for making core of an electromagnet?

A. Air B. Steel C. Cu -Ni alloy D. Soft iron

11. The magnetic force experienced by a charged particle moving in a magnetic field will be minimum when it moves

A. Perpendicular to the field B. Parallel to the field

C. Inclined parallel to the field D. At an angle o f 45

12. The relationship between Tesla and smaller unit Gauss of magnetic induction is given by

A. 1=103 B. 1=104 C. 1=102 D. 1=104

13. If the plane of the rectangular coil is parallel to the magnetic field (i.e radial magnetic field) the torque on the coil is

A. = NIAB cos B. = NIAB sin C. = NIAB tan D. = NIAB

14. SI unit of flux density is

A. 11 B. 1 C. 1 D. 2

15. Magnetic flux and flux density are related by

A. Magnetic flux = flux density / area B. Magnetic flux = flux density x area

C. Flux density = magnetic flux area D. Flux density = magnetic flux x area

16. The standard vector symbol for flux density is

A. M B. L C. H D. B

17. The charged particle enters the uniform magnetic field in such a way that its initial velocity is not perpendicular to the field the orbit will be

A. A circle B. A spiral C. An ellipse D. Helix

18. An electron enters a region where the electric field E is perpendicular to the magnetic field B. It will suffer no deflection if

A. E = BeV B. B = eE/V C. E = BV D . E = BeV/2

19. Value of permeability of free space in SI units is

A. 410911 B. 410711

C. 4101011 D. 410811

20. The magnetic field strength of solenoid is

A. B = ni B. B = N/I C. B = nI D. Both B and C

21. An instrument which can measure potential without drawing any current is

A. Voltmeter B. Galvanometer

C. Cathode ray oscilloscope (CRO) D. Ammeter

22. The deflection for 50 division of galvanometer is decreased to 25 divisions by shunt resistance of 12. Galvanometer resistance is

A. 18 B. 30 C. 24 D. 12

23. When the coil of the galvanometer is in equilibrium then the deflecting couple is

A. Zero B. Equal to the restoring couple

C. Greater than the restoring couple D. Smaller than the restoring couple

24. The sensitivity of a galvanometer is given by

A. C/BAN B. CAN/B C. BAN/C D. ABC/N

25. Which one of the following is not an electromechanical instrument?

A. Galvanometer B. Voltmeter

C. Ammeter D. AC transformer and DC generator

26. Minimum current required to produce a deflection of 1 mm on a scale at a distance of 1 meter is

A. 0.1 A B. 1:00 AM C. Current sensitivity D. 1 mA

27. In a multi -range ammeter as the range increases

A. Shunt value decreases B. Shunt value increases

C. Shunt value remains the same D. None of the above

28. While measuring the unknown resistance the help of a slide wire bridge the greatest accuracy can be achieved when

A. A most sensitive galvanometer is used

B. A steady voltage cell is used

C. The balance point is close to the middle of the wire

D. A high resistance box is used in one of its gaps

29. A sensitive galvanometer gives full -scale deflection with 100 mV. If the resistance of the galvanometer is 50? the maximum current that can flow through safely is

A. 2.0 mA B. 20 mA C. 200 mA D. 0.2 mA

30. An ammeter measures the total current flowing through a circuit when it is connected

A. In series with the circuit

B. In parallel with the circuit

C. In series with any of the parallel resistances in the circuit

D. In parallel with any of the series resistance in the circuit

31. Coil of a galvanometer is suspended in a radial magnet ic field so that the deflecting torque on the coil is always

A. BINA cos B. BINA sin C. BINA tan D. BINA

32. A galvanometer basically is an instrument used to

A. Detect current in a circuit

B. Measure current flowing through a circuit

C. Measure voltage across a circuit

D. Measure the potential difference between two points in a circuit

33. The effective way to increase the sensitivity of a moving coil galvanometer is to

A. Use a very long and fine suspension B. Use a coil of very large area

C. Use a coil with a very large number of turns D. Use a very strong magnetic field

34. A wheat stone bridge is said to be balanced when

A. Maximum current flows through the galvanometer branch

B. Minimum current flows through the galvanometer branch

**Chapter 7**

**A. Very Short Question Answer.**

1. Define AC and DC.

- Alternative current describes the flow of charge that changes direction periodically. As a result, the voltage level also reverses along with the current.

- Direct Current (DC) is a bit easier to understand than alternating current. Rather than oscillating back and forth, DC provides a constant voltage or current.

1. Write application of AC.

- The application of AC are given below :-

i) It is used to power electric motor.

ii) It is used in transmission lines for less energy lost.

iii) It is used to run large appliances like dishwashers, refrigerators, and so on, which run on AC.

iv) It is used in wireless energy transferring system such as tesla coil.

1. Draw different waveforms of AC.
2. Define Frequency.

- The frequency of a signal is defined as the number of cycles it completes.

1. Define Time Period.

- Period refers to the time in seconds that the waveform takes to repeat itself from start to finish.

1. Define Amplitude.

- Amplitude refers to the magnitude or intensity of the signal waveform measured in volts or amps. It is the maximum value, positive or negative, that the waveform can attain.

1. Define Wavelength.

- Wavelength refers to the distance of the cycle of the wave to complete one cycle.

1. Define Single Phase Current.

- Single phase current is the type of supplying current which requires two wires for completing the circuit, i.e, the conductor and neutral.

1. Define Three phase Current.

- Three phase current is the method to supply current which consist four wires, three conductor and one neutral.

**B. Short Question Answer.**

1. Explain Characteristics of AC Waveforms.

- The characteristics of AC Waveforms are explained below :-

i) Frequency (f)

Alternating Current (AC) frequency is the number of cycles per second in an AC sine wave. Frequency is the rate at which current changes direction per second.

ii) Period ( T)

It refers to the time in seconds that the waveform takes to repeat itself from start to finish. It is the time duration of one cycle of the waveform and the time interval required between successive repetitions of the periodic waveform.

iii) Amplitude (A)

It refers to the magnitude or intensity of the signal waveform measured in volts or amps. The peak value or the maximum value that a waveform achieves is called its amplitude.

1. Differentiate between AC and DC.

- The differentiate between AC and DC are given below :-

|  |  |  |  |
| --- | --- | --- | --- |
| S.N | Alternating Current (AC) | S.N | Direct Current(DC) |
| 1 | The direction of the current keeps reversing periodically. | 1 | The direction of the current remains the same in DC. |
| 2 | We can transmit it over long distance with a few losses. | 2 | We can transmit it over long distance with negligible losses. |
| 3 | It doesn't have polarity. | 3 | It have polarity. |
| 4. | AC's load is resistive, inductive or capacitive. | 4. | DC's load is generally resistive in nature. |

1. Differentiate between one phase and three phase current.

- The differentiate between one phase and three phase current are given below :-

|  |  |  |  |
| --- | --- | --- | --- |
| S.N | One Phase | S.N | Three Phase |
| 1. | It supplies power through one conductor. | 1. | It supplies power through three conductor. |
| 2. | It has less efficiency. | 2. | It has more efficiency. |
| 3. | It requires two wires for completing the circuit. | 3. | It requires four wires for completing the circuit. |
| 4. | It is used for home appliances. | 4. | It is used in large industries for running heavy loads. |

1. Explain single phase current in detail.

- The single phase requires two wires for completing the circuit, i.e, the conductor and the neutral. The conductor carries the current and the neutral is the return path of the current. The single phase supplies the voltage up to 230 volts. It is mostly used for running the small appliances like a fan, cooker, grinder, heater, etc.

1. Explain three phase current in detail.

- The three phase system consist four wires, three conductors and one neutral. The conductors are out of phase and space 120 apart from each other. The three phase system is also used as a single phase system. For the low load, one phase and neutral can be taken from the three phase supply.

**Multiple Choice Question**

1. In general in an alternating current circuit

A. the average value of current is zero

B. the average value of square of the current is zero

C. average power dissipation is zero

D. the phase difference between voltage and current is zero

2. The frequency of A.C. mains in NEPAL is

A. 30 c/s B. 50 c/s C. 60 c/s D. 120 c/s

3. A.C. power is transmitted from a power house at a high voltage as

A. the rate of transmission is faster at high voltages

B. it is more economical due to less power loss

C. power cannot be transmitted at low voltages

D. a precaution against theft of transmission lines

4. The electric mains supply in our homes and offices is a voltage that varies like a sine function with time such a voltage is called A and the current driven by it in a circuit is called the B Here, A and B refer to

A. DC voltage, AC current B. AC voltage, DC current

C. AC voltage, DC voltage D. AC voltage, AC current

5. Alternating currents can be produced by a

A. dynamo B. choke coil C. transformer D. electric motor

6. The peak value of the a.c. current flowing throw a resistor is given by

A. 0 = 0/R B. 0= e/R C. 0= 0 D. 0= R/0

7. The alternating current can be measured with the help of

A. hot wire ammeter B. hot wire voltmeter

C. moving magnet galvanometer D. suspended coil type galvanometer

8. Alternating current cannot be measured by D.C. ammeter, because

A. A. C. is virtual

B. A. C. changes its direction

C. A. C. cannot pass through D.C. ammeter

D. average value of A. C for complete cycle is zero

9. The heat produced in a given resistance in a given time by the sinusoidal current I0sint will be the same as that of a steady current of magnitude nearly

A. 0.71 0 B. 1.412 0 C. 0 D. 0

10. An A.C. source is connected to a resistive circuit. Which of the following is true?

A. Current leads ahead of voltage in phase

B. Current lags behind voltage in phase

C. Current and voltage are in same phase

D. Any of the above may be true depending upon the value of resistance.

11. In which of the following circuits the maximum power dissipation is observed?

A. Pure capacitive circuit B. Pure inductive circuit

C. Pure resistive circuit D. None of these

12. With increase in frequency of an A.C. supply, the inductive reactance

A. decreases B. increases directly with frequency

C. increases as square of frequency D. decreases inversely with frequency

13. If the frequency of an A.C. is made 4 times of its initial value, the inductive reactance will

A. be 4 times B. be 2 times C. be half D. remain the same

14. A capacitor acts as an infinite resistance for

A. DC B. AC

C. DC as well as AC D. neither AC nor DC

15. The capacitive reactance in an A.C. circuit is

A. effective resistance due to capacity B. effective wattage

C. effective voltage D. None of these

16. Of the following about capacitive reactance which is correct?

A. The reactance of the capacitor is directly proportional to its ability to store charge

B. Capacitive reactance is inversely proportional to the frequency of the current

C. Capacitive reactance is measured in farad

D. The reactance of a capacitor in an A.C. circuit is similar to the resistance of a capacitor in a D.C. circuit

17. Phase difference between voltage and current in a capacitor in an ac circuit is

A. B. /2 C. 0 D. /3

18. A capacitor has capacitance C and reactance X, if capacitance and frequency become double, then reactance will be

A. 4X B. X/2 C. X/4 D. 2X

19. When an ac voltage of 220 V is applied to the capacitor C, then

A. the maximum voltage between plates is 220 V.

B. the current is in phase with the applied voltage.

C. the charge on the plate is not in phase with the applied voltage.

D. power delivered to the capacitor per cycle is zero.

20. In LCR circuit if resistance increases quality factor

A. increases finitely B. decreases finitely

C. remains constant D. None of these