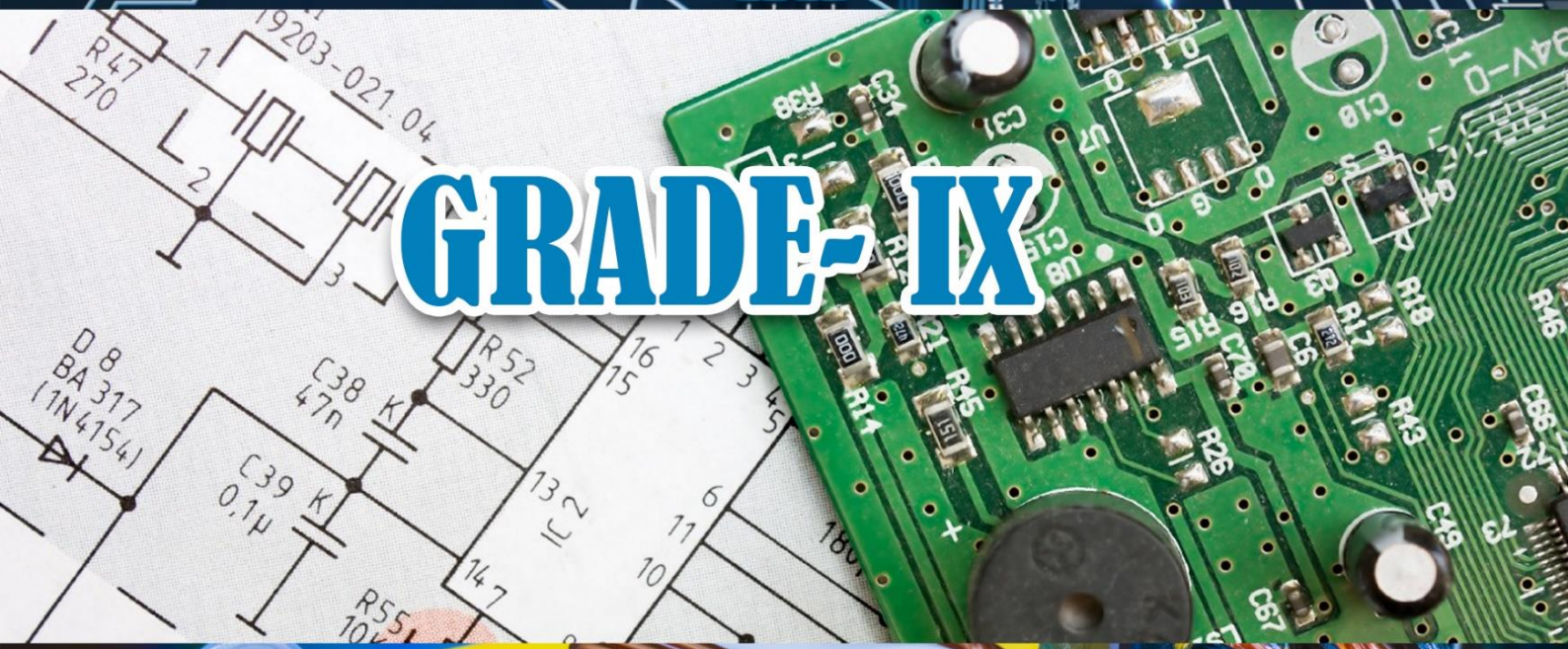
FUNDAMENTALS OF ELECTRO SYSTEM



GRADE- IX

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CHAPTER-1 INTRODUCTION TO ELECTROSTATICS

Numericals

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 $9 \times 10^9\ Nm^2/C^2$

The formula to calculate electrostatic force between the charges is:

$$F = k\frac{q_1 q_2}{r^2}$$

Substitute the given values in the above expression as,

F= $9 \times 10^9 \frac{2x(-1)}{1^2}$

= $18 \times 10^9\ N$

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 / r^2)

Substitute the given values in the above expression as,

F = (9 × 10^9 Nm^2/C^2) [(-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 (q^2 / r^2) .....(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)/ r^2] .....(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, q_1 is 2×10^{-7} C.

The second charge, q_2 is 4.5×10^{-7} C.

The force acted upon them, F is 0.1 N.

The formula to calculate e

rostatic force between the charges is:

$F = k q_1 q_2 / r^2$

Substitute the given values in the above expression as,

$0.1 \text{ N} = (9 \times 10^9 \text{ Nm}^2/\text{ C}^2)(2 \times 10^{-7} \text{ C})(4.5 \times 10^{-7} \text{ C}) / (r)^2$

$r = 0.09$ 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:

$F = k q^2 / r^2$

where q is the charge.

Rearrange the above formula for q as,

$q^2 = Fr^2 / k$

Substitute the given values in the above expression as,

$q^2 = (1000 \text{ N}) (0.1 \text{ m})2 / (9 \times 10^9 \text{ Nm}^2/\text{ C}^2)$

$q = 0.33 \times 10^{-5}$ C

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

WORKOUT EXAMPLES

A. VERY SHORT QUESTION ANSSWER.

1. Define Electric Charge.
2. Define Static Electricity.
3. Define Current Electricity (Dynamic Electricity).
4. Define Hydroelectricity.
5. Define Solar Electricity.
6. List application (uses) of electricity.
7. How can you use electricity for entertainment.
8. Define atom.
9. List components of atom.
10. Define (Components of Atom)
11. Define atomic nucleus.
12. Define atomic Mass.
13. Define atomic Weight.
14. Define Free electrons.
15. Define electric field.
16. Define electric potential.
17. Define potential difference
18. Define electrical energy
19. State Colomb's law.
20. List limitation of colombs law.

B. SHORT ANSWER QUESTIONS.

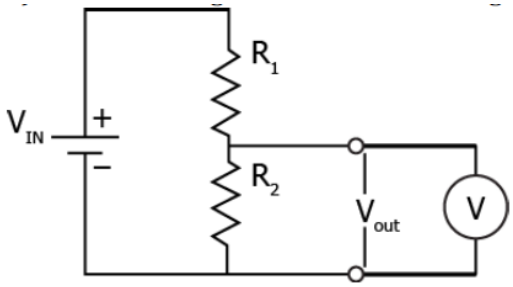
21. What do you mean by electro statics. Explain.
22. List types of electricity and explain any one.
23. List uses of electricity and explain any two.
24. Define atom and list its components.
25. `Define Isotopes and give any one example.
26. State and explain colomb's law in detail.

C. LONG ANSWER QUESTIONS.

27. Explain types of electricity in details.
28. List uses of electricity and explain any four.
29. Define atom and explain its various components.

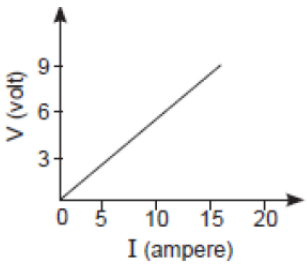
E. MULTIPLE CHOICE QUESTIONS

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



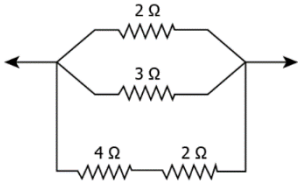
a. Current in the circuit
b. Voltage in the circuit
c. The voltage across the resistor
d. The resistance offered by the resistor

2. The least resistance obtained by using 2 Ω, 4 Ω, 1 Ω and 100 Ω is
a. < 100 Ω b. < 4 Ω c. < 1 Ω d. > 2 Ω
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 and 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 Ω b. 3/5 Ω
c. 5/2 Ω d. 2/5 Ω

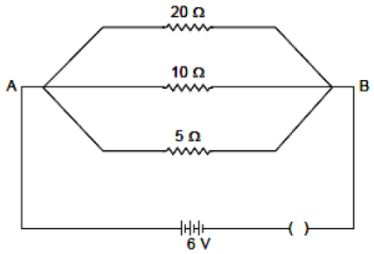


11. A current of 1 A is drawn by a filament of an electric bulb.The number of electrons passing through a cross-section of the filament in 16 seconds would be roughly
a. 10^{20} b. 10^{16} c. 10^{18} d. 10^{23}
12. How much more heat is produced if the current is doubled?
a. Twice the original amount 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 volts 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 Ω resistor and 4 Ω resistor offers the least resistance to current in the circuit?
a. Series combination, which results in a net resistance of 2 Ω
b. Parallel combination, which results in a net resistance of 2 Ω
c. Series combination, which results in a net resistance of 1.5 Ω
d. Parallel combination, which results in a net resistance of 0.5 Ω
16. In an electrical circuit, two resistors of 2 Ω and 4 Ω, respectively, are connected in series to a 6 V battery.The heat dissipated by the 4 Ω 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. R/n^2 b. n^2/R c. n/R d. R/n
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 Ω.When connected in parallel, give 2.4 Ω.Then the individual resistance is
a. each of 5 Ω b. 6 Ω and 4 Ω c. 7 Ω and 4 Ω d. 8 Ω and 2 Ω

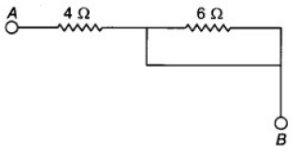
21. A battery of 10 volt carries 20,000 C of charge through a resistance of 20 Ω.The work done in 10 seconds is
    a. $2 \times 10^3\ joule$ b. $2 \times 10^5 joule$
    c. $2 \times 10^4 4\ joule$ d. $2 \times 10^2\ joule$
22. Two bulbs are rated 40W, 220W and 60W, 220W.The ratio of their resistances 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 Ω b. 1.0 Ω
    c. 1.5 Ω d. 2.0 Ω
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 kW h?
    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 Ω 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 Ω b. 6 Ω
    c. May be 10 Ω
    d. Must be 10 Ω

Answer key

1	C		6	D		11	A		16	C		21	B		26	D
2	C		7	B		12	C		17	A		22	D		27	B
3	C		8	B		13	A		18	D		23	B		28	A
4	D		9	B		14	D		19	D		24	B			
5	B		10	B		15	D		20	B		25	A			

CHAPTER-2 ELECTRIC FUNDAMENTALS

WORKOUT EXAMPLES

A. VERY SHORT QUESTION ANSSWER.

1. Define potential difference.
2. Define electric current.
3. Define electrical resistance.
4. Write the formula to calculate resistivity and conductivity. From given V and I
5. Define capacitors.
6. List standards units of capacitance.
7. Define inductor.
8. Define Conductor.
9. Define Insulator.
10. Define Semi Conductor.
11. List any five example of conductors.
12. List any five example of insulators.
13. List sources of electricity.
14. Define sources of electricity.
15. Define nuclear fission and fusion.
16. List types of resistors.
17. List uses of resistors.
18. List factors that affect the resistance of conductor.

B. SHORT ANSWER QUESTIONS.

19. Define capacitors and list SI unit of capacitance.
20. List any five examples of conductors and insulators each.
21. List sources of electricity and explain any three.
22. List uses of resistor and explain any three.
23. List important properties of insulators.
24. List factor affecting the resistance of conductor and explain any two.

C. LONG ANSWER QUESTIONS.

25. Explain factors affecting the resistance of conductor.
26. Classified the objects on the basis of resistance or conductance.
27. Explain uses of resistor.
28. Define resistor. Mention its unit and explain uses of resistor.
29. Explain about sources of electricity.

D. MULTIPLE CHOICW QUESTRIONS

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:

RESISTIVITY OF SELECTED MATERIALS		
Resistivity (ρ)		
Conductor	**@ 20 °C**	**Use**
Aluminium	2.83 E–8 Ωm	Pure metals used for conductors
Copper	1.72 E–8 Ωm	
Gold	2.44 E–8 Ωm	
Lead	2.04 E–8 Ωm	
Platinum	10.09 E–8 Ωm	
Silver	1.63 E–8 Ωm	
German silver	33 E–8 Ωm	Alloys used as resistance wire
Advance	49 E–8 Ωm	
Manganin	48 E–8 Ωm	
Nichrome	112 E–8 Ωm	

   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 conductor. $R = \rho l/A$. In the formula the symbol ρ stands for the:
   A. cross-sectional area of the conductor in m^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. ambient 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 various 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 burns 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 that 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 sun's 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 recognise a good source of fuel?
A. physical 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

ANSWER KEY

1	A		6	B		11	A		16	C		21	B
2	B		7	C		12	C		17	D		22	C
3	C		8	B		13	D		18	D		23	B
4	D		9	C		14	A		19	B		24	D
5	A		10	D		15	B		20	B		25	D

CHAPTER-3 ELECTRICAL CIRCUIT

Numerical

3.7.1 OHM'S LAW EXAMPLES

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 6Ω 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

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

$= \frac{3}{6}$

=0.5

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

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

Solution:

Current (I)= 0.2A

Resistance (R)= 1.4kΩ

= 1.4x1000Ω

=1400Ω

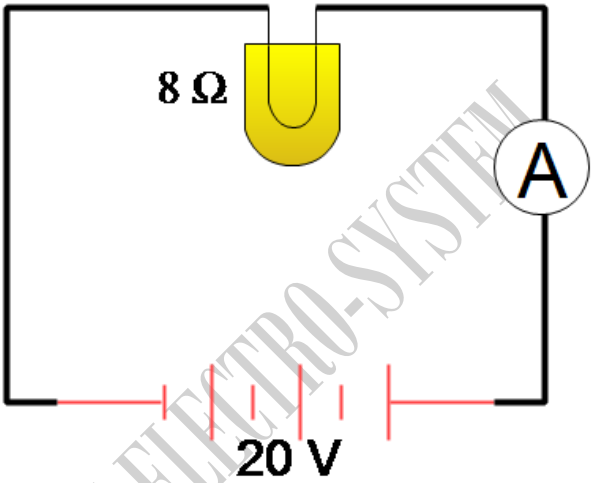
using Ohm's law, $V = IR$ we have

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

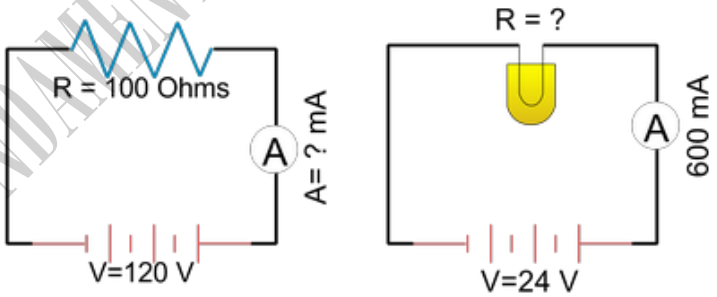
$$I = \frac{V}{R}$$

$$= \frac{20}{8}$$

=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

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

$$= \frac{120}{100}$$

=1.2A

Thus, **the current that shows in ammeter = 1.2A**

For second figure

Voltage (V)= 24V

Current (I)= 600mA

$$= \frac{600}{1000}$$

=0.6A

From ohm's law

V=IR

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

$$= \frac{24}{0.6}$$

=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 $I = \frac{1.5}{1.5} = 1A$ with a 1.5 volts battery and a current $I = \frac{3}{1.5} = 2A$ with replacement new one. In these cases, the light bulb will most likely burn out.

Problem (7): In a circuit, a 10Ω resistor is removed and replaced by a 20Ω 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,$I = \frac{V}{R}$ current

$I = \frac{V}{R} = \frac{120}{10} = 12A$

flows through the 10 Ω resistor and current

$I = \frac{V}{R} = \frac{120}{20} = 6A$ flows through the 20 Ω resistor

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

3.7.2 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.

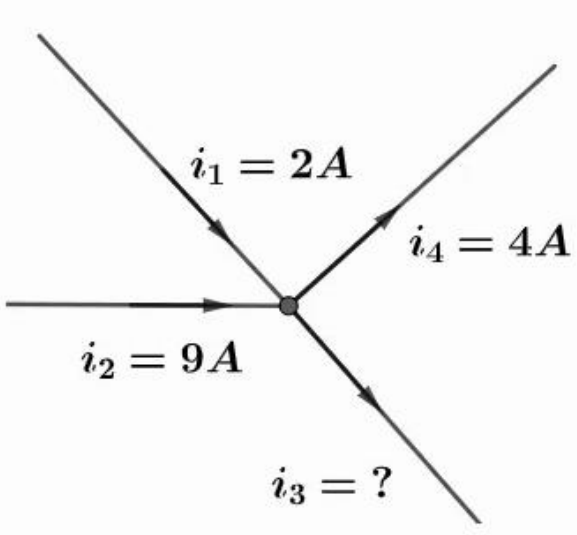
i1+i2 = i3+i4

Substitute the known quantities

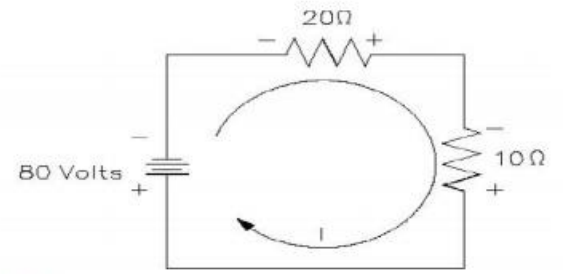
2+9=i3+4

Solve for i3

i3=7 A



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



Solution:

$80 = 20(I) + 10(I)$

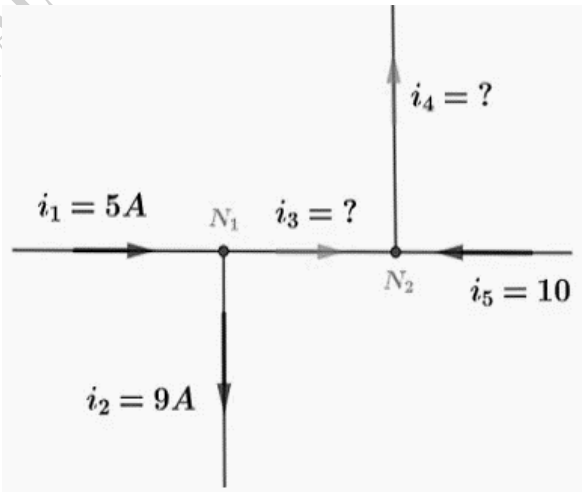
$80 = 30(I)$

$I = 80/30 = 2.66$ amperes

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.

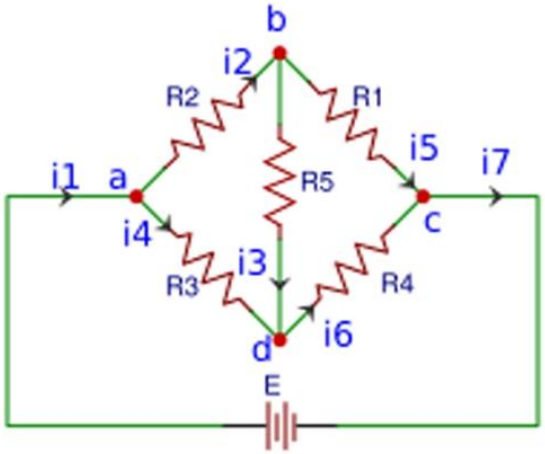
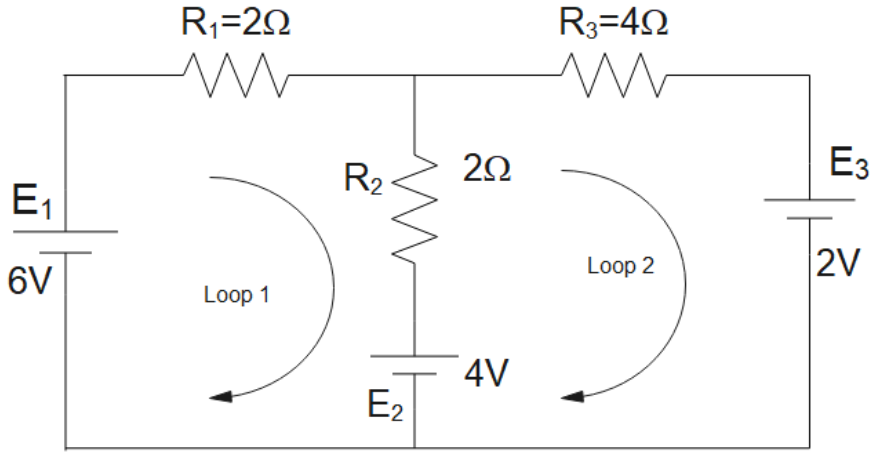


Figure 1

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
$I1=1.2A$
$I2=1.4A$

WORKOUT EXAMPLES

A. VERY SHORT QUESTION ANSSWER.

1. Define Electric Circuit.
2. List different types of Electric Circuit.
3. Define Series Circuit.
4. Define Parallel Circuit.
5. Define Open Circuit.
6. Define Short Circuit.
7. Define Closed Circuit.
8. Define Domestic Electric Circuit.
9. List the different types of wires in domestic circuit.

B. SHORT ANSWER QUESTIONS.

10. Write some precaution that should follow while using electric circuit.
11. State Ohms law.
12. List the limitation of ohm's law.
13. List the application of Ohm's law in Daily Life.
14. State and explain Kirchhoff's Current Law.
15. State and explain Kirchhoff's Voltage law.

C. MULTIPLE CHOICE QUESTION

1. If a current of 5 Amperes flows through the conductor. The number of electrons per second will is
   A. $1.6\ x\ 10^{-19}$ B.$3.12\ x\ 10^{19}$ C. $4\ x\ 10^{19}$ D. $7.68\ x\ 10^{20}$
2. Ohm's 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 the 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 analyse the circuit?
    A. Newton's law B. Faraday's 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 Kirchhoff's first law $\Sigma i = 0$ 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. Kirchhoff's 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 emf 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

ANSWER KEY

1	A		6	A		11	B		16	A
2	B		7	B		12	D		17	C
3	A		8	B		13	A		18	B
4	A		9	A		14	B		19	B
5	A		10	A		15	D		20	A

CHAPTER-4 ELECTRICAL POWER AND THEORY

NEMERICALS:

Electric energy – problems and solutions

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

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

2. 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.

3. 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

4. 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

5. 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
2 lamps 10 Watt = 2 x 10 Watt = 20 Watt
3 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
Given:
V = 10
I = 5
P = VI
⇒ P = (10)(5)
⇒ P = 50W

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 = 10W

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,
$P = V^2/R$

Given:
V = 5
R = 50
$P = V^2/R$
$\Rightarrow P = (5^2)/(50)$
⇒ 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,
$P = V^2/R$
Given:
V = 20
R = 15
$P = V^2/R$
$\Rightarrow P = (20^2)/(15)$
⇒ 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,
$P = I^2R$
Given:
I = 5
R = 10
$P = I^2R$
$\Rightarrow P = (5^2)(10)$
⇒ 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,
$P = I^2R$
Given:
I = 10

R = 20

$P = I^2R$

$P = (10^2)(20)$

$P = (100)(20)$

$P = 2000\,W$

WORKOUT EXAMPLES

A. VERY SHORT QUESTION ANSSWER.

1. Define electrical power.
2. List types of component in electric circuit.
2. Define Watt.
4. List multiples and submultiples of watt.
5. Write the formulas used for calculating electric power.
6. Define electrical energy.
7. List uses of electrical energy.
8. List sources of electrical energy.

B. MULTIPLE CHOICE QUESTION

1. Electric power is represented by formula……
   *A. $P = I^2R$ B. $P = R^2I$ C. $P = V^2R$ D. $P = I^2IR^2$
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. $360\,J$ B. $36 \times 10^3\,J$ *C. $3.6 \times 10^6\,J$ D. $36 \times 10^6\,J$
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 Ω, 200 Ω and 300 Ω 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 Ω 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 Ω B. 50 Ω C. 52 Ω D. 54 Ω
12. An electric iron of 600 watt works on 220 volt supply, current dwarn 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 month of April is…
   A. 18 kW B. 36 kW *C. 54 kW D. 72 kW
14. A wire of resistance 2 kΩ 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

CHAPTER-5 CELL AND CAPACITOR

Sample Problems

REGISTOR

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,

E2 = 5and

E3 = 10

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,

$$\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$$

Given: R1 = 2Ω,
R2 = 2Ω and
R3 = 4Ω

Substituting these values in the equation,

$$\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$$

$$\Rightarrow \frac{1}{R} = \frac{1}{2} + \frac{1}{2} + \frac{1}{4}$$

$$\Rightarrow \frac{1}{R} = \frac{2+2+1}{4}$$

$$\Rightarrow \frac{1}{R} = \frac{4}{5}$$

$$\Rightarrow R = 5/4\ \Omega$$

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,

$$\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2}$$

Given: R1 = 5,
R2 = 5

Substituting these values in the equation,

$$\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2}$$

$$\Rightarrow \frac{1}{R} = \frac{1}{5} + \frac{1}{5}$$

$$\Rightarrow \frac{1}{R} = \frac{2}{5}$$

$$\Rightarrow R = 2.5\ \Omega$$

The equivalent emf is given by,

$$\frac{Eeq}{req} = \frac{E1}{r1} + \frac{E2}{r2}$$

$$\Rightarrow \frac{Eeq}{2.5} = \frac{10}{5} + \frac{10}{5}$$

$$\Rightarrow \frac{Eeq}{2.5} = 4$$

$$\Rightarrow Eeq = 10\ V$$

Capacitor

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

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,

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3}$$

Given:

C1 = 2pF,
C2 = 2pF and
C3 = 4pF

Substituting these values in the equation,

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3}$$

$$\Rightarrow \frac{1}{C} = \frac{1}{2} + \frac{1}{2} + \frac{1}{4}$$

$$\Rightarrow \frac{1}{C} = \frac{2+2+1}{4}$$

$$\Rightarrow \frac{1}{C} = \frac{5}{4}$$

$\Rightarrow$ C = 4/5pF

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

Solution

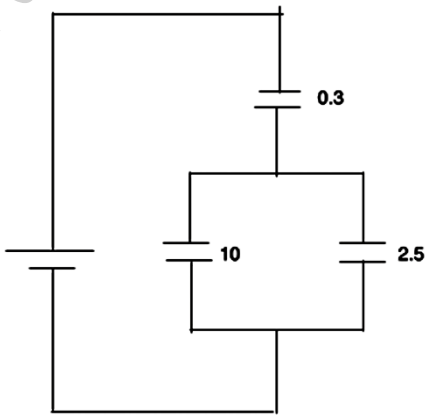
The formula for parallel capacitance is given by,

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3} + \cdots$$

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,

$C_{e1} = C1 + C2$

$\Rightarrow C_{e1}$ = 10 + 2.5

$\Rightarrow C_{e1}$ = 12.5

C_{e1} and C1 are in series

Substituting these values in the equation,

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C_{e1}}$$

$$\Rightarrow \frac{1}{C} = \frac{1}{0.3} + \frac{1}{12.5}$$

$$\Rightarrow \frac{1}{C} = \frac{12.8}{12.5\ x\ 0.3}$$

⇒ C = 0.29

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

Solution

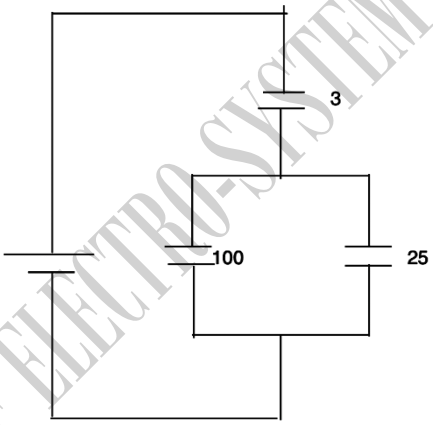
The formula for parallel capacitance is given by,

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3} + \cdots$$

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,

$C_{e1} = C1 + C2$

⇒ C_{e1} = 100 + 25

⇒ C_{e1}= 125

C_{e1} and C1 are in series

Substituting these values in the equation,

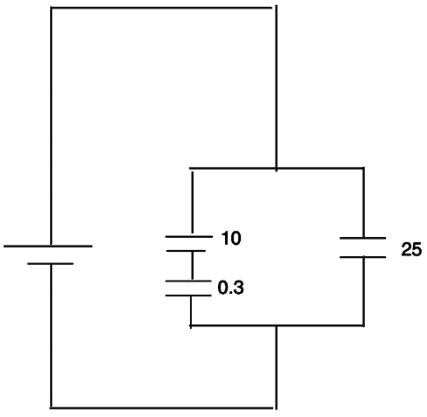
$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C_{e1}}$$

$$\Rightarrow \frac{1}{C} = \frac{1}{3} + \frac{1}{125}$$

$$\Rightarrow \frac{1}{C} = \frac{128}{125\ x\ 3}$$

⇒ 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,

$$\frac{1}{C} = \frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3} + \cdots$$

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,

$$\frac{1}{C_{e1}} = \frac{1}{C1} + \frac{1}{C2}$$

$$\Rightarrow \frac{1}{C_{e1}} = \frac{1}{10} + \frac{1}{0.3}$$

$$\Rightarrow 1/C_{e1} = 10.3/30$$

$$\Rightarrow C_{e1} = 30/10.3$$

$$\Rightarrow C_{e1} = 2.91 \text{ μF}$$

C_{e1} and C3 are in parallel so

substituting these values in the equation,

C = C_{e1} + C3

⇒ C = 2.91 + 25

⇒ C = 27.91 μF

Work out examples

A. VERY SHORT ANSSWER QUESTION.

1. Define cell.
2. Define battery. List types of battery.
3. List types of primary and secondary battery.
4. Define electric cell.
5. Define Galvanic cell.
6. List application of primary and secondary cell.
7. List types of cell.
8. List application of reserve cell, fuel cell.
9. List advantages of battery over other power sources.
10. List drawbacks of battery.
11. List the factors for choosing right battery according to your application.
12. Define Capacitor.
13. List standard unit of capacitor.

B. LONG ANSWER QUESTION.

14. Explain types of battery in details.
15. Explain primary battery in details.
16. Explain secondary battery in details.
17. Differentiate between cell and battery.
18. Explain types of cells in details.
19. Explain primary cell in details.
20. Differentiate between primary cell and secondary cell.
21. Explain reserved cell and fuel cell in detail.
22. Explain reserved cell and fuel cell in detail.
23. Explain advantage and drawbacks of battery.
24. Explain the factor for choosing right battery according to the application.
25. Explain types of combination of cell in details.
26. Explain working of capacitor in details.
27. Explain characteristics of capacitor.
28. Explain factor affecting capacitance of capacitor.
29. Explain connection of capacitor.

C. MULTIOLE 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. Prevent sulphation 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 the 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 is 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 the 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 H_2SO_4 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. trielectric

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. $Q = VC^2$ D. $Q = V^2C$

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

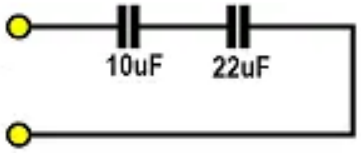
33. For a capacitor consisting of two parallel plates, the capacitance can be found from the following equation:
$C = \frac{\epsilon_0 \epsilon_1 A}{D}$.
In the formula symbol 'A' stands for:
A. cross-sectional distance between the plates
B. distance between the plates in metres
C. absolute permittivity of the dielectric
D. area of the plates in square metres

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

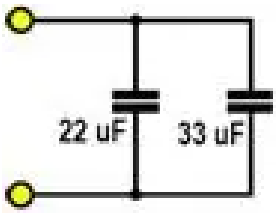
37. Look at the following diagram, A 10 uF and a 22 uF capacitor have been connected in series as shown in the above diagram. The total resulting capacitance will be approximately:



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 capacitor's 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

ANSWER KEY

1	C		9	D		17	B		25	D		33	D
2	C		10	D		18	A		26	D		34	B
3	D		11	B		19	B		27	A		35	B
4	D		12	A		20	C		28	B		36	C
5	D		13	C		21	A		29	C		37	D
6	D		14	B		22	D		30	A		38	B
7	D		15	A		23	D		31	B		39	C
8	D		16	B		24	D		32	C		40	D

CHAPTER-6 MAGNETISM AND ELECTROMAGNETISM

A. VERY SHORT ANSSWER QUESTION.

1. Define magnet
2. What are temporary magnets?
3. What are permanent magnets.
4. Define electro magnets.
5. Define magnetic field.
6. Define magnetic induction.
7. Define magnetic flux.(Φ).
8. Define electromagnetic force.
9. How are the electro magnetic waves travels?

B. SHORT ANSSWER QUESTION.

10. What are the properties of magnet
11. Explain characteristics of magnet
12. What are the uses of magnet
13. Explain types of magnetic materials.
14. Explain magnetic effect of current in a conductor.
15. Explain about magnetic field produced in solenoid due to flow of current.
16. Explain faraday's first law of electromagnetism in detail.
17. Explain lenz's law
18. What are the application of faraday's law.

C. LONG ANSSWER QUESTION.

19. Explain types of magnets in detail
20. Explain types of materials on the basis of magnetic properties.
21. Explain the steps followed to magnetize ferromagnetic material
22. Explain magnetic effect of current in a conductor.
23. Explain about magnetic field produced in solenoid due to flow of current.
24. Explain principle of electromagnetism in detail.
25. Explain faradays law in detail.

D. MILTIPLE CHOICE QUESTIONS.

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/Bsinθ C. F/0 D. F=1/Bcosθ

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 won't be affected
   C. It's all energy won't be affected
   D. Its kinetic force won't 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 100Ω 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 of 45°
12. The relationship between Tesla and smaller unit Gauss of magnetic induction is given by
    A. $1T = 10^3G$ B. $1T = 10^{-4}G$ C. $1T = 10^{-2}G$ D. $1T = 10^4G$

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. τ = NIAB cosφ B. τ = NIAB sinφ C. τ = NIAB tanφ D. τ = NIAB
14. SI unit of flux density is
A. $NA^{-1}m^{-1}$ B. NAm^{-1} C. NmA^{-1} D. NmA^{-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. $4\pi x10^{-9}WbA^{-1}m^{-1}$ B. $4\pi x10^{-7}WbA^{-1}m^{-1}$
C. $4\pi x10^{-10}WbA^{-1}m^{-1}$ D. $4\pi x10^{-8}WbA^{-1}m^{-1}$
20. The magnetic field strength of solenoid is
A. B = Mni B. B = μN/l C. B = μnI 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 12Ω. Galvanometer resistance is
A. 18Ω B. 30Ω C. 24Ω D. 12Ω
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 magnetic field so that the deflecting torque on the coil is always
A. BINA cosθ B. BINA sinθ C. BINA tanθ 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
C. The potential difference across the galvanometer branch is maximum
D. The potential difference across the galvanometer branch is zero
35. When an electron moving with a uniform speed in a vacuum enters a magnetic field in a direction perpendicular to the field the subsequent path of the electron is

A. A straight line parallel to the field
B. A parabola in a plane perpendicular to the field
C. A circle in a plane perpendicular to the field
D. A straight line along its initial direction

36. A particle of mass m charge q and speed V enters a uniform magnetic radius r. The radius r of the circle is
A. Independent mass m B. Directly proportional to m
C. Directly proportional to q D. Directly proportional to B

37. Galvanometer is a very sensitive device with
A. Very low damping B. Very high damping
C. No damping at all D. Radial field disintegration

38. Which one of the following methods would be able to increase the sensitivity of a moving coil galvanometer?
A. Connect a shunt across the coil
B. Use a coil of smaller cross-sectional area
C. Use a coil having less number of turns
D. Use spiral springs whose force constant is small

39. Heating a magnet will
A. Weaken it B. Strengthen it
C. Reverse its polarity D. Demagnetize it completely

40. If a current carrying solenoid is suspended freely it will
A. Be rotating
B. Come to rest in the N-S direction
C. Vibrating like galvanometer needle
D. Comes to rest after rotation

41. Which of the following is the unit of magnetic flux density?
A. Weber /$Meter^2$ B. Tesla
C. Newton/ampere-metre D. All of the above

42. The magnetism of a magnet is due to
A. earth
B. cosmic rays
C. due to pressure of big magnet inside the earth
D. spin motion of electrons

43. Which of the following materials is the most suitable for making a permanent magnet?
A. Soft Iron B. Nickel C. Copper D. Steel

44. A sensitive magnetic field instrument can be effectively shielded from the external magnetic field by placing it inside which of the following materials?
A. Plastic Material B. Teak Wood
C. Soft Iron of high permeability D. A metal of high conductivity

45. Which of the following statements is true about magnetic field intensity?
A. Magnetic field intensity is the number of lines of force crossing per unit volume.
B. Magnetic field intensity is the number of lines of force crossing per unit area.
C. Magnetic field intensity is the magnetic induction force acting on a unit magnetic pole.
D. Magnetic field intensity is the magnetic moment per unit volume.

46. What happens to the magnetic needle kept in a non-uniform magnetic field?
A. It experiences force but not torque
B. It experiences torque but not force
C. It experiences both force and torque
D. It neither experiences force nor torque

47. What is the torque acting on the bar magnet of moment M which is placed in a uniform field H making an angle of 300 with the field?
A. MH B. MH/2 C. MH/3 D. MH/4

48. What happens to the magnetic moment if a hole is made at the centre of a bar magnet?
A. Decreases B. Increases C. Not a change D. None of the above

49. Which of the following statements is true about magnetic lines of force?
A. Magnetic lines of force are always closed.
B. Magnetic lines of force always intersect each other.
C. Magnetic lines of force tend to crowd far away from the poles of the magnet
D. Magnetic lines of force do not pass through the vacuum.

50. Magnetic lines of force of a bar magnet do not intersect because
A. The lines have similar charges hence they repel each other
B. The lines always diverge from a single point
C. A point always has a single net magnetic field
D. The lines need magnetic lenses to intersect

ANSWER KEY

1	C		11	B		21	C		31	D		41	B
2	C		12	D		22	D		32	A		42	D
3	C		13	D		23	B		33	D		43	D
4	B		14	A		24	A		34	D		44	C
5	B		15	B		25	D		35	C		45	C
6	A		16	D		26	C		36	B		46	A
7	A		17	D		27	A		37	A		47	B
8	D		18	C		28	C		38	D		48	C
9	C		19	B		29	A		39	A		49	A
10	D		20	D		30	A		40	B		50	C

CHAPTER-7 FUNDAMENTALS OF CURRENT AND PHASE CURRENT

WORKOUT EXAMPLES

A. VERY SHORT ANSSWER QUESTION.

1. Define AC and DC.
2. write application of AC
3. Draw different waveforms of AC.
4. Define frequency.
5. Define time period.
6. Define amplitude.
7. Define wavelength.
8. Define single phase current.
9. define three phase current?

B. SHORT ANSSWER QUESTION.

10. explain characteristics of ac waveform
11. differentiate between AC and DC.
12. differentiate between one phase and three phase current.
13. Explain single phase current in detail.
14. Explain three phase current in detail.

C. MILTIPLE CHOICE QUESTIONS.

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. $I_0 = e_0/R$ B. $I_0 = e/R$ C. $I_0 = e_0$ D. $I_0 = R/e_0$
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 can not be measured by D.C. ammeter, because
   A. A. C. is virtual
   B. A. C. changes its direction
   C. A. C. can not 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 I0sinωt will be the same as that of a steady current of magnitude nearly
   A. 0.71 I_0 B. 1.412 I_0 C. I_0 D. $\sqrt{I_0}$
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. π B. π/2 C. 0 D. π/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

1	A		6	A		11	C		16	B
2	B		7	A		12	B		17	B
3	B		8	D		13	A		18	C
4	D		9	A		14	A		19	D
5	A		10	C		15	A		20	B

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CLASS NOTES

ENGINEERING STREAM

COMPUTER ORGANISATION AND ARCHITECTURE, GRADE - XI
FUNDAMENTAL OF ELECTRO SYSTEM, GRADE - IX
FUNDAMENTAL OF COMPUTER APPLICATION GRADE - IX
DIGITAL DESIGN & MICROPROCESSOR GRADE - X

GENERAL STREAM

COMPUTER SCIENCE, GRADE - XI
COMPUTER SCIENCE, GRADE - XII