Workbook Cum Question Bank with Answers

Physics

Class-XII (CHSE)

SCHEDULED CASTES & SCHEDULED TRIBES
RESEARCH & TRAINING INSTITUTE (SCSTRTI)
ST & SC DEVELOPMENT DEPARTMENT
BHUBANESWAR

PHYSICS

WORKBOOK-CUM-QUESTION BANK
WITH ANSWERS

CLASS - XII (CHSE)

Compiled by :

Dr. (Mrs.) Binodini Pradhan
Reader in Physics (Retd.)
R. D. Womens University,
Bhubaneswar

ST & SC DEVELOPMENT DEPARTMENT
GOVERNMENT OF ODISHA

Prepared by

SCHEDULED CASTES SCHEDULED TRIBES
RESEARCH AND TRAINING INSTITUTE
BHUBANESWAR-751003

2022

Contents

***

CHAPTER ONE

(ELECTRIC CHARGES AND FIELDS)

OBJECTIVE TYPE QUESTIONS (OTQ)

A-I

MCQ

Choose the correct answer out of the four probable given at the end of each question.

1. **The minimum charge on an object is**

   (a) One Coulomb

   (b) One Stat coulomb

   (c) 1.6×10^{-20} Coulomb

   (d) 1.6×10^{-19} Coulomb

2. **In MKS system $\frac{1}{4\pi\varepsilon_0}$ equals**

   (a) 9×10^9 Newton metre^2 /(Coulomb)^2

   (b) 1 Newton metre^2 /(Coulomb)^2

   (c) 1 Dyne × cm^2 / (Stat Coulomb)^2

   (d) 9×10^9 Dyne × cm^2 / (Stat Coulomb)^2

3. **Two charges are at distance d apart in air. The coulomb force between them is F. If a dielectric material of dielectric constant K is placed between them, the coulomb force now becomes.**

   (a) F/K **(b)** FK

   (c) F/K^2 **(d)** K^{2}F

4. **A charge q is placed at the centre of a cube of side 'a'. The electric flux through any one face of a cube is .**

   (a) q/ε_0 **(b)** $q/3\varepsilon_0$

   (c) $q/6\varepsilon_0$ **(d)** $6q/\varepsilon_0$

5. **In a region of space having a uniform electric field E, a hemispherical closed bowl of radius r is placed. The electric flux through the bowl is**

   (a) $\pi r^2 E$ **(b)** $2\pi r^2 E$

   (c)$2\pi r E$ **(d)** $4\pi r^2 E$

6. **A hollow spherical conductor of radius 2m carries a charge of $500\mu c$. Then the electric field strength at its surface is**

   (a) Zero

   (b) $1.125 \times 10^6 N/C$

   (c)$2.25 \times \frac{10^6 N}{C}$

   (d) $4.5 \times 10^6 N/C$

7. The electric field intensity on the surface of charged conductor is:

(a) zero

(b) directed normally to the surface

(c) directed tangentially to the surface

(d) directed along 45° to the surface

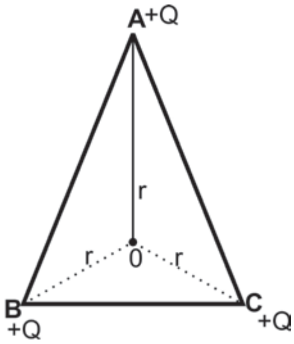
8. Three charges each of +Q are placed at the corners A,B,C of an equilateral triangle as shown. The electric field strength at the circum centre O is

(a) Zero

(b) $\frac{1}{4\pi\varepsilon_0} \frac{3Q}{r^2}$

(c) $\frac{1}{4\pi\varepsilon_0} \frac{Q}{r^2}$

(d) $\frac{1}{4\pi\varepsilon_0} \frac{Q^2}{r^2}$



9. The electric field intensity E due to an infinite uniformely charged plane sheet at a point distant r from the sheet is

(a) $E \propto$ r

(b) $E \propto r^{-1}$

(c) $E \propto r^{-2}$

(d) E is independent of r

10. An electric dipole consists of two opposite charges each of magnitude $1.6 \times 10^{-19} C$ at separation $IA°$. The dipole moment is

(a) $1.6 \times 10^{19} Cm$

(b) $1.6 \times 10^{-29} Cm$

(c) $1.6 \times 10^{-9}\ Cm$

(d) $0.8 \times 10^{-29} cm$

11. An electric dipole of moment $\vec{P}$ is placed in uniform electric field $\vec{E}$. The torque acting on the dipole is.

(a) $\vec{P}.\vec{E}$ **(b)** $\vec{P} \times \vec{E}$

(c) $\vec{E} \times \vec{P}$ **(d)** $\vec{P}.(\vec{P} \times \vec{E})$

12. The S.I. unit of electric flux is

(a) Weber

(b) N/C

(c) Volt × meter

(d) J/C

13. The Units of permittivity of free space ε_0 can be written as

(a) C/Nm^2 **(b)** C^2/Nm

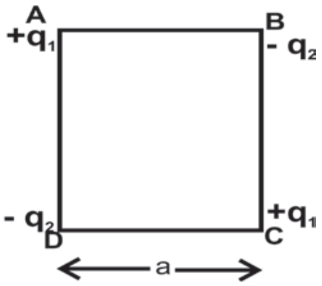
(c) C^2/Jm **(d)** C/Jm

14. Two point charges having a total charge Q are distance x apart. What is the charge on each point so that the force they exert on one another is maximum ?

(a) $\frac{Q}{4}$; $\frac{3Q}{4}$ **(b)** $\frac{Q}{2}$; $\frac{Q}{2}$

(c) $\frac{Q}{8}$; $\frac{7Q}{8}$ **(d)** $Q, zero$

15.



Four charges are placed at the corners of a square ABCD of side a as shown is the above figure. The Charge A is in equilibrium. Then the ratio q_1/q_2 is

(a) 1 **(b)** $\sqrt{2}$

(c) $\frac{1}{\sqrt{2}}$ **(d)** $2\sqrt{2}$

16. A body gets positive charge. It means that

(a) it has lost electrons

(b) it has gained protons

(c) it has gained positrons

(d) it has gained \∝ − particles

***

A-II

FILL IN THE BLANKS

1. **The unit of electric field intensity in S.I. System is ________.**

2. **The electric field intensity inside a solid uniformely charged spherical conductor is ______.**

3. **A sphere of radius 100cm has a charge of $\left(\frac{2\pi}{3}\right)\mu C$. Its surface density of charge in SI units is____.**

4. **Two spheres have their surface density of charge in the ratio 2:3 and their radii in the ratio 3:2. The ratio of the charges on them is__________.**

5. **An alpha particle is situated in an electric field of $15 \times 10^4\ N/C$. The force exerted on it is _______.**

6. **A charge of $0.33 \times 10^{-7}\ C$ is brought in an electric field. It experience a force of $10^{-5}\ N$. The electric field strength at the point is ______.**

7. **ABC is an equilateral triangle of side 10cm. Charges $+100\mu C$ and $100\mu C$ are placed at B and C. The resultant intensity at A is _____.**

8. **Two Spheres of equal radii have charges 'q' and '3q'. The ratio of their surface density of charge is ________.**

9. **The mass of a body ____when it is negative charged.**

10. **_____ is the surer test of electrification.**

11. **An electric line of force is directed away from a__________ charge.**

12. **The coulomb force between two charged bodies is a ____ force.**

13. **The coulomb force between two charged bodies is a ___________ range force.**

14. **For a uniform electric field the electrostatic lines of force are ____.**

15. **The ratio of Coulomb force and Gravitational force between two charged particles is approximately equal to _______.**

16. **The dimension of electric flux is ________.**

17. **The electric lines of forces due to an isolated negative point charge are________.**

18. **I Coulomb =_______ state coulomb.**

19. **A dipole of dipole moment $\vec{P}$ is placed in a uniform electric field $\vec{E}$. The net force acting on it is ______.**

20. **The total charge given to a conductor resides on its _______.**

***

A-III

GIVE ONE WORD ANSWER TO THE FOLLOWING QUESTIONS.

1. **What type of force is an electrostatic force?**

2. **What quantity defines charge per unit area?**

3. **What is the intensity of electric field near a plane sheet of charge?**

4. **What is the region surrounding an electric charge in which another charge experience forces called. ?**

5. **Which particles are responsible for electrification of a body?**
6. **What is the name given to a pair of equal and opposite charges separated by small distance.**
7. **How does the mass of a body change when it is positively charged.**
8. **What amount of flux is linked with XY pane of a square of side 10cm if electric field $\vec{E} = 2\hat{i} + 3\hat{j}$.**
9. **Is dipole moment a scalar or a vector.**
10. **Which law relates the net electric flux through a surface to the net charge enclosed by it.**
11. **Which law governs the force between two point charges.**
12. **Which property of charges indicates that a charged body cannot posses charge which is fraction of e.**
13. **What is the angle between the electrostatic line of force and the surface of a charged conductor just outside the conductor.**

***

A-IV

GIVE ANSWER IN ONE SENTENCE.

1. **Define electric field intensity at a point.**
2. **What is the Law of conservation of charge ?**
3. **What is meant by quantization of charge ?**
4. **Why two electric lines of force do not interest ?**
5. **How does the strength of electric field due to a very small dipole change with distance 'r' or the axis and on equatorial line.**
6. **Define an electric dipole.**
7. **State Gauss Law in electrostatics.**
8. **What happens to a electric dipole when it is placed in a uniform electric field.**

9. A table tennis ball which has been convered with a conducting paint is suspended by a silk thread so that it hangs between two metallic plates. One plate is earthed while the other plate is connected to a high voltage generator. What will be the motion of the ball ?

10. How does the electric field strength varies with distance near an infinite long uniformly charged line charge.

***

SUBJECTIVE QUESTIONS

1. What is an electric dipole ? find expression for the electric field intensity on the axis of an ideal dipole.

2. Define dipole moment of an electric dipole. Find expression for the electric field intensity of an ideal dipole on the equatorial line.

3. Given an example of an electric dipole. Find the torque on a dipole placed in a uniform electric field.

4. State Gauss' Law and apply it to find the electric field intensity due to an uniformly charged infinite plane sheet of charge.

5. State Gauss' Law and apply it to find electric field intensity due to an infinitely long straight uniformly charged wire.

***

ANSWERS KEY

Chapter -1

A-I

MCQ

1. (d)
2. (a)
3. (a)
4. (c)
5. (a)
6. (b)
7. (b)
8. (a)
9. (d)
10. (b)
11. (b)
12. (c)
13. (c)
14. (b)
15. (d)
16. (a)

***

A-II

FILL IN THE BLANKS.

1. N/C
2. Zero
3. $1.67 \times 10^{-7} C/m$^2
4. 3:2
5. $4.8 \times 10^{-4} N$
6. $300\, V/m$
7. $9 \times 10^{7}\ N/C$
8. 1:3
9. Increases
10. Repulsion
11. Positive
12. Conservative / central
13. Long
14. Parallel
15. 10^{40}
16. $ML^{3}T^{-3}A^{-1}$
17. Convergent
18. 3×10^{9}
19. Zero
20. Surface

***

A-III

ONE WORD ANSWER

1. Conservative
2. Surface Charge density
3. $\sigma/2\varepsilon_0$
4. Electric field
5. Electrons
6. Electric dipole
7. Decreases.
8. Zero
9. Vector
10. Gauss
11. Coulomb
12. Quantization
13. 90°

***

CHAPTER TWO

(ELECTRIC POTENTIAL & CAPACITANCE)

SECTION -A

A-II

MCQ

1. **Two charges $+10C$ and $-10C$ are placed 10Cm apart .Potential at the centre of the line joining the two charges.**

   (a) $2V$

   (b) Zero

   (c)$-2V$

   (d) none of the above

2. **An electron of mass m and charge e is accelerated through a P.D of V volts in vacuum. Its final velocity.**

   (a) $\frac{eV}{m}$ **(b)**$\frac{eV}{2m}$

   (c)$\sqrt{\frac{ev}{m}}$ **(d)**$\frac{\sqrt{2eV}}{m}$

3. **The possible unit of Electric field intensity is**

   (a) Newton / meter

   (b) Newton- Coulomb

   (c)$Jc^{-1}m^{-1}$

   (d)$J\ c\ m^{-1}$

4. **A parallel plate capacitor with air between the plates has capacitance of $2\mu F$. If the capacitor is immersed in a liquid of dielectric constant 5. Its capacitance will be .**

   (a) $05\mu F$ **(b)**$10\mu F$

   (c)$5\mu F$ **(d)**$2\mu F$

5. **The electric potential at a point at a distance of 2m from a point of charge of 0.1μC is 450V. The electric field at the point will be**

   (a)225N/c

   (b)2.25N/C

   (c)22.5N/c

   (d) None of the above

6. **There are 10 units of charge at the centre of a circle of radius of 1m. The work done in moving 1 unit of charge once around the circle is .**

   (a) 10units

   (b) 100 units

   (c) 150units

   (d) Zero

7. Two concentric spheres of radii R and r have similar charges with equal surface densities, σ what is the electric potential at their common centre.

(a) $\frac{\sigma}{\epsilon_0}$

(b)$\frac{\sigma}{\epsilon_0}(R+r)$

(c)$\frac{R\sigma}{\epsilon_0}$

(d)$\frac{\sigma}{\epsilon_0}(R-r)$

8. A particle A has a charge +q and particle B has a charge of +4q. Each of them have same mass m. When the particle are allowed to fall from rest through same P.D., ratio of their speeds $\frac{vA}{vB}$ is

(a) 1:4

(b) 1:2

(c)2:1

(d)4:1

9. The electric potential V is given as function of x . $V(x) = 5x^2 + 10x - 4$. The value of electric field at . $x = 1m$ is

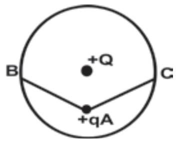
(a) – $20V/m$

(b) – $23V/m$

(c) $11\ V/m$

(d) $6V/m$

10. The electric field exist in space around a point charge +Q. A +ve charge +q is carried from A to B and A to C .,where B, C lie on the circle with +Q at the centre . Work done is:



(a) greater along path AC than charge AB

(b) greater along path AB then charge AC

(c) same in both the case

(d) zero in both the case.

11. The distance between the plates of a parallel plate capacitor of capacitance C is doubled and area of each plate is reduced to half. It's new capacitance will be:

(a) $2C$

(b) $\frac{C}{2}$

(c) $\frac{C}{4}$

(d) 4C

12. The radius of sphere having capacitance of $0.1\mu F$ is

(a) 9km

(b) 0.9 km

(c) 8km

(d) 0.8km

13. **A capacitor of capacitance $20\mu F$ is charged to a P.D of 500 volts . The energy stored in the capacitor is**

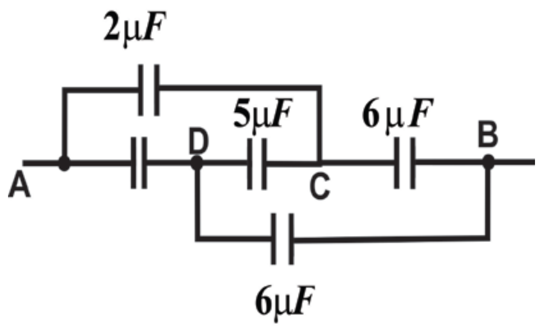
(a) 25joules

(b) 500 joules

(c) 2.5 joules

(d) 0.25 joules

14.



The equivalent capacitance between A and B is

(a)$3\mu F$ **(b)**$4\mu F$

(c)$5\mu F$ **(d)**$6\mu F$

15. **The radius of soap bubble whose potential is16V is doubled . The new potential of the bubble is**

(a) 2V **(b)** 4V

(c) 8V **(d)** 16V

16. **The capacitance of capacitor does not depend upon**

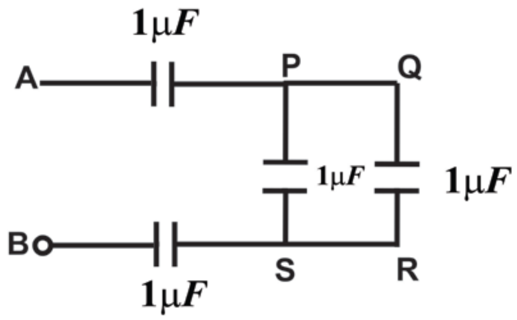
(a) charge

(b) voltage

(c) nature of material

(d) all of these

17. **The effective capacitance between two points A and B**



(a)$2\mu F$ **(b)**$4\mu F$

(c)$3\mu F$ **(d)**$0.4\mu F$

18. **The minimum number of capacitors of $2\mu F$ each required to obtain a capacitance of $5\mu F$ is**

(a) 6

(b) 4

(c) 3

(d)5

19. **A $10\mu F$ capacitor is charged to a P.D of 50 Volts and is connected to another uncharged capacitor in parallel. Now common potential difference becomes 20V. The capacitance of the second capacitor is .**

(a)$15\mu F$

(b)$30\mu F$

(c)$20\mu F$

(d)$10\mu F$

20. The electric charge Q is uniformly distributed around a semicircle of radius 'r'. The electric potential at the centre of semicircle is

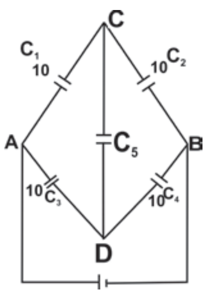
a) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$

(b) $\frac{1}{8\pi\varepsilon_0}\frac{Q}{r}$

(c) $\frac{1}{\varepsilon_0\pi}\frac{Q}{r}$

(d) Zero

21. Five capacitors of $10\mu F$ capacitance each are connected to a d.c potential of 100 volt as shown in the figure. The equivalent capacitance between two points A and B is .



(a) $40\mu F$

(b) $20\mu F$

(c) $10\mu F$

(d) $30\mu F$

22. If a dielectric slab of 4×10^{-5} m thick in introduced between the plates of parallel plate capacitor, the distance between the plates is to be increased by $3.5 \times 10^{-5} m$ to resume the capacity to the original value . Then dielectric constant of the material slab is

(a) 6 **(b)** 8

(c) 12 **(d)** 20

23. A parallel plate capacitor has the space between its plates filled by two dielectrics of thickness d/2 with dielectric constants K_1 and K_2. If d is the distance of separation between the plates, the capacitance of the capacitor is.

(a) $\frac{2\,\epsilon_0\,d}{A}\left(\frac{K_1+K_2}{K_1-K_2}\right)$

(b) $\frac{2\,\epsilon_0\,A}{d}\left(\frac{K_1K_2}{K_1+K_2}\right)$

(c) $\frac{2\,\epsilon_0\,d}{A}\left(\frac{K_1-K_2}{K_1+K_2}\right)$

(d) $\frac{2\,\epsilon_0\,A}{d}(K_1 - K_2)$

***

A-II

FILL IN THE BLANKS.

1. All line of force intersects at _____ degree with an equipotential surface.

2. The capacitance of a charged conductor is C and potential energy due to charge on it is V Joule. Then the charge on the conductor is _____________.

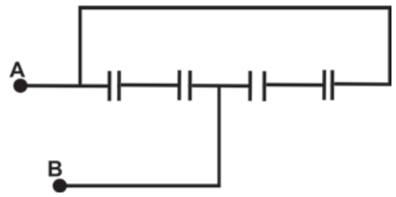
3. Two $1\mu F$ capacitors in series is equal to ___________.

4. Charges of $+\left(\frac{10}{3}\right) \times 10^{-17} C$ are placed at each of the four corners of a square of side 8Cm the potential at the intersection of the diagonals is _________.

5. The work done is carrying a charge of $5\mu C$ from a point A to B is 8mJ. The difference of potential between A and B is _____.

6. The electric potential V at any point x,y,z (in metre) in space is given by $V = 4x^2$. Then the electric field at the point (1m, 0m, 2m) is __________ V/m.

7. In the figure given below each capacitor has a capacitance of $1\mu F$. The equivalent capacitance of the system between A and B is ______μF.



8. A hollow metallic sphere of radius 5cm is charged such that the potential on its surface is 10V. The potential at the centre of the sphere is _______.

9. A parallel plate capacitor has capacitance C. if he distance between the plates be doubled, the new capacity will be _______.

10. A large sphere P of radius R is charged positively. It is momentarily connected to a small sphere Q of radius r . The two spheres now have same _______.

11. The equipotential line due to a point Charge Q is a _______.

12. A charge 5C is given a displacement of 0.5m and the work done in the process is 10J. the difference of potential between the two points is.

13. A hollow spherical conductor of radius 1m has a charge of $2.5\mu C$. Then the electric potential at a point. $0.5m$ from the centre of the spherical conductor is __________.

14. The work done by a charge q in moving around any charge Q in a circular path of radius R is __________.

***

A-III

GIVE ANSWER IN ONE WORD.

1. **What is the work done to carry an electron from the +ve terminal of a 12V battery to its negative terminal?**
2. **What is the work done to move a charge of 2C to infinity from a point 2m away from a charge of 1C.**
3. **Which physical quantity can be measured in electron volt.**
4. **What is the dimension formula of electric potential.**
5. **An electric dipole of moment $\vec{P}$ is placed normal to the line of force of electric field $\vec{E}$. Then what is the work done in deflecting it through an angle of $180°$.**
6. **What is the energy supplied by the battery in order to charge a capacitor C to a potential difference V.**
7. **What happens to the capacitance of a capacitor if a glass plate is introduced between the plates.**
8. **What is the electrical resistance of a perfect dielectric ?**
9. **A parallel plate capacitor of capacitance $100\mu F$ is charged to a potential of $500V$ and the battery is disconnected. The plate separation**

is then reduced to half f its original value. What is the new potential ?

10. The electric potential due to an electric dipole at and axial point distant r from the dipole is V. If the distance is 3r then what is the potential.

*****

SECTION –B

EACH QUESTION CARRIES 2 MARKS

1. **Two spherical conductors of capacitances 3pF and 5pF are charged to potentials of 300V and 500V respectively. The two are connected resulting in redistribution of charges. Then find out (i) final potential. (ii) final charge on the 3pF conductor .**

2. **A parallel plate capacitor is charged and then isolated . What in the effect of increasing plate separation on (i) charge (ii) capacitance (iii) potential give reasons.**

3. **Two charges of magnitude 4×10^{-8}C and -6×10^{-8}C at A and B respectively are 50cm apart. Find the distance of the point from point A where the electric potential is zero.**

4. **Eight drops of mercury each charged to a potential 3V form a big drop. Find out the potential of the big drop.**

5. **The potential difference between the two parallel plates is $10^4 V$. If the plates are separated by $0.5cm$ find out (i) The electric intensity between the plates. (ii) The force on an electron if it is placed between the plates.**

6. **A charge of 2C is moved to infinity form a point 2m away from a charge 1C. Find out the work done.**

7. **What is potential gradient. How is it related to electric field intensity at a point.**

8. **What is meant by dielectric polarisation.**

9. **If the air capacitor is charged to V volts and dielectric slab is introduced between the plates with the battery still connected then how does it affect the (i) charge (ii) capacity (iii) potential diff. between plates (iv) Electric field between plates.**

10. **The permittivity of diamond is $1.46 \times 10^{-10}\ C^2/Nm^2$. Calculate the dielectric constant and electric susceptibility of diamond given $\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/Nm^2$**

***

SECTION –C
LONG QUESTIONS

1. **Derive an expression for potential at a point on the axis of a dipole.**

2. **Define electrostatic potential at a point. Derive expression for potential at a point due to a point charge Q.**

3. **Show that the work done is moving a test charge 'q' in the electric field due to a point charge Q is independent of the path along which the charge is moved.**

4. **There charge q_1, q_2, q_3 are placed at position vectors $\vec{r}_1, \vec{r}_2, \vec{r}_3$ respectively. Find out the total electrostatic potential energy of the system.**

5. **Derive an expression for capacitance of a parallel plate capacitor.**

6. **Derive expression for capacity of a system of two capacitors of capacities C_1 and C_2 when they are connected (i) in series (ii) in parallel**

7. **Define Dielectric constant, electric susceptibility and dielectric strength.**

***

ANSWERS

Chapter -2

SECTION-A

A-I

IMCQ

1. (b)
2. (d)
3. (c)
4. (b)
5. (a)
6. (d)
7. (b)
8. (b)
9. (a)
10. (c)
11. (c)
12. (b)
13. (c)
14. (a)
15. (c)
16. (c)
17. (d)
18. (b)
19. (a)
20. (a)
21. (c)
22. (b)
23. (b)

***

A-II

FILL IN THE BLANKS.

1. 90
2. $\sqrt{2VC}$
3. $0.5\mu F$
4. $1500\sqrt{2}$V
5. $1.6KV$
6. $-8V/m$
7. $1\mu F$
8. 10V
9. 0.5C
10. Potential
11. Circle
12. 2V
13. $22.5 \times 10^3\ V$
14. Zero

***

A-III

ONE WORD ANSWER

1. $1.92 \times 10^{-18} J$
2. $9 \times 10^{9} J$
3. Energy
4. $ML^2T^{-3}A^{-1}$
5. $Zero$
6. CV^2
7. Increases
8. Infinite
9. 250V
10. V/9

***

SECTION-B

2 MARKS EACH ANSWER.

1. $\boldsymbol{V} = \frac{C_1V_1 + C_2V_2}{C_1+C_2}$

$= \frac{3 \times 10^{-12} \times 300 + 5 \times 10^{-12} \times 500}{(3+5) \times 10^{-12}}$

$= \frac{3400}{8} = 425V$

$Q = C_1V = 3 \times 10^{-12} \times 425 = 1275\ PC$

2. (i) since isolated charge remain constant.

(ii) capacitance decreases as $C = \frac{\varepsilon_0\ AK}{D}$ d increased here

(iii) Potential $= \frac{Q}{c}$. So it decreases.

3. $V = k\left[\frac{4\times10^{-8}}{x} - \frac{6\times10^{8}}{\left(\frac{1}{2}-x\right)}\right] = 0$

$\Rightarrow \quad 2 - 4x = 6x \Rightarrow 10x = 2m$

$x = 0.2m = 20cm$

4. $\frac{kq}{r} = 3, 8 \times \frac{4\pi}{3} R^3 \Rightarrow R = 2r\ q = \frac{3r}{K}$

$V = \frac{K\times8\times\frac{3r}{K}}{2r}$= 12V

5. $|E| = \frac{V}{l} = \frac{10^4}{\frac{5}{100}} = 2 \times 10^6 \frac{V}{m}$

$|F| = eE = 1.6 \times 10^{-19} \times 2 \times 10^6$

$= 3.2 \times 10^{-13} N$

6. $V = \frac{KQ}{r} = 9 \times 10^9 \frac{1}{2}, W = qV = 2 \times \frac{9\times10^9}{2} = 9 \times 10^9 J$

7. $\frac{dV}{dr}\ of\ \nabla V, \vec{E} = -\nabla V$

8. The stretching of dielectric atoms due to displacement of charges in the atoms under the action of applied electric field to a dielectric is called dielectric polorisation

9. (i) When dielectric present charge increases

(ii) capacity increases.

(iii) Potential diff. constant

(iv) E. Field constant

10. $K = \frac{\varepsilon}{\varepsilon_0} = \frac{1.46\times10^{-10}}{8.85\times10^{-12}} = 16.5$

$x_e = \varepsilon_0(K-1)$

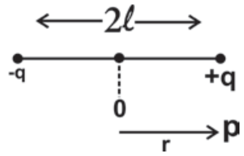
$= 8.85 \times 10^{-12} \times (16.5^{-1})$

$= 1.37 \times 10^{-10} C^2/Nm^2$

***

Answers To Subjective Question

1.



$V = V_1 + V_2$

$$= \frac{1}{4\pi\varepsilon_0 K}\frac{q}{(r-l)} - \frac{1}{4\pi\varepsilon_0 K}\frac{q}{(r-l)}$$

$$= \frac{1}{4\pi\varepsilon_0 K}\frac{q}{(r^2-l^2)}$$

$l \ll r$ so

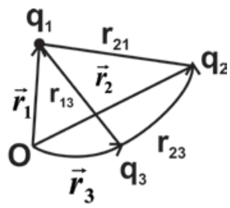
$$\boxed{V = \frac{1}{4\pi\varepsilon_0\, K}\frac{P}{r^2}}$$

2. Definition $V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$

3. $W = -q\int_A^B E\,.dl$ show that it depends on position of A & Bonly.

$= \frac{R}{4\pi\varepsilon_0}\left(\frac{Q^1}{r_B} - \frac{Q^1}{r_A}\right)$ not on intermediate points taking any path.

4.



W

$$= 0 + \frac{1}{4\pi\varepsilon_0}\frac{q_1}{|\vec{r_2} - \vec{r_1}|}{}^{q_2}$$

$$+ \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{|\vec{r_3} - \vec{r_1}|} - \frac{q_2}{|\vec{r_3} - \vec{r_1}|}\right) q_3$$

$$= \frac{1}{4\pi\varepsilon_0}\left[\frac{q_1q_2}{r_{12}} + \frac{q_1q_3}{r_{13}} + \frac{q_2q_3}{r_{23}}\right]$$

5. Derivation $C = \frac{\varepsilon_0 AK}{d}$

6. $C_{ceries} = \frac{C_1C_2}{C_1+C_2}$

$C_{11} = C_1 + C_2$

7. Definition

***

CHAPTER THREE

(CURRENT ELECTRICITY)

SECTION-A

A-I

MCQ

Choose the correct answer out of the four probables given at the end of each question

1. **The length of a conductor s halved. Its conductance will be**

   (a) halved

   (b) unchaged

   (c) doubled

   (d) quadrupled.

2. **Five cells each of internal resistance $\mathbf{0.2\Omega}$ and emf $\mathbf{3V}$ are connected in series with an external resistance of $\mathbf{5\Omega}$. The current through the external resistance is**

   (a) $0.2A$ **(b)** $0.5A$

   (c) $\left(\frac{15}{26}\right)A$ **(d)** 2.5 A

3. **Three resistances of $\mathbf{10\Omega, 5\Omega, 2\Omega}$ are connected in parallel. Net resistance will be**

   (a) more than 10Ω

   (b) between 5Ω and 10Ω

   (c) between 5Ω and 2Ω

   (d) less than 2Ω

4. **The masses of three wires of copper are in the ratio 1:3:5 and their lengths are in the ratio of 5:3:1. The ratio of their electrical resistances is**

   (a) 1:3:5

   (b) 125:15:1

   (c) 5:3:1

   (d) 1:15:125

5. **An electron charge e is revolving in a circular orbit of radius r around a nucleus of charge ze with speed v. The equivalent current is**

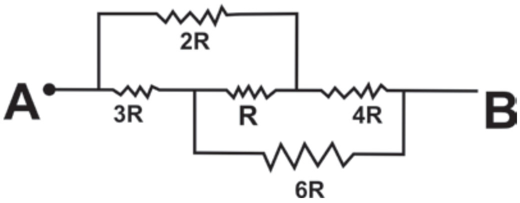
   (a) Zero

   (b) $\frac{Zev}{2\pi r}$

   (c) $\frac{ev}{2\pi r}$

   (d) $\frac{e2\pi r}{v}$

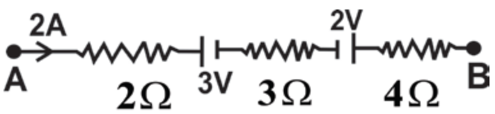
6. **The equivalent resistance between A and B is .**



(a) $\frac{9R}{5}$ **(b)** $\frac{14R}{5}$

(c) $\frac{16R}{5}$ **(d)** $\frac{18R}{5}$

7. **The potential difference between A and B is**



(a) 18V

(b) 19V

(c) 20V

(d) 9V

8. **For ohmic conductors the drift speed v_d and the electric field applied across it are related as**

(a) $v_d \propto \sqrt{E}$

(b) $v_d \propto E$

(c) $v_d \propto E^{\frac{3}{2}}$

(d) $v_d \propto E^2$

9. **The unit of resistivity is**

(a) Ohm / m^3

(b) ohm/m^2

(c) ohm m

(d) $(\text{ohm.m})^{-1}$

10. **A wire of resistance 2Ω is redrawn so that its length is quadrupled. The resistance of the redrawn wire is**

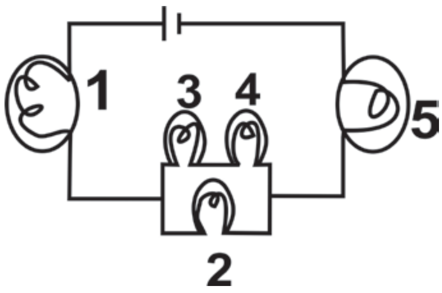
(a) 2Ω

(b) 8Ω

(c) 16Ω

(d) 32Ω

11. **All the bulbs in the figure below are identical. Which bulb(s) leight(s) most brightly ?**



(a) 1 Only

(b) 2 only

(b) 3 and 4

(d) 1 and 5

12. **A cell of emf E and internal resistance $'r'$ has an external resistance R connected across it. If the potential difference across the terminals of the cell is V then**

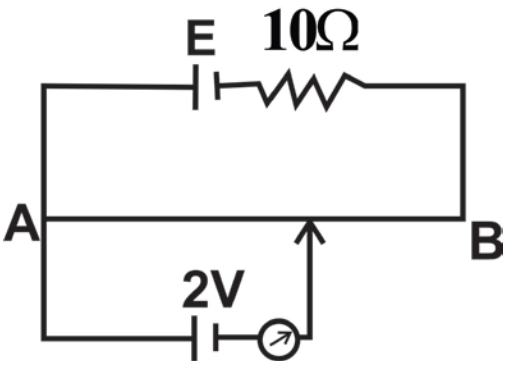
(a) $r = R$

(b) $r = R\left(\frac{E}{V}\right)$

(c) $r = R\ (E - V)/V$

(d) $r = RV/E$

13. In the given circuit AB is a potentiometer wire of length 10m and resistance 1Ω. The balancing length for 2 Volt cell is 8m. The emf of the battery E is



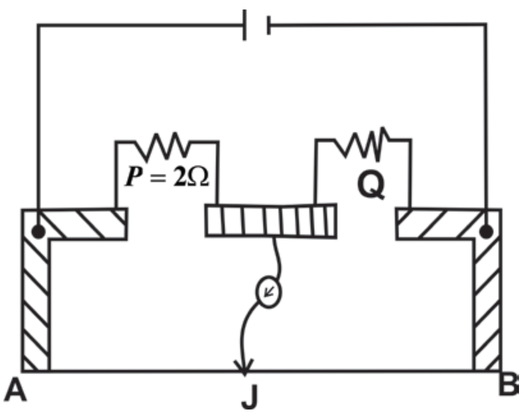
(a) 2.75V

(b) 13.75V

(c) 27.5 V

(d) 5.5V

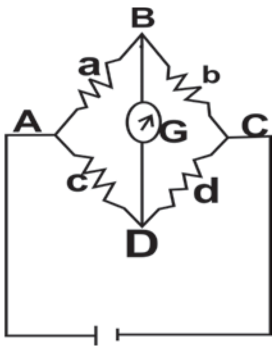
14. The metre bridge circuit shown above is balanced when jockey J divides wire AB into two parts AJ and BJ in the ratio of 1:2. The unknown resistance Q is:



(a) 1Ω **(b)** 2Ω

(c) 4Ω **(d)** 3Ω

15.



In the Wheatstone bridge circuit shown above $c = d$ and $a > b$. The current

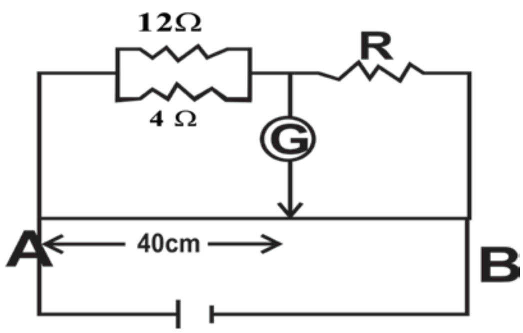
(a) flows from B to D

(b) flows from D to B

(c) is zero in the arm BD

(d) none of the above

16.



In a metre bridge arrangement as shown the null point is observed at 40cm. The resistance R is

(a) 1Ω

(b) 4.5Ω

(c) 5Ω

(d) 3.5Ω

17. In potentiometer experiment, the balance point with a cell is at the

length of 240cm. On shunting the cell with a resistance of 2ohm, the balance point changes to 120cm. Then the internal resistance of the cell is

(a) 2ohm

(b) 1ohm

(c) 0.5ohm

(d) 4ohm

18. In comparing emfs of two cells with the help of potentiometer, at the balance point, the current flowing through the wire is taken from.

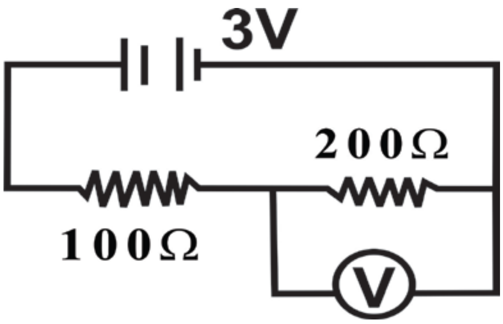
(a) one of these cells

(b) both of these cells

(c) The battery in the main circuit.

(d) both the cells and battery in main circuit.

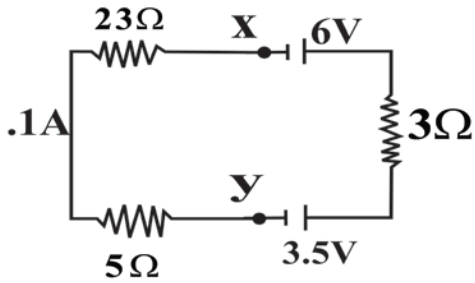
19. The voltmeter in the given figure has a resistance of 200ohm. The reading of voltmeter V is :



(a) 1.5V **(b)** 2V

(c) 1V **(d)** 3V

20. In the figure the difference of potential between points x and y is :



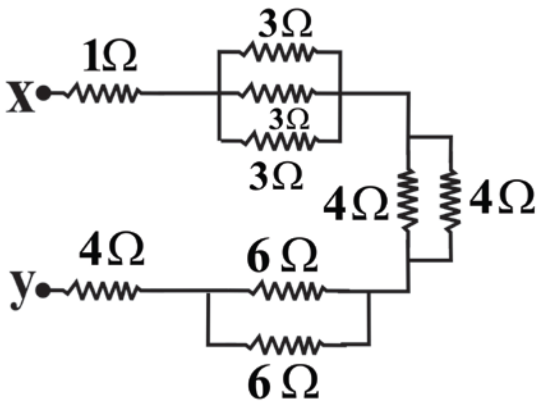
(a) 9.8V

(b) 9.2V

(c) 2.8V

(d) 9.5V

21. In Fig. the equivalent resistance between points *X* and Y is



(a) 11Ω

(b) 16Ω

(c) 14Ω

(d) 18Ω

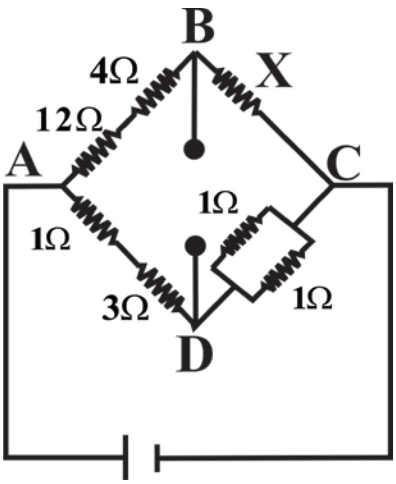
22. In a potentiometer experiment, the balancing length is 8m when the two cells E_1 and E_2 are joined in series. When the two cell are connected opposition the balancing

length is 4m. The ratio of the emfs of the two cells E_1/E_2 is:

(a) 1:2 **(b)** 2:1

(c) 1:3 **(d)** 3:1

23.

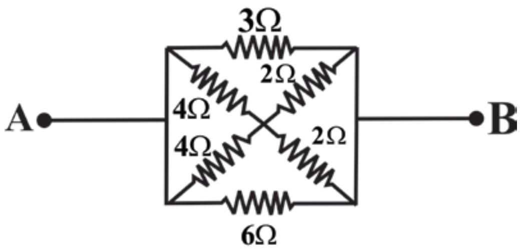


In the above arrangement of resistances shown in figure the potential difference between B and D will be Zero when the unknown resistance X is

(a) 4Ω **(b)** 2Ω

(c) 3Ω **(d)** 8Ω

24. In the figure below the equivalent resistance between A and B is :



(a) 4/5 .

(b) 9/5

(c) 6/5

(d) 11/5

***

A-II

FILL IN THE BLANKS

1. **Wheatstone bridge cannot be used for measurement of very __________ resistances.**

2. **A cell of emf 1.5V and internal resistance of 1ohm is connected to a resistance of 4ohm. The terminal voltage of the cell in the closed circuit is ________.**

3. **Current in a conductor is proportional to the ____________ at the ends of the conductor.**

4. The value of internal resistance of an ideal cell is______________.

5. Kirchhoff's two laws for electrical circuits are manifestations of law of conservation of _____________.

6. Three 4Ω resistors are connected in the form of an equilateral triangle. Total resistance between any two corners is _______________.

7. The terminal potential difference of a cell is greater than its emf when it is ________________.

8. One of the best instruments for accurate measurement of emf of cell is _______________.

9. A resistance wire of R ohm is cut into ten equal lengths. These ten pieces are connected in parallel. The resistance of these parallel combination is ______________.

10. Five dry cells each of emf 1.5V are connected in parallel. The emf of the combination is _____________.

11. Post Office Box works on the principle of ___________.

12. An electric bulb rated 500W and 100V in used in a circuit having a 200V supply. The resistance R That must be put in series with the bulb so that the bulb delivers 500w is _____________.

13. Twelve identical wires each of resistance R are connected to form a cube. The equivalent resistance of cube when current enters at one corner and leaves at the opposite corner is _____________.

14. Twelve wires each having resistance R are joined to form a cube. The equivalent resistance between the corners of a face diagonal is ______.

15. Twelve wires each having resistance R are joined to form a cube. The equivalent resistance between the corners of the same edge of the cube is __________.

***

A-III

ANSWER IN ONE WORD.

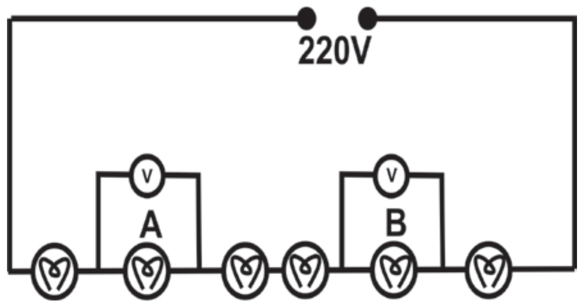
1. **How does the drift speed of electron change with rise in temperature ?**
2. **What is the efficiency of cell delivering maximum power to a load?**
3. **Write the dimensional formula of C^2V^2R.**
4. **How does the resistivity of a metallic conductor change with rise in temperature.**
5. **In which grouping of resistors different current may flow through different conductors.**
6. **In which grouping of resistors the same current flows through all the conductors.**
7. **What is the cgs electromagnetic unit of current**
8. **Name a material whose temperature coefficient of resistance is zero.**
9. **What is the resistance of a unit volume and unit length of a wire equal to .**
10. **Which quantity represents the ratio of Drift speed of electron and applied electric field intensity.**

***

SECTION -B

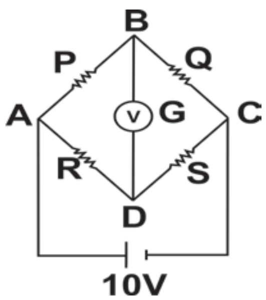
EACH QUESTION CARRIES 2 MARKS

1.

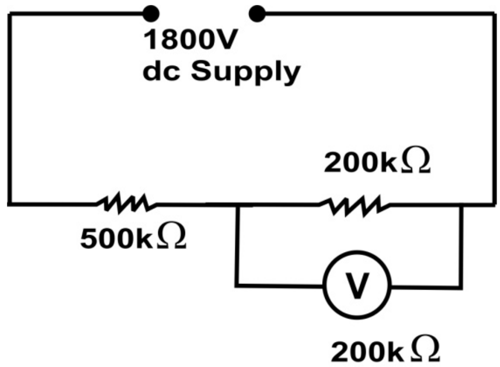


Mains circuit contains six similar bulbs connected in series. The bulb A has a broken filament. Ideal voltmeters are connected as shown. What are the voltmeter readings ? Justify

2. The value of resistances P, Q, R and S of a wheat stone bridge are 16,24,20 and 30 ohms respectively. Calculate the current passing through the battery of negligible internal resistance.



3. A constant voltage dc source is connected as shown in the circuit across a resistance of 500KΩ and 200KΩ what is the reading of the voltmeter of resistance (200KΩ) when connected across the second resistor as shown ?

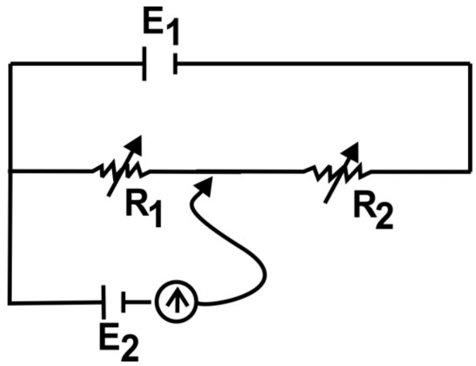


4. If the balance point is obtained at the 35th cm in a meter bridge, calculate the ratio of resistance in the left gap and right gap.

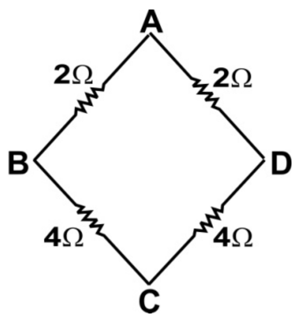
5. A circuit whose resistance is R is connected to n similar cells. If the current in the circuit is same, whether the cells are connected in series or in parallel, then find the internal resistance r of each cell.

6. Two cells of emfs E_1 and E_2 and negligible internal resistances are connected with two variable resisters as shown in the circuit.

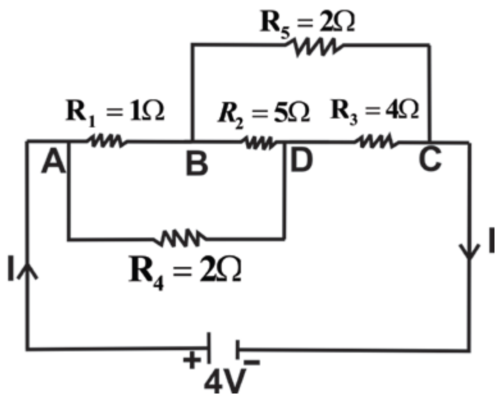
When the galvanometer shows no deflection the value of the resistances are R_1 and R_2. Find out the value of E_1/E_2 ?



7. Four resistances are connected as shown in the circuit. Between which two points does the maximum resistance of the combination occur ?

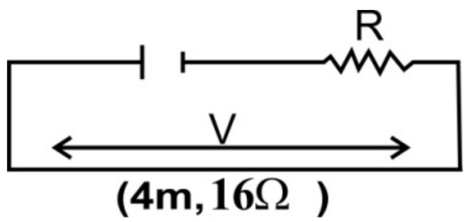


8. Determine I in the circuit.



9. A potentiometer circuit has been set up for finding internal resistance of a given cell. Battery supplied is of e.m.f 2.0 V and negligible internal resistance. Potentiometer wire is 4 m long. When the resistance R connected across the given cell has values of (i) infinity (ii) 9.5Ω , the balancing lengths in the potentiometer wire are found to be 3m and 2.85m respectively. Find the value of internal resistance of the cell.

10. A potentiometer wire has length 4m and resistance 16Ω. What is the valve of resistance that must be connected in series with the wire and an accumulator of e.m.f. 2V so as to get a potential gradient 1mv per cm.

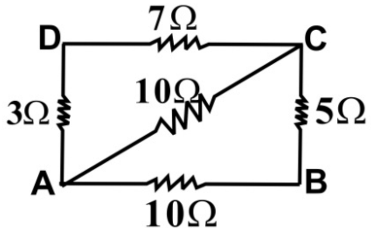


11. A potentiometer wire is 1000cm long and a constant potential difference is maintained across it. Two cells are connected in series to support one another and then in

opposite direction. Balance points are obtained at 500cm and 200cm from the positive end of the wire in two cases. Find the ratio of e.m.f s of cells.

12. **A potentiometer wire is 100cm long and constant potential difference is maintained across it. Two cells are connected in series to support one another and then in opposite direction. Balance points are obtained at 50cm and 10cm from the positive and of the wire in two cases. Find out the ratio of e.m.fs of cells.**

13. **For the circuit shown below, calculate the equivalent resistance between A and B.**



14. **If the voltage across a bulb rated 220V-100w drops by 3% of its rated value, then calculate the percentage of the rated value by which the power would decrease.**

15. **Resistance of 100 cm long potentiomenter wire is 10Ω.It is connected to a bettery of 2 volt and resistance R is in series. A source of 10mV gives null point at 40cm length, then find out external resistance R.**

***

LONG QUESTIONS

1. **Define drift speed of electron in a conductor and establish it relation with electric current.**

2. **What is an ohmic resistor. Compare the V-I characteristics of ohmic and non-ohmic restors. How can you find conductance from these graphs? How will the V-I graph of conductor change if temperature increases ?**

3. **Differentiate between emf and potential difference. What is internal resistance of a cell ?**

4. **N cells each of emf E and internal resistance 'r' are connected in**

series. Find the effective emf and internal resistance.

5. **n cells each of emf E and internal resistance 'r' are connected in parallel. Find the effective emf and internal resistance**

6. **State Kirchhoff's laws and briefly explain taking an example of a circuit**

7. **Apply Kirchhoff's laws to find balance point condition in Wheatstone bridge.**

8. **What is the principle of Potentiometer? How is it used to compare emf's of two cells.**

9. **How is a potentiometer used to find internal resistance of a cell. What is the advantage of using potentiometer in experiments.**

***

ANSWERS

SECATION-1
A-I

MCQ

1. c
2. d
3. d
4. b
5. c
6. d
7. b
8. b
9. c
10. d
11. d
12. c
13. c
14. c
15. b
16. b
17. a
18. c
19. a
20. c
21. a
22. d
23. b
24. c

***

A-II

1. Law
2. 1.2V
3. Potential difference
4. Zero
5. Both charge and energy
6. 8/3 ohm
7. Being charged
8. Potentiometer
9. R/100 ohm or 01R
10. 1.5V
11. Wheatstone bridge
12. 200hm

    Hint resistance of bulb $= 100^2/500$ when connected to $200V = 20\Omega$ an equal resistance must be put in series so that p.d. across it is 100V and bulb delivers rated power
13. $\frac{5}{6}\boldsymbol{R}$
14. $\frac{3}{4}$**R**
15. $\frac{7}{12}$ **R**

A-III

ANSWER IN ONE WORD

1. **1.** Decreases
2. **2.** 50%
3. **3.** ML^2T^{-1}
4. **4.** Increases
5. **5.** Parallel
6. **6.** Series
7. **7.** Abampere
8. **8.** Manganin / constantan
9. **9.** Resistivity
10. **10.** Mobility

***

SECTION –B

2 MARKS EACH.

1. A reading 220V B reading 0V Since no current flows through the circuit all the voltage, drops across the bulb that has a broken filaments i.e. reading of voltmeter $A = 220V$ and the reading of voltmeter $B = 0V$

2. 0.45A

When a wheat stone bridge is balanced

$:-$ there is no current passing through the galvanometer . So P and Q in series and R and S in series.

$$\therefore R_{eff} = \begin{matrix} (P+Q) & || & R+S \\ & || & (20+30) \\ 16+24 & || & 40\Omega \end{matrix}$$

$$\therefore R_{iq} = \frac{50 \times 40}{90} = 22.22\Omega$$

$$\therefore i = \frac{V}{R_{eq}} = \frac{10}{22.22} = 0.45A$$

3. 300V

Effective resistance across

Voltmeter $= \frac{200 \times 200}{400} = 100K\Omega$

Total resistances across do supply is

$= (500 + 100) = 600K\Omega$

$= 600 \times 10^3\Omega$

Current drawn from the supply is

$$\frac{1800}{600 \times 1000} = \frac{3}{1000}\ A$$

Potential difference across voltmeter is

$$i\,R = \frac{3}{1000} \times 100 \times 1000 = 300V$$

4. 7:13

When bridge is balanced

$$\frac{p}{Q} = \frac{35}{100-35} = \frac{35}{65} = \frac{7}{13}$$

$$\therefore 7:13$$

5. r = R

(i) In series combination : -

Net e.m.f in series – nE

Net int. resistance = nr

$$\therefore I_s = \frac{nE}{nr+R}$$

(ii) in parallel combination

Net e.m.f = E, net int. resistance = r/n

$\therefore i_p = \frac{E}{\frac{r}{n}+R}$ given $i_s = i_p$

$$\frac{nE}{nr+R} = \frac{E}{\frac{r}{n}+R}$$

Or $nr + R = r + nR$

Or $R(1-n) = r(1-n)$

$R = r$

6. $\frac{R_1+R_2}{R_1}$

Potential difference across $R_1 = V_1$

$$V_1 = \left[\frac{E_1}{R_1+R_2}\right].R_1$$

We have $V_1 = E_2$

$$E_2 = \left[\frac{E_1}{R_1+R_2}\right].R_1$$

$$\frac{E_2}{E_1} = \frac{R_1}{R_1+R_2}$$

Or $\frac{E_1}{E_2} = \frac{R_1+R_2}{R_1}$

7. $R_{eff_{AB}} = \frac{10\times2}{10+2} = \frac{20}{12} = \frac{5}{3}\Omega$

$$R_{eff_{BC}} = \frac{8\times4}{8+4} = \frac{32}{12} = \frac{8}{3}\Omega$$

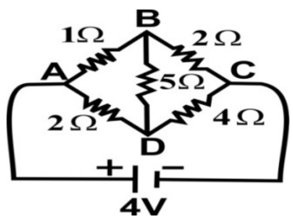
$$R_{eff_{CD}} = \frac{8\times4}{8+4} = \frac{32}{12} = \frac{8}{3}\Omega$$

$$R_{eff_{AD}} = \frac{10\times2}{10+2} = \frac{20}{12} = \frac{5}{3}\Omega$$

Max R across C.D, B.C

8. 2A

Take points A B C D .

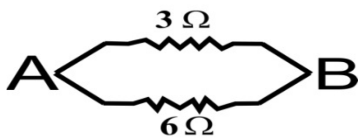


$i_{BD} = 0$

$\left(\therefore \frac{1}{2} = \frac{p}{q} = \frac{R}{S} = \frac{2}{4}\right)$bridge is balanced

Remove 5Ω

$\therefore (1\,\Omega + 2\Omega) || \ (2\Omega + 4\Omega)$

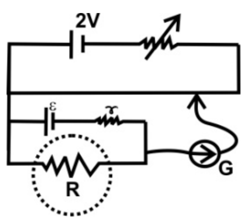


$$\frac{1}{R_{eq}} = \frac{1}{3} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$$

$R_{eq} = 2\Omega$

$$\therefore i = \frac{V}{R_{eq}} = \frac{4V}{2\Omega} = (2\ Amp)$$

9. 0.50Ω



To Find r

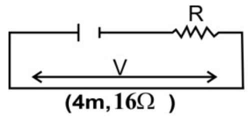
$r = ?$

$$r = R\left(\frac{l_1}{l_2} - 1\right)$$

$$r = 9.5\left(\frac{3}{2.85} - 1\right)$$

$$= 9.5 \times \frac{0.15}{2.85} = 0.50\Omega$$

10. 64Ω



$\phi =$ 1mv / cm

pot. gradient

$= 10^{-3}V/10^{-2}m$

$=$ 10^{-1} v/m

Find R to make $\phi = 10^{-1}$ v/m

Sol :- $\phi = \frac{pot.drop\ V}{l} = \frac{I \times 16\ \Omega}{4\text{m}}$

$= 4I$

$= \frac{1}{10}$v/m

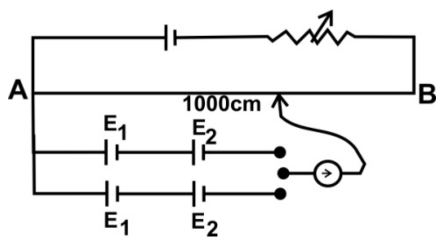
Or $I = \frac{1}{40} = \frac{Total\ e.m.f.}{total\ \ resistance}$

$$= \frac{2}{16 + R} = \frac{1}{40}$$

$80 = 16 + R$

$R = 64\Omega$

11. 7:3



$E_1 + E_2 = \phi \times 500$

$$E_1 - E_2 = \phi \times 200$$

(same polarity balancing)

$$\frac{E_1 + E_2}{E_1 - E_2} = \frac{5}{2}$$

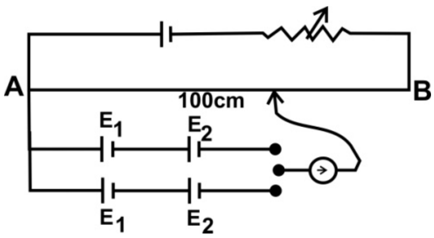
$$\frac{E_1}{E_2} = x = ?$$

$$\frac{\frac{E_1}{E_2} + 1}{\frac{E_1}{E_2} - 1} = \frac{x+1}{x-1} = \frac{5}{2}$$

$$2x + 2 = 5x - 5$$

$$x = \frac{7}{3}$$

12. 3:2



$$E_1 + E_2 = \phi \times 50$$

$$E_1 - E_2 = \phi \times 10$$

$$\frac{E_1 + E_2}{E_1 - E_2} = \frac{50}{10} = 5$$

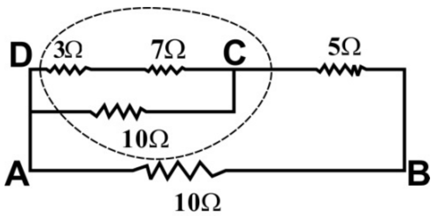
$$\frac{\frac{E_1}{E_2} + 1}{\frac{E_1}{E_2} - 1} = 5 = \frac{x+1}{x-1}$$

$$5x - 5 = x + 1$$

$$4x = 6$$

$$x = \frac{6}{4} = \frac{3}{2}$$

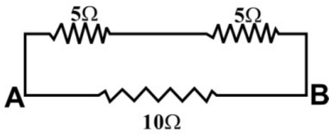
13. 5Ω



$$R_{\parallel} = (3\Omega + 7\Omega = 10\Omega) \parallel 10\Omega$$

$$R_{\parallel} = \left(\frac{10 \times 10}{20}\right) \parallel 10\Omega$$

$$10\Omega \parallel 10\Omega$$



$$\frac{1}{10} + \frac{1}{10} = \frac{1}{R_{AB}} \Rightarrow R_{AB} = \frac{10}{2} = 5\Omega$$

14. 6%

$$P = V^2 \backslash R$$

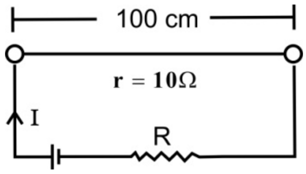
$$\frac{\Delta p}{p} = 2\frac{\Delta V}{V} + \frac{\Delta R}{R} \to 0$$

$$= 2\frac{\Delta V}{V}$$

$$\therefore \frac{\Delta p}{p} \times 100\ \% = 2\frac{\Delta V}{V} \times 100\%$$

$$= 2 \times 3\% = 6\%$$

15. 790Ω



$\epsilon = 2V$

$$I = \frac{\varepsilon}{R + r}$$

$$10mV = \frac{E\,r}{(R + r)L} \times l$$

$$R + r = \frac{Erl}{L \times 10 \times 10^{-3}}$$

$$= \frac{2 \times 10\Omega \times 40\ cm}{100cm \times 10^{-2}}$$

$$R + r = 800$$

$$R = 800 - 10 = 790\Omega$$

***

CHAPTER FOUR
(MAGNETIC EFFECT OF CURRENT)

A-I

MCQ

Choose the correct answer from the multiple choices.

1. **The dimension of magnetic induction is**

   (a) $[ML^0T^{-2}A^{-1}]$

   (b)$[MLT^{-2}A]$

   (c) $[ML^2T^{-1}A^{-1}]$

   (d) $[M^2L\,T^{-1}A]$

2. **Which of the following motion cannot be deflected by the magnetic field ?**

   (a) Electron **(b)**Proton

   (c) Positron **(d)** Neutron

3. $\left(\frac{\boldsymbol{Weber}}{\boldsymbol{ampere\,.metre}}\right)$ **is the unit of**

   (a) Magnetic flux

   (b) Magnetic moment

   (c) Magnetic induction

   (d) Magnetic permeability

4. **If 'r' is the radius of a circular coil, then magnetic induction $(\vec{\boldsymbol{B}})$ at the centre of the coil.**

   (a) $\vec{B} \propto \frac{1}{r}$ **(b)**$\vec{B} \propto \frac{1}{r^2}$

   (c) $\vec{B} \propto r$ **(d)** $\vec{B} \propto r^2$

5. **The magnitude of the magnetic field induction at a point due to a current element is given by**

   (a) Coulomb's law

   (b) Biot Savart's law

   (c) Gauss's law

   (d) Lenz's law

6. **Magnetic induction of the centre of a circular coils carrying current is**

   (a) $\frac{\mu_0 NI}{2\pi}$

   (b)$\frac{\mu_0 NI}{2r}$

   (c) $\frac{\mu_0 NI}{4\pi}$

   (d) $\frac{\mu_0 NI}{4r}$

7. **Which of the following represent mathematical form of Ampere's circuital law ?**

   (a) $\oint B\,dl = \frac{I}{\mu_0}$

   (b)$\oint B\,dl = \frac{\mu_0}{I}$

   (c)$\oint B.dl = \mu_0 I$

   (d) $\oint B.dl = \mu_0 I^2$

8. Magnetic field intensity at any point near a long straight conductor is

(a) $2\frac{\mu_0 I}{\pi r}$ **(b)** $\frac{2\pi}{\mu_0 r}$

(c) $\frac{\mu_0 I}{2\pi r}$ **(d)** $\frac{\mu_0 I}{4\pi r}$

9. Two thin long parallel wires are separated by a distance (r) and carrying current I ampere each. The magnitude of the force per unit length exerted by one wire due to the other is :

(a) $\frac{\mu_0 I^2}{r^2}$ **(b)** $\frac{\mu_0 I}{2\pi r}$

(c) $\frac{\mu_0 I}{4\pi r^2}$ **(d)** $\frac{\mu_0 I^2}{2\pi r}$

10. Force acting on a moving charge in a uniform magnetic field is

(a) $q\left(\vec{v} \times \vec{B}\right)$

(b) $q\left(\vec{B} \times \vec{v}\right)$

(c) $q\,\vec{B}$

(d) $q\vec{v}$

11. Radius of the path of an electron projected in to a magnetic fields perpendicular to the direction of the field is

(a) $\frac{qv}{mB}$ **(b)** $\frac{qB}{mV}$

(c) $\frac{mq}{vB}$ **(d)** $\frac{mv}{qB}$

12. Force acting on a current carrying conductor in the presence of magnetic field is

(a) $I\left(\vec{\imath} \times \vec{B}\right)$ **(b)** $I\left(\vec{B} \times \vec{l}\right)$

(c) $I\left(\vec{l}.\vec{B}\right)$ **(d)** $\vec{l}\left(I.\vec{B}\right)$

13. An electron of mass 'm' charge 'e' enters into a uniform magnetic field region of induction B and is found to describe a circle of radius 'r'. The magnetic field induction B is given by

(a) $\frac{mev}{r}$

(b) $\frac{mvr}{e}$

(c) $\frac{mv}{er}$

(d) $\frac{ev}{mr}$

14. Time period of revolution of a charged particle is

(a) $\frac{2\pi m}{qB}$ **(b)** $\frac{qB}{2\pi m}$

(c) $\frac{B}{2\pi mq}$ **(d)** $\frac{q}{2\pi mB}$

15. Frequency of revolution of charged particle is

(a) $\frac{qB}{2\pi}$ **(b)** $\frac{qBm}{2\pi}$

(c) $\frac{qB}{2\pi m}$ **(d)** $\frac{qm}{2\pi B}$

16. **In the moving coil galvanometer, the deflection θ of the coil is related to the electric current by the relation.**

(a)$i \propto \theta$ **(b)**$i \propto \theta^2$

(c)$i \propto \frac{1}{\theta}$ **(d)** $i \propto \sqrt{\theta}$

17. **A circular coil A has radius 'a' and the current flowing through it is 'I'. Another circular coil has radius '2a' and if '2I' is the current flowing through it, then the magnetic fields at the centre of the circular coils are in the ratio of :**

(a) 2:1 **(b)** 1:1

(c) 4:1 **(d)** 1:2

18. **The magnetic field at a distance 'r' from a long straight wire carrying current I is 0.4 tesla. The magnetic field at a distance 4r is**

(a) 0.8 tesla **(b)** 0.4 tesla

(c) 0.2 tesla **(d)** 0.1 tesla

19. **The strength of the magnetic field at a point distance 'r' near a long straight current carrying wire is B . The field at a distance $\frac{r}{2}$ will be.**

(a) $4B$ **(b)**$\frac{B}{4}$

(c)$2B$ **(d)** $\frac{B}{2}$

20. **The flux density in air at a point 0.06m from a long straight wire carrying a current of 9 A is**

(a) $9 \times 10^{-5} T$

(b) $3 \times 10^{-5} T$

(c) $3 \times 10^{5} T$

(d) $3 \times 10^{-4} T$

21. **A circular coil of wire consisting of 100 turns, each of radius $\frac{22}{7}$ cm carries a current of 0.4A . The magnitude of the magnetic field at the centre of the coil is .**

(a) $4 \times 10^{-4} T$

(b) $4 \times 10^{-3} T$

(c)$8 \times 10^{-4} T$

(d)$8 \times 10^{-3} T$

22. **A long straight wire carries a current of 25 A . The magnitude of the field B at a point 20 cm from the wire is**

(a) $2.5 \times 10^{3} T$

(b)$2.5 \times 10^{-4} T$

(c)$2.5 \times 10^{-3} T$

(d)$2.5 \times 10^{-5} T$

23. **The magnitude of magnetic force per unit length on a wire carrying current of 4A and making an angle**

of $30°$ with the direction of a uniform magnetic field of 0.15T is

(a) $0.6\ Nm^{-1}$

(b) $0.3\ Nm^{-1}$

(c)$0.5\ Nm^{-1}$

(d) $0.8\ Nm^{-1}$

24. **A 2 cm wire carrying a current of 5A is placed inside a solenoid perpendicular to its axis. The magnetic field inside the solenoid is given to be 0.2T. The magnitude of force on the wire is**

(a) $0.002\ T$

(b)$0.02T$

(c)$0.2T$

(d)$0.4T$

25. **A proton and an α particle, after being accelerated through same P.D. enter uniform magnetic field. The direction of magnetic field is perpendicular to the velocities. The ratio of radio of curvature of their trajectories are**

(a) 1:2 **(b)** 2:1

(c) $1{:}\sqrt{2}$ **(d)** $\sqrt{2} : 1$

26. **An electron and a proton possessing equal moment are injected to a region at right angles to a uniform magnetic field. The ratio of their radius of curvature while moving inside the magnetic field is**

(a) 1:2 **(b)** $1{:}\sqrt{2}$

(c) 1:1 **(d)** 1:4

27. **Tow particles x and y having equal charges, after being accelerated through the same P.D. enter a region of uniform magnetic field and describe circular paths of radius R_1 and R_2 respectively. The ratio of their masses are**

(a) $\frac{R_1}{R_2}$ **(b)** $\left(\frac{R_1}{R_2}\right)^2$

(c) $\frac{R_2}{R_1}$ **(d)** $\left(\frac{R_2}{R_1}\right)^2$

28. **A proton is moving under the influence of a perpendicular magnetic field B and possesses energy (E). What will be energy of the proton (E') if the magnetic field increased to $4B$ while it is compelled to move in the circular path of same radius ?**

(a) $\frac{E'}{E} = 2$ **(b)** $\frac{E'}{E} = 4$

(c) $\frac{E'}{E} = 8$ **(d)** $\frac{E'}{E} = 16$

29. **The resistance of a galvanometer is 49.9 ohm and the maximum current which can be passed through it is 0.001 A. What resistance must be**

connected to it in the order to convert it in to an ammeter of range 0.5 $\dot{A}$?

(a) 0.001 ohm

(b) .01 ohm

(c) 0.1ohmn

(d) 1 ohm

30. The resistance of a galvanometer is 99 ohm and the maximum current which can be passed through it is 0.001 A. What resistance must be connected to it in the order to convert it in to a voltmeter of range 5V ?

(a) 4951Ω **(b)** 4950Ω

(c) $4901\ \Omega$ **(d)** 4900 ohm.

31. A proton, which carries a charge of $\mathbf{1.6 \times 10^{-19}}$ C, moving with a velocity of $\mathbf{2 \times 10^{6}}$ m/s enters a magnetic field of intensity $\mathbf{200\, Wb\, m^{-2}}$ at right angle to it . The magnitude of the force acting on proton is

(a) $6.4 \times 10^{-12}\ N$

(b) $6.4 \times 10^{-11} N$

(c) $6.4 \times 10^{-10}\ N$

(d) $3.2 \times 10^{-11}\ N$

32. A closely flat circular coil of 25 turns of wire has diameter 0.2m and carries a current of $\frac{35}{11}$ A. The flux density at the centre of the coil is

(a) $5 \times 10^{-5}\ T$

(b) $5 \times 10^{-4}\ T$

(c) $2.5 \times 10^{-5} T$

(d) $2.5 \times 10^{-4} T$

****

A-II

FILL IN THE BLANKS

1. **Force acting on a charge at rest in a uniform magnetic field is _____.**

2. **Two straight conductors carrying current along same direction ____ each other.**

3. **SI Unit of magnetic field intensity is ___.**

4. **1 tesla is equal to _____ gauss.**

5. **Maxwell is the product of gauss and ___.**
6. **Magnetic field intensity due to a solenoid is _____**
7. **Galvanometer can be converted into an ammeter by connecting a _____ resistance in parallel.**
8. **A voltmeter is a _________ resistance instrument.**
9. **Magnetic flux is the dot product of __________ and area vector.**
10. **Lorentz force is the combined effect of _______ and _______ field on a moving charged particle.**
11. **1 Weber is equal to ______ Maxwell.**
12. **An ammeter is a _____ resistance instrument.**
13. **Amperes circuital law relates _______ to _________.**
14. **Two free parallel wires carrying current in opposite direction ________ each other.**
15. **An electron move with a uniform velocity 'v' and enters a region of uniform magnetic field B. if v and B are parallel to each other then the electron will move in ____**
16. **An electron moves with a uniform velocity $\vec{v}$ and enters a region of uniform magnetic field B. if v and B are orthogonal to each other then the electron will move in ____.**
17. **The resistance of an ideal ammeter is ___.**
18. **The resistance of an ideal voltmeter is ___**
19. **If a strong magnetic field is applied to a stationary electron, then electron ___**
20. **SI Unit of magnetic flux is ____.**

***

A-III

ANSWER THE QUESTIONS IN ONE WORD.

1. **Write the CGS and SI unit of magnetic flux.**
2. **Write the relation between Maxwell and gauss.**
3. **Write the CGS and SI unit of magnetic field intensity**
4. **Write the relation between weber and Maxwell**
5. **What is the angle between the magnetic induction and normal to the plane of a coil in the moving coil galvanometer ?**
6. **An ∝-particle is moving parallel to a magnetic field . How much force acts on the particle ?**
7. **What is the nature of force between two parallel conductor carrying currents in the same directions ?**

***

A-IV

ANSWER THE QUESTIONS IN ONE SENTENCES.

1. **Write Biot-Savart's law in vector form.**
2. **Write an expression for the strength of magnetic field, at the center of a circular coil carrying current.**
3. **What is Lorentz force ?**
4. **State Flaming's left rand rule/**
5. **How do you define current sensitivity of a galvanometer ?**
6. **What is meant by voltage sensitivity of a galvanometer ?**
7. **How would you convert a galvanometer in to an ammeter ?**
8. **How would you convert a galvanometer in to a voltmeter ?**

9. How is an ammeter connected in an electric circuit ?

10. How is an voltmeter connected in an electric circuit ?

11. Define magnetic flux .

12. Why concave shaped magnet is used in moving coil galvanometer ?

13. What is the force when a current carrying conductor is placed in a magnetic field?

14. Find an expression for the force acting an a charge 'q' moving with velocity $\vec{v}$ at an angle θ with magnetic induction $\vec{B}$.

15. State the expression for magnetic induction $\vec{B}$ at a distance s from a straight conductor carrying current I.

16. Write the expression for the torque acting on a rectangular current carrying coil in an uniform magnetic field.

***

A-E

SECTION B

2 MARKS EACH

1. Distinguish between ammeter and voltmeter

2. Why the magnet in a galvanometer has concave pole-pieces ?

3. Find the relation between weber and Maxwell.

4. State Fleming's left hand rule.

5. State Amperes circuital law.

6. State Biot-Savart's law

7. What is current sensitivity of a galvanometer and obtain an expression for the same ?

8. What is voltage sensitivity of a moving coil galvanometer and obtain an expression for the same ?

9. Explain how would you convert a galvanometer into an ammeter.

10. What is Lorentz force ?

11. **How is a galvanometer converted in to an voltmeter ?**

12. **Give two merits and demerits of a moving coil galvanometer.**

***

A-F

SECTION –C

LONG TYPE

1. **State and explain Biot- savarts law. Using this obtain an expression for the magnetic field intensity at the centre of a circular coil carrying current.**

2. **State Biot-savart's law and derive an expression for magnetic induction at axial point due to a circular coil carrying current.**

3. **Obtain an expression for the torque acting on a rectangular coil carrying current in a uniform magnetic field.**

4. **Describe the principle construction and working of a moving charge galvanometer.**

5. **State amperes circuital law and explain it. Find magnetic field intensity due to a long straight conductor.**

***

ANSWERS

A-I

MCQ

1. a
2. d
3. d
4. a
5. b
6. b
7. c
8. c
9. d
10. a
11. d
12. a
13. c
14. a
15. c
16. a
17. b
18. d
19. c
20. b
21. c
22. d
23. b
24. b
25. c
26. c
27. b
28. d
29. c
30. c
31. b
32. b

***

A-II

FILL IN THE BLANKS

1. Zero
2. Attract
3. Tesla
4. 10^4
5. Cm^2
6. $B = \mu_0 n I$
7. Low
8. High

9. Magnetic induction

10. Electric and magnetic

11. 10^8

12. Low

13. Magnetic field to electric current

14. Repel

15. In same direction

16. Circular path

17. Zero

18. \∞

19. Remains stationary

20. Weber

***

A-III

ONE WORD ANSWER

1. Maxwell, weber
2. 1 Maxwell = 1 gauss cm^2
3. Gauss, tesla
4. 1 weber = 10^8 maxwell
5. $\theta = 0$
6. $\vec{F} = q\left(\vec{v} \times \vec{B}\right) = 0 \quad \therefore \theta = 0$

***

A-IV

ANSWER FOR ONE SENTENCE QUESTION.

1. $d\vec{B} = \frac{\mu_0}{4\pi} \frac{I\left(d\vec{l} \times \vec{r}\right)}{r^3}$

2. $B = \frac{\mu_0 NI}{2r}$

3. $\vec{F} = q\vec{E} + q(\vec{v} \times \vec{B})$

4. Statement

5. Current sensitivity $= K = \frac{C}{nBA}$

6. Statement

7. A small resistance in parallel

8. A high resistance in series

9. Ammeter is connected in series in an electric circuit

10. Voltmeter is connected in parallel in an electric circuit

11. $\phi = \vec{B}.\vec{A}$

12. To produce redial field.

13. $\vec{F} = I\,(\vec{l} \times \vec{B})$

14. $\vec{F} = q\,(\vec{v} \times \vec{B})$

15. $B = \frac{\mu_0 I}{2\pi S}$

16. ζ = NIBA $\cos\theta$

***

A-V

1.

Ammeter	**Voltmeter**
(i) Current measuring	(i) Measures potential diff.
(ii) Its resistance is low	(ii) Resistance high
(iii) Made by connecting the low resistance in shunt to galvanometer	(iii) Made by connecting high resistance in series to galvanometer.
(iv) Used in series to a cct	(iv) Connected in parallel to devices.

2. To get radial magnetic field.

3. 1 weber = $\frac{1\,Joule}{1\,Amp}$

$$= \frac{10^7 erq}{\left(\frac{1}{10}\right) abamp} = 10^8 Maxwell$$

4. Statement

5. Statement

6. Statement

7. Deflection for unit current $\frac{\theta}{I} = \frac{C}{BNA}$

8. Deflection for unit potential difference $\frac{\theta}{V} = \frac{C}{BNAR}$

9. Connecting low resistance in parallel to a galvanometer as a shunt S.

$$S = \frac{Ig}{I^{-Ig}} \times G$$

10. $\vec{F}_{lorentz} = \vec{F}_e + \vec{F}_{mag} = q(\vec{E} + \vec{v} \times \vec{B})$

11. By connecting high resistance R in series with galvanometer. $R = \frac{V}{Ig} - G$

12. Merits :-

(i) Very sensitive so low currents can be detected .

(ii) High accuracy .

Demerits: -

(i) Only dc

(ii) Not portable

***

A- VI

LONG TYPE

1. Statement, Brief explanation with diagram and direction of $\vec{B}$

$$B_{centre} = \frac{\mu_0 nI}{2r}$$

2. As above $B_{axis} = \frac{\mu_0 IR^2}{2(x^2+R^2)^{\frac{3}{2}}}$
3. |Torque|= $nIBA\ Sin\ \theta$
4. Principle : A current loop placed in a magnetic field experience torque which produces deflection proportional to the current construction, working.
5. Statement

   Explanation

$$B = \frac{\mu_0 I}{2\pi r}$$

***

CHAPTER FIVE

A-I

MCQ

1. **When the distance between two magnetic poles is doubled, the force between the poles**
   (a) became double
   (b) becomes halved
   (c) becomes 4 times
   (d) decreases to $1/4^{th}$

2. **The value of permeability in air is**
   (a) $10^{-7} NA^{-2}$
   (b) $4\pi \times 10^{-9} NA^{-2}$
   (c) $4\pi \times 10^{-7} NA^{-2}$
   (d) $10^{-9} NA^{-2}$

3. **Iron is used as a core in transformer became**
   (a) it is strong enough
   (b) It has high density
   (c) It has high permeability
   (d) None of these.

4. **For a diamagnetic substance**
   (a) $x\ is\ +ve$
   (b) $x\ is -ve$
   (c) $x = 0$
   (d) $x = 1$

5. **The sure test of magnetism is**
   (a) attraction
   (b) repulsion
   (c) both of these
   (d) none of these

6. **A uniform magnetic field is represented by a set of lines of force which are**
   (a) parallel
   (b) convergent
   (c) both of these
   (d) None of these

7. **The unit of pole strength is**
   (a) henry **(b)** tesla
   (c) ampere- meter **(d)** weber

8. **Dimension of pole strength is**
   (a) $M^0L^0T^1A^1$
   (b) $M^0L^1T^{-1}A^0$
   (c) $M^0L^1T^0A^1$
   (d) $M^1L^{-1}T^0A^0$

9. **The unit of magnetic moment is**
   (a) Ampere meter
   (b) henery
   (c) tesla
   (d) ampere $meter^2$

10. Dimensions of magnetic moment are

(a) $M^0L^0T^2A^{-1}$

(b) $M^0L^1T^0A^{-2}$

(c) $M^0L^1T^2A^1$

(d) $M^0L^2T^0A^1$

11. Which of the following represents the unit of magnetic field intensity?

(a) tesla

(b) Weber

(c) Henry

(d) coulomb

12. The magnetic moment of a magnet of magnetic length $(2\boldsymbol{l})$ and pole strength (m) is

(a) $ml/2$ **(b)** ml/4

(c) 2lm **(d)** 4lm

13. Above Curie point, a ferromagnetic substance becomes

(a) Diamagnetic

(b) Paramagnetic

(c) Ferromagnetic

(d) Non-magnetic

14. The unit of permeability is

(a) NA^{-2}

(b) $N^{-2}A^2$

(c) N^2A^{-2}

(d) $N^{-1}A^{-1}$

15. Angle dip is maximum near

(a) equator

(b) 45° latitude

(c) pole

(d) none of above

16. A diamagnetic material in a magnetic field moves

(a) perpendicular to the magnetic field

(b) from weaker part to the stronger part

(c) from stronger part to the weaker part

(d) in none of the above directions.

17. A magnet with magnetic moment M is given. It is bent into a semicircular form. Its new magnitude moment will be

(a) M/π **(b)** M/2

(c) M **(d)** $\frac{2M}{pi}$

18. At a certain place an earth $\boldsymbol{B_H = \frac{1}{\sqrt{3}} B_v}$. the dip angle is

(a) 60° **(b)** 30°

(c) 45° **(d)** 90°

19. Which of the following relation is correct in magnetism ?

(a) $I^2 = V^2 + H^2$

(b) $V = I^2 + H^2$

(c) $I = V + H$

(d) $V^2 = I + H$

20. A bar magnet of magnetic moment (M) is cut into two parts of equal lengths. The magnetic moment and pole strength of either part will be

(a) $\frac{M}{2}, \frac{m}{2}$ **(b)** $M, \frac{m}{2}$

(c) $\frac{M}{2}, m$ **(d)** M, m

21. If number of turns, area and current through a coil are gives by n, A and I respectively then the magnetic moment is given by

(a) nIA **(b)** n^2IA

(c) nIA^2 **(d)** $nI/\sqrt{A}$

22. Which of the following statement is not correct about the magnetic field?

(a) Magnetic line of force do not cut each other

(b) Inside the magnet, the lines of force 90 from north pole to south pole of the magnet.

(c) The magnetic lines form a closed loop.

(d) Tangents to the magnetic line gives direction of magnetic field.

23. Angle of dip is 90° at

(a) Equator **(b)** Poles

(c) at both **(d)** none of these

24. Two wires of same length are shape into a square and a circle. If they carry same current the ratio of magnetic moments will be

(a) $2:\pi$ **(b)** $\pi:2$

(c) $\pi:4$ **(d)** $4:\pi$

25. If a magnetic substance is kept in a magnetic field then which of the following substance is thrown out ?

(a) Para magnetic

(b) ferromagnetic

(c) diamagnetic

(d) anti- ferromagnetic

26. Dipole moment of a revolving electron is

(a) $\frac{evr}{2}$ **(b)** evr

(c) ev^2r **(d)** $\frac{evr^2}{2}$

***

A-II

FILL IN THE BLANKS

1. **The value of angle of dip at pole is __________**
2. **The value of angle of dip at equator is ____________**
3. **Magnetic pole strength in SI units is equal to __________ times the pole strength in cgs units.**
4. **The pole strength per unit area in a measure of __________.**
5. **Susceptibility of a _______ substance is negative.**
6. **The Earth's magnetic field always has a vertical component except at _________.**
7. **Line joining the place of zero dip is called __________.**
8. **Lines joining the place of equal dip are called ___________.**
9. **Lines joining the place of equal horizontal intensity are called ____.**
10. **Lines joining the place of zero declination are called ____.**
11. **The Earth's magnetic field always has a horizontal component except at the _________.**
12. **A region can be magnetically screened by surrounding the desired region by a _________material.**

***

SECTION –B

2 MARKS EACH QUESTION:

1. **Define intensity of magnetization.**

   How is it related to magnetic field intensity H.

2. **State any two property of magnetic lines of induction.**

3. **On passing a current through a vertical circular coil, a compass needle at its centre is not deflected. What conclusion can be drawn regarding the orientation of coil.**

4. **Define susceptibility. How is it related to magnetic permeability**

5. **Distinguish between paramagnetic and ferromagnetic substances**

***

ANSWERS

Chapter – 5

A-I

MCQ

1. d
2. c
3. c
4. b
5. b
6. a
7. c
8. c
9. d
10. d
11. a
12. c
13. b
14. a
15. c
16. a
17. d
18. a
19. a
20. c
21. a
22. b
23. b
24. c
25. c
26. a

***

A-II

FILL IN THE BLANKS

1. 90°
2. Zero
3. 10
4. Intensity of magnetization
5. Diamagnetic
6. Magnetic equator
7. Aclinic
8. Isoclinic
9. Isodynatnic
10. Agonic
11. Magnetic poles of earth.
12. Ferromagnetic

SECTION – B

2 MARKS

1. $I = \frac{M}{V}$,

   $I = X_m H \; X_m =$ Succeptibility

2. Any two properties

   (i) Closed curves

   (ii) Two lines never intersect

   (iii) Crowded near high B

3. The plane of the coil in perpendicular to magnetic meridian. The magnetic field B_F produced by the coil and the horizontal component of Earth's magnetic field B_H will be alone the same direction when coil is in vertical plane. Hence no additional torque will develop and needle will be undeflected.

4. $\mu = 1 + 4\pi X_m$

5.

Ferromagnetic	Paqramagnetic
1. Strongly magnetiised in the direction of field 2. μ is much greater than 1 3. Susceptibility is large and +ve 4. At curie temp ferromagnetic substance become paramagnetic	1. Acquire feeble magnetic when placed in magnetic field. 2. μ is slightly are then I. 3. Susceptibility is small and +ve 4. At Curie temperature paramagnetic substance become diamagnetic

***

CHAPTER SIX
(ELECTROMAGNETIC INDUCTION)

A-I

MCQ

Choose the tight answer out of the four probable given.

1. **For magnetic flux ($\emptyset_m$) which is correct ?**

   (a) $\emptyset_m = \vec{B} \times \vec{A}$

   (b) $\emptyset_m = \vec{B}/\vec{A}$

   (c) $\emptyset_m = \vec{B}.\vec{A}$

   (d) $\emptyset_m = \vec{A} \times \vec{B}$

2. **The magnetic flux linked with a closed circuit depends on the number of turns of coil (N) as follows.**

   (a) directly on N

   (b) inversely on N

   (c) directly on N^2

   (d) inversely on N^2

3. **The direction of induced current is governed by**

   (i) Faraday's first law of e.m. induction.

   (ii) Faraday's second law of e.m. induction.

   (iii) Lenz's law

   (iv) Laplaces rules

4. **The magnitude of induced emf in a coil depends on**

   (i) The amount of magnetic flux linked

   (ii) The change in magnetic flux linked.

   (iii) The rate of change of magnetic flux linked

   (iv) The rate of change of electric flux linked.

5. **Lenz's law obeys the principles of conservation of**

   (i) Momentum

   (ii) Energy

   (iii) Angular momentum

   (iv) Charge

6. **A straight conductor of length (l) moves with velocity ($\vec{v}$) at right angles to a magnetic field of induction ($\vec{B}$) the magnitude of induced emf is**

   (i) $l\,v\,B\sin\theta$

(ii) $l\ v\ B$

(iii) $l\ v\ B\cos\theta$

(iv) $\frac{Bl}{v}\cos\theta$

7. **Henry is the unit for measurement of**
   - (i) Self – inductance only
   - (ii) Mutual –inductance only
   - (iii) Both self and mutual inductance
   - (iv) Induced emf.

8. **The self-inductance of an inductor depends on the number of turns of the coil (N) as follows.**
   - (i) Directly as N
   - (ii) Directly as N^2
   - (iii) Inversely as N
   - (iv) Inversely as N^2

9. **For the self- inductance (L). Which of the following in correct ?**
   - (i) $L = \frac{\mu^2 NA}{l}$
   - (ii) $l = \frac{\mu N^2 A^2}{l}$
   - (iii) $l = \frac{\mu N A^2}{l}$
   - (iv) $l = \frac{\mu N^2 A}{l}$

10. **Mechanical energy is converted to electrical energy in presence of a magnetic field in**
   - (i) motor (ii) inductor
   - (iii) generator (iv) galvanometer

11. **Electrical energy is converted to mechanical energy in presence of a magnetic field in a**
   - (i) motor (ii) inductor
   - (iii) generator (iv) galvanometer

12. **Mutual inductance between two closed circuits depends on the following factors of the coils.**
   - (i) number of turns in both the coils only
   - (ii) area of cross- section of the coils only
   - (iii) permeability of the cores of the coils and permeability of the separating medium.
   - (iv) All the above factors.

13. **The self inductance of a coil depends on its length (l) and area of cross-section (A) as follows.**
   - (i) directly as l and inversely as A
   - (ii) directly as A and inversely as l
   - (iii) directly as l and directly as A
   - (iv) inversely as l and inversely as A

14. **A high resistance is connected in series in a motor to reduce the current at**
   - (i) start (ii) stop
   - (iii) all instants (iv) desired speed

15. An alternating current is that for which

(a) Only the magnitude varies continuously.

(b) Only the direction reverses periodically.

(c) Both magnitude varies continuously and direction reverses periodically.

(d) None of these

16. The ammeter that measure a.c actually masers

(a) I_{rms} **(b)** I_0

(c) I **(d)** $\sqrt{2}\, I_0$

17. The power factor of an a.c. circuit containing pure resistance is

(a) 0 **(b)** 0.5

(c) 1.0 **(d)** 2.0

18. The power factor of an a.c. circuit containing pure inductor or capacitor is

(a) 0 **(b)** 0.5

(c) 1.0 **(d)** 2.0

19. The power factor of an a.c. circuit containing R,L,C in series is

(a) 0

(b) 1.0

(c) greater than one

(d) greater than zero but less than one.

20. The power factor of R,L,C circuit at resonance is

(a) 0

(b) 1.0

(c) greater than one

(d) greater than zero but less than one.

21. The phase difference between I and e (emf) in an a.c circuit containing pure resistance is

(a) zero

(b) $\frac{\pi}{2}$

(c) $\frac{-\pi}{2}$

(d) $\frac{\pi}{3}$

22. The phase difference between I and e in an a.c. circuit containing pure inductor or capacitor is

(a) 0 **(b)** $\frac{\pi}{4}$

(c) $\frac{\pi}{2}$ **(d)** $\frac{\pi}{3}$

23. In and a.c. circuit, the phase difference between I and e is $\frac{\pi}{4}$. The circuit contains.

(a) a pure resistance

(b) a pure inductance

(c) a pure capacitance

(d) resistance, inductance and capacitance

24. A pure inductor in a.c. circuit

(a) Stores energy in its electrostatic field.
(b) Stores energy in its magnetic field.
(c) does not store energy
(d) dissipates energy

25. A pure capacitor in an a.c. circuit

(a) Stores energy in its electrostatic field.
(b) Stores energy in its magnetic field.
(c) does not store energy
(d) dissipates energy

26. The impedance $(\boldsymbol{Z})$ and admittance $(\boldsymbol{Y})$ in SI units respectively

(a) Ohm, mho
(b) mho, Ohm
(c) ohm, ohm
(d) mho, mho

27. The gain in voltage is the loss of current in a

(a) resistor
(b) inductor
(c) capacitor
(d) transformer.

28. The voltage applied across a primary of a transformer is 220 volt d.c. If the turn ratio is 10, the voltage developed across secondary is

(a) Zero **(b)** 22 volt
(c) 220 volt **(d)** 2200 volt

29. Which of the following is more suitable for making core of a transformer ?

(a) Steel **(b)** soft iron
(c) copper **(d)** brass

30. The core of a transformer is laminated to reduce

(a) copper loss
(b) eddy current loss
(c) hysteresis loss
(d) leakage loss

31. The primary and secondary coils of a transformer have 500 and 2500 turns respectively . If the primary is connected to 220 volt a.c, the voltage developed across the secondary is

(a) 220 V
(b) 4.4 V
(c) 1100 V
(d) Zero

32. A circuit has an inductance of $\frac{1}{\pi}$ henry and resistance 2100 ohm. A supply of 50 cycle a.c. is connected across it. The reactance is

(a) $50\ \Omega$ **(b)** $100\ \Omega$
(c) 2102.4Ω **(c)** $100\pi\ \Omega$

A-II

FILL IN THE BLANKS

1. **Magnetic flux is a ____quantity**
2. **Induced emf = _____ × Resistance**
3. **____ is known as electrical inertia**
4. **Eddy current is analogous to ____ in mechanics**
5. **Due to eddy current, loss of ____takes place**
6. **Dimension of $\frac{L}{R}$ is _____**
7. **Dimension of LC is ____**
8. **A coil of self-inductance 0.6 H carries a current of 2A. Energy stored in the coil is ____.**
9. **The expression for mutual inductance of two long co-axical solenoids having radii r_1 & $r_2 (r_2 > r_1)$ and different number of turns $(N_1 and\, N_2)$ placed in air is ____.**
10. **In India frequency of a.c. is ____**
11. **Equivalent d.c. of $I = I_0 \sin \omega t$ is ____**
12. **The opposition offered by inductance and capacitance in an a.c. circuit is known as ____**
13. **Reciprocal of impedance is called ____**
14. **____ circuit is called oscillating circuit.**
15. **Frequency of LC circuit is f=____**
16. **The average value of a.c. over a complete cycle is ____**
17. **Power consumption in a purely inductive or purely capacitive circuit is _____**
18. **An inductor blocks ____**
19. **In a L,C,R, series circuit, if inductive reactance becomes equal to the capacitive reactance, the frequency becomes ____**
20. **Expression for impedance in a series L,C,R Circuit is ____**
21. **The current and voltage in an a.c. circuit are given by**

    $i = 3.5 \sin(628\,t + 30°)\ Amp.$

$V = 28\sin(628\,t\ - 30°)\ volt$

Time period is _____ sec and phase difference between current and voltage is ____ radian.

22. Average power consumed per cycle for ac voltage $E_0 \sin \omega t$ in a resistive circuit of resistance R ____.

23. A coil of number of turns N, area A is rotated at a constant angular speed ω, in a uniform magnetic field B and connected to a resistor R. The expression for $\overline{P}$ is____.

24. The equation of an a.c. voltage is $V = 100\sqrt{2}\ \ \sin(100\pi t)$ The root-mean-square value is ____ and frequency is ____

***

SECTION-B

EACH QUESTION CARRIES 2 MARKS

1. An alternating source of emf having frequency $50\,H_z$ is applied to a capacitor of capacitance $10\mu F$. What is the capacitive reactance

2. A generator is marked "220V, $50H_z$". What is the instantaneous emf (e)

3. The current through a 1 H inductor varies sinusiidally with an amplitude of 5A and frequency $50H_z$. What is the magnitude of the voltage developed across it.

4. The instantaneous emf applied across an a.c. circuit is $e = 200\sin 200\pi t$. What are the peak voltage, the rms voltage and frequency of ac voltage.

5. The efficiency of a step-up transformer is 90% . If 220 V is applied to the primary having resistance 20Ω. What are the input power, output power and power loss.

6. (a) Does the induced emf in a coil depend on

(i) number of turns in the coil ?

(ii) resistance of the coil ?

Justify .

7. **Does current induced in the coil depend on resistance ? (Write Yes or No) . How much if Yes, I$i = \frac{N\frac{\Delta\backslash\emptyset m}{\Delta t}}{R}$**

8. **A wire 1m long along north – south direction is released to fall freely. Is any emf induced across its ends?**

9. **A coil is placed at rest in a non-uniform magnetic field. State if induced emf is produced in it. Give the reason.**

10. **A bar magnet falls through a closed ring conducting. What will be the acceleration of magnet give reasons for your answer. What will be the direction of current in the coil.**

11. **A closed loop of wire is made to move from positive towards negative plates of a capacitor. Will there be induced emf produced ? Justify your answer.**

12. **Two identical loops one of copper and the other of aluminum, are rotated with the same angular speed inside a uniform magnetic field. Compare the induced emfs and current produced in them.**

13. **A wheel has to metallic spokes, each 0.5 m long is rotated with 120 rev/min normal to a magnetic field of 0.4 gauss. Calculate the induced emf between the axle and rim of the wheel.**

14. **A 28 turn coil with average diameter of 0.02m is placed $\perp^r$ to a magnetic field of 8000 T. if the field changes to 3000 T in 4 sec, what will be the induced emf. ?**

15. **A circular loop of wire of radius 4 cm carries a current of 80A. Calculate the energy density at the centre of the loop.**

16. **Current in a circuit falls from 5A to 0A in 0.1 sec. if induced emf developed be 200 volt, what will be the self inductance of the circuit ?**

17. **A pair of adjacent coils have a mutual inductance of 1.5H. If current in one coil changes from 0 to 20A in 0.5 sec. What is the change n magnetic flux linked with the other coil.**

18. **If rate of change of current of 3A/s induces an emf of 30 millivolt in a**

solenoid calculate the self inductance of it.

19. A coil has 1000 turns. When a current of 2.5A is passed through it. If magnetic flux linked with it is 0.5 microweber what is the self-inductance of it.

20. Why does a metallic piece becomes very hot when it is surrounded by a coil carrying high frequency a.c.

***

SECTION-C

LONG QUESTION

1. **State Lenz’s laws. Justify that it obeys conservation of enrgy.**

2. **Two parallel conductors ‘ab’ and ‘cd’ joined at one end by conductor ac forming a U shape. They are located in a uniform magnetic field of induction B which in perpendicular to the plane of the conductors. A conducting bar ‘ef’ placed on the U shaped conductor and moves at constant speed $\vec{v}$ parallel to conductors ab and cd. Find out magnitude and sense of induced emf in the conductor frame.**

***

ANSWERS

A-I

1. a
2. a
3. c
4. c
5. b
6. b
7. c
8. d
9. b
10. c
11. a
12. d
13. ba
14. a
15. c
16. a
17. c
18. a
19. d
20. b
21. a
22. c
23. d
24. b
25. a
26. a
27. d
28. a
29. b
30. b
31. c
32. b

***

A-II

FILL IN THE BLANKS.

1. Scalar
2. Induced current
3. Self inductance
4. Friction
5. Energy
6. Time
7. T^2
8. 2J
9. $\frac{\pi_0 N_1 N_2 \pi r_1^2}{2}$
10. $50H_z$
11. $\frac{I_0}{\sqrt{2}}$

12. Reactance

13. Admittance

14. LC

15. $\frac{1}{2\pi\sqrt{LC}}$

16. Zero

17. Zero

18. Ac

19. $\frac{1}{2\pi\sqrt{LC}}$

20. $\sqrt{R^2 + \left(\omega L - \frac{1}{\omega c}\right)^2}$

21. .01, $\frac{\pi}{3}$

22. $E_0^2/2R$

23. $\frac{(NBAW)^2}{2R}$

24. 100V, $50H_z$

***

SECTION-B

2 MARKS EACH QUESTION

1. $X_c = \frac{1}{wc} = \frac{1}{2\pi fc} = \frac{1}{2\pi\times50\times10\times10^{-6}} = \frac{1000}{\pi}\, ohm$

2. $e = E_0 \sin 2\pi ft = 220\sqrt{2}\sin 100\pi t = 311 \sin 100\pi t$

3. $\left|L\frac{di}{dt}\right| = 1571.4v$

4. $200V, 141.4V, 100Hz$

5. 2420W,2178W, 242W

6. Yes as induced emf = $N\frac{d\emptyset}{dt}$

   No as $\emptyset$ deso not depend on R

7. Yes because induced current = $\frac{-N\frac{d\emptyset}{dt}}{R}$

8. No, there is no change in magnetic flux due to H or V of the earth.

9. No induced emf is produced because there is no rate of change of magnetic flux in it.

10. The acceleration of the magnet will be less then ‘g’ because the current induced in the coil will produce a magnetic field that will oppose the free fall.

11. No, becase rate of change of electric flux does not produce induced emf.

12. Induced emf's will be the same in both the loops $\left(\because e = -\frac{\Delta\emptyset_m}{\Delta t}\right) = BA\omega \sin \omega t \;\; \emptyset_m = BA \cos \omega t$

Induced current will be different $\because i = \frac{e}{R}$ R is less for cu so that 'I' will be more in it.

13. $\omega = \frac{120\times2\pi}{60\ sec}\ red = 4\pi \frac{rad}{s}$

$l = 0.5\ meter$, B= 0.4×10^{-4} Tesla

Time period $\frac{2\pi}{\omega} = \frac{2\pi}{4\pi} = \frac{1}{2}$ sec.

Induced emf $e = \frac{-\Delta\emptyset_m}{\Delta t} = \frac{-\Delta(BA)}{T} = -B\frac{\Delta A}{T}$

$$= -B\frac{\pi l^2}{\left(\frac{1}{2}\right)} = -6.28 \times 10^{-15} Volt$$

14. Induced emf

$$e = -N\frac{\Delta\emptyset_m}{\Delta t} = -N\frac{\Delta(B\ A \cos 0)}{\Delta t}$$

$= \frac{NA}{4}\ \Delta B = \frac{-28\times\pi\ (0.02)^2}{4} \times (8000 - 3000) =$

$11\ volt$ numerically.

15. Magnetic induction at the centre of a circular current carrying loop =B= $\frac{\mu_0 I}{2r}$

$$u_m = \frac{B^2}{2\mu_0} = \frac{1}{2\mu_0}\frac{\mu_0^2\ I^2}{4r^2} = \frac{\pi_0 I^2}{8r^2}$$

$$= \frac{4\pi \times 10^{-7} \times (80)^2}{8 \times (0.04)^2}$$

$$= 0.628\ jule/m^3$$

16. $e = -L\frac{\Delta I}{\Delta t}$

$\Rightarrow L = \frac{e}{\frac{-\Delta I}{\Delta t}} = -\frac{200}{\left(\frac{0-5}{0.1}\right)} = 40 \times 0.1 = 4\ H$ (H for Henry)

17. $(\emptyset_m)_2 = M\ I_1$

$\Rightarrow \Delta\emptyset_{m\,2} = M\ \Delta I_1$

$= 1.5\ (20 - 0) = 30\ weber.$

18. $e = -L\frac{\Delta I}{\Delta t} = -L\ .3$

$$\Rightarrow |L| = \frac{30 \times 10^{-3}}{3\ A/s}\ volt$$

$$= 10 \times 10^{-3} H$$

$$= 10\ mH$$

19. $e = -N\frac{\Delta\emptyset_m}{\Delta t} = -L\frac{\Delta I}{\Delta t}$

$\Rightarrow N\ \Delta\emptyset_m = L\ \Delta I$

$\Rightarrow L = \frac{N\Delta\emptyset_m}{\Delta I} = \frac{100\times(0.5\times10^{-6}-0)}{(2.5-0)} = 0.2\ mH$

20. Reason – the magnetic flux lined with the metallic piece changes by a large amount. Heavy eddy currents are induced in the metallic piece. These currents cause the heating

CHAPTER SEVEN

ALTERNATIVE CURRENT

A-I

MCQ

1. **A voltage $E = 60\ sin\ 120\pi\lambda$ is applied across a 20Ω resistance. An A.C ammeter in series with resistance will read ?**

   (a) $3A$ **(b)** $2.12A$
   (c) $\frac{1}{3}A$ **(d)** $3.12\ A$

2. **An A.C ammeter reads 10 A in an AC circuit . The peak value of current is:**

   (a) $\frac{10}{\sqrt{2}}A$ **(b)** $\frac{20}{\pi}A$
   (c) $5\pi A$ **(d)** $10\sqrt{2}A$

3. **The effective value of alternating current is 5A. The current passes through 12Ω resistor. The maximum potential difference across the resistor is**

   (a) $60\ volts$
   (b) $\frac{60}{\sqrt{2}}volts$
   (c) $60\sqrt{2}\ volts$
   (d) $12\sqrt{2}\ volts$

4. **A 100Ω iron is connected to a 220 volt, 50 cycle wall plug. The r.m.s value of current is**

   (a) $22\ Amp$ **(b)** $220\ Amp$
   (c) $2.2\ Amp$ **(d)** $100\ Amp$

5. **A 100 Hz a.c is flowing in a 14 mH coil. The reactance of the coil is**

   (a) 88Ω
   (b) 14Ω
   (c) 1.4Ω
   (d) 8.8Ω

6. **A capacitor of 1μF is connected to a source of AC having $E\ mf$ given by equation $E = 200\sqrt{2}\ cos\ 50\ t.$ The r.ms value of current through the capacitor is**

   (a) 1 amp
   (b) 0.001 amp
   (c) 0.01A
   (d) 10 amp

7. **In a circuit containing an inductance of zero resistance the current leads the applied a.c voltages by a phase angle.**

   (a) $90°$ **(b)** $-90°$

   (c) $0°C$ **(d)** $180°$

8. **The average power dissipated in a pure capacitive a.c circuit is**

   (a) $\frac{1}{2}CV^2$

   (b) CV^2

   (c) $\frac{1}{4}.CV^2$

   (d) $zero$

9. **Energy needed to establish an alternating current I in a circuit of self induction L is**

   (a) $L\frac{dI}{dt}$

   (b) $zero$

   (c) $\frac{1}{2}LI^2$

   (d) $\frac{1}{2}I\,L^2$

10. **A circuit has an inductions of $\frac{1}{\pi}H$ and a resistance of 2000 ohm. A 50 cycle a.c is applied to it. The impendence of the circuit is**

    (a) $200\ \Omega$

    (b) $2000\ \Omega$

    (c) 2002.5Ω

    (d) 202.5Ω

11. **A 100 Hz alternating current is flowing in a coil of inductance 7mH. The reactance of the coil is**

    (a) $7\ \Omega$ **(b)** $100\ \Omega$

    (c) 44Ω **(d)** 4.4Ω

12. **An A.C voltage $E = 200\sqrt{2}$ $sin\,100\,t$ is connected in a circuit containing an a.c. ammeter and a capacitor of capacitance 1 μF . The reading of the ammeter is :**

    (a) 2A **(b)** 0.02A

    (c) 20A **(d)** 40A

13. **If E represents the peak value of voltage in an ac current the rms value of voltage will be.**

    (a) $\frac{E}{\pi}$ **(b)** $\frac{E}{2\pi}$

    (c) $\frac{E}{\sqrt{2}}$ **(d)** $\frac{E}{2}$

14. **An alternating current cannot be measured by D.C ammeter because**

    (a) A.C changes direction.

    (b) A.C. cannot pass through D.C ammeter

    (c) Average value of current for complete cycle is zero .

    (d) D.C ammeter will be damaged.

15. **A coil has a resistance of 8Ω and inductive reactance of 6Ω. The impedance of coil is**

    (a) $10\ \Omega$

    (b) 8Ω

    (c) 6Ω

    (d) 14Ω

16. **In A.C circuit containing inductance and capacitance in series. The current is found to be maximum when value of induction is 0.5 H and capacitance is $8\mu F$. The angular frequency of input A.C is**

    (a) 500 **(b)** 5×10^4

    (c)5000 **(d)** 4000

17. **The primary coil of transformer has 500 turns and secondary has 5000 turns. The primary in connected to AC supply 20V, 50 Hz. The secondary, will have output of.**

    (a) 200V, 500Hz

    (b) 200 V 50 Hz

    (c) 2V, 50 Hz

    (d) 2V 5Hz

***

A-II
FILL IN THE BLANKS

1. **A choke coil works on the principle of _____**
2. **The rms value of A.C. voltage whose peak value is 100V is ____ volt.**
3. **A choke coil has _____inductance and low resistance**
4. **In a given L,C,R, circuit the angle of lag between emf and circuit current will be ____**
5. **If an a.c. of 50Hz is flowing through a conducting wire the current becomes zero ____ times in one second.**
6. **A coil of inductance 10mH and capacitance $100\mu F$ form a resonant circuit. The resonant frequency of the circuit is ___Hz.**
7. **In an A.C. circuit, the potential difference across a capacitance ___ the current by $\frac{\pi}{2}$**

8. **A pure inductive coil has _____ resistance.**
9. **With increase in frequency of an ac supply the inductive reactance ____**
10. **The ratio of the mean value over half cycle to the rms value of an A.C is ____**
11. **AC ammeters work on the principle of___ effect of electric current.**
12. **The power factor in an ac circuit in the ratio of resistance to ____.**
13. **The power factor of a pure inductive circuit is ____**
14. **A transformer works on the principle of _____ induction**
15. **A capacitor stores energy in its ____ field.**
16. **An inductor stores energy in its____ field.**
17. **The phenomenon of _____ is used while tuning a radio.**
18. **For a purely resistive circuit the power factor is _____**
19. **The energy stored in an inductor L carrying current I is ____.**
20. **In a series LCR circuit at resonance the impedance of the circuit is ____.**

***

A-III

ANSWER IN ONE WORD/ SENTENCE

1. **What is the mean value of an A.C over one complete cycle.**
2. **Write the relation between peak value V_0 and rms value V_{rms} of alternating voltage.**
3. **Give two examples of circuits in which wattles current will flow.**
4. **What is the magnitude of inductive reactance for direct current.**
5. **What is the magnitude of capacitive reactance for direct current.**
6. **How many times the direction of alternating current changes in one complete cycle ?**

7. **What is the value of impedance in series LCR circuit at resonance.**

8. **If E_{rms} is the rms value of alternating voltage what is its peak to peak value?**

9. **Name an element that blocks dc but bypasses ac.**

10. **What is the frequency of ac mains in India.**

***

SECTION -B

EACH QUESTION CARRIES 2 MARKS.

1. **Define rms and peak value of alternating voltage and state the relation between them.**

2. **Why is ac more dangerous than dc of the same voltage.**

3. **Ac cannot be measured by moving coil galvanometer why ?**

4. **A bulb and a solenoid are connected in series to an a.c source. If a soft – iron core is inserted inside the solenoid what will be its effect on the intensity of light giving out by the bulb.**

5. **Write the expression for pure inductive reactance in an ac circuit and explain how it depends on the frequency of a.c. What is its unit.**

6. **Write the expression for pure capacitive reactance in an ac circuit and explain how it depends on the frequency of a.c. What is its unit.**

7. **Why a capacitor blocks dc ?**

8. **In order to reduce the current in ac circuit, an inductor is more suitable than a resistor . Why ?**

9. **What is meant by resonance in a series LCR circuit**

10. **What is Wattles current?**

11. **A transformer works with a c supply but not with dc why ?**

12. **Why laminated core is used in transformer ?**

13. **What is hysteresis loss in transformer . How it is minimized ?**

14. **What is iron loss and copper loss in transformer ? how are they reduced.**

15. **In a transformer $N_1 = 50, N_2 = 500, I_1 = 5A, 50Hz$ then find out magnitude and frequency of current I_2 in secondary coil.**

16. **Draw graphs to show variation of X_L with f and with L.**

17. **Draw graphs to show variants on of X_c with f and with C.**

18. **Plot a graph showing variation of impedance of a series LCR circuit with frequency. On what factors the resonant frequency depend.**

***

SECTION-C

LONG QUESTION

1. **What do you mean by root mean square value of ac. Obta#in an expression for it.**

2. **Describe the construction and theory of working of a transformer.**

3. **Draw impedance triangle of a series LCR circuit and find out the impedance and current in the circuit when $X_L > X_C$**

***

ANSWERS

A-I

MCQ

1. b.
2. d.
3. c.
4. c.
5. d.
6. c
7. b.
8. d.
9.
10. c.
11. d.
12. b.
13. c
14. c.
15. a
16. a
17. b

***

A-II

FILL IN THE BLANKS

1. Wattles current
2. $50\sqrt{2}$
3. High
4. $\tan^{-1}\frac{\omega L-\frac{1}{wc}}{R}$
5. 100
6. $\frac{500}{\pi}$
7. Bgs
8. Zero
9. Increases
10. $2\sqrt{2}:\pi$
11. Heating
12. Impedance
13. Zero
14. Mutual
15. Electrostatic
16. Magnetic
17. Resonance
18. One
19. $\frac{1}{2}LI^2$
20. R

A-III

1. Zero
2. $V_{rms} = .637\, V_0$
3. Pure inductive

   pure capacitive
4. Zero
5. Infinity
6. Two times
7. R
8. $2\sqrt{2}\, E_{rms}$
9. Capacitor
10. $50Hz$

***

SECTION– B

1. Def^n. $V_{Peak\ Value} = \sqrt{2}\ V_{rms}$
2. Max value of alternative emf $= \sqrt{2}$ times rms value A 220V ac means its rms value of ac volt is 220v. Sop peak value = $\sqrt{2} \times 220 = 311.13V$
3. Ac does not show magnetic effect. Average deflecting couple is zero .
4. Intensity of the light of the bulb will decrease. Introducing soft iron core in solenoid its inductance increases. So inductive reactance WL increases. So net impedance of circuit increase. Current in circuit will decrease.
5. $X_L = 2\pi fL \quad X_L \propto f, ohm$
6. $X_C = \frac{1}{2\pi fC}\ X_c \propto \frac{1}{f}, ohm$
7. $fw\ dc\ f = 0,\ X_c = \frac{1}{2\pi fc} \to \infty$
8. If resistor used a part of electrical energy is lost in the form of heat if inductor is used, there is no energy loss in the form of heat because the power factor of inductive component is zero

   $\bar{P} = I_{rms}\ V_{rms} \times Poswer\ factor$

   $= I_{rms} \times V_{rms} \times \cos\emptyset$

   $\emptyset$ = phase difference

   In L, $\emptyset = 90°$ so $\cos\emptyset = 0$
9. In series LCR when voltage and current are in same phase, the impedance of circuit is minimum and the circuit current in maximum – The

situation is called resonance. It occurs at frequency $f = \frac{1}{2\pi\sqrt{LC}}$

10. In ac circuit when average consumed power is zero the current is called wattles.

$\bar{P} = V_{rms}\ I_{rms} \cos\emptyset$ $\emptyset$ is phase diff. between emf z current in pure inductive z pure capacitive circuits $\emptyset = \frac{\pi}{2}$

11. Principle of transformer – natural induction

12. To reduce energy loss due to eddy current

13. Magnitisation of iron core during one half and damagnetistion in next half of ac takes place core retains magnetic energy – hysteresis loss. Minimized by soft iron core which has thin hysteresis loop.

14. Iron Loss – Eddy currents set up in core – heat minized by taking laminated core.

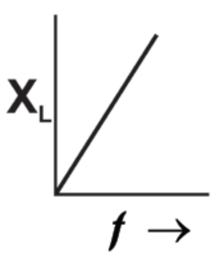
Copper loss - heat loss due to resistance of transformer coils

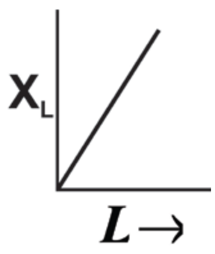
Reduced by taking thick coils in transformer

15. $\frac{I_1}{I_2} = \frac{N_2}{N_1}$ $\frac{5}{I_2} = \frac{500}{50} \Rightarrow I_2 = \frac{5\times50}{500} = 0.5A$

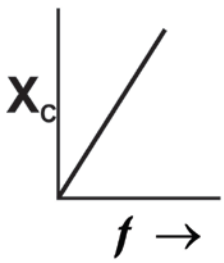
frequency remains same 50Hz

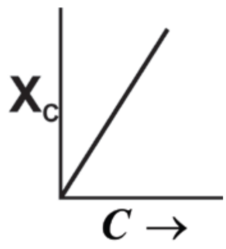
16.



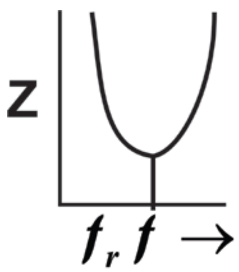


17.





18.



f_r depends on L and C $f_r = \frac{1}{2\pi\sqrt{LC}}$

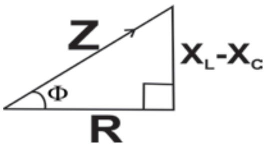
SECTION –C

HINTS TO ANSWER

1. $I_{rms} = \frac{I_0}{\sqrt{2}}$

2. $\frac{V_2}{V_1} = \frac{I_1}{I_2} = \frac{N_2}{N_1}$

3.



$$Z^2 = R^2 + (x_2 - x_c)^2 \quad \tan \emptyset = \frac{x_2 - x_c}{R}$$

$$Z = \sqrt{R^2 + (x_L - x_C)^2}$$

$$I_0 = \frac{E_0}{Z} \; I = \frac{E_0}{Z} \sin(\omega t - \emptyset)$$

***

CHAPTER EIGHT

ELECTROMAGNETIC WAVES

A-I
MCQ

1. **Electromagnetic waves are**
   (a)longitudinal wave
   (b) transverse wave
   (c)may be longitudinal or transverse
   (d) none of these

2. **Electromagnetic waves travel with velocity of**
   (a) $3 \times 10^{10} m/s$
   (b)$3 \times 10^{6} m/s$
   (c)3×10^{8}m/s
   (d)332m/s

3. **In an electromagnetic wave the electric and magnetic fields are**
   (a) parallel to each other
   (b) perpendicular to each other
   (c)inclined at acute angle
   (d) inclined at obtuse angle

4. **Which of the following does not support the wave nature of light ?**
   (a) interference
   (b) diffraction
   (c)polarization
   (d) photoelectric effect

5. **Reflection of radio waves takes place from**
   (a) stratosphere
   (b) troposphere
   (c)ionosphere
   (d) mesosphere

6. **The process of mixing sound wave with carriers waves is called**
   (a) modulation
   (b) demodulation
   (c) amplification
   (d) rectification

7. **Which of the following waves are used for sterilizing foods and utensils ?**
   (a) microwave
   (b) X-ray
   (c)γ-ray
   (d) ultraviolet wave.

8. **Bolometers are used to detect the following waves.**
   (a) microwave
   (b) X-ray
   (c)γ-ray
   (d) infrared ray.

9. The frequency of electromagnetic wave used for radio transmission as compared to that of visible region is:

(a)larger

(b)smaller

(c)may be larger or smaller

(d)same

10. An electromagnetic wave of wavelength $5 \times 10^{-5} cm$ lies in the region.

(a) Gamma ray

(b) ultraviolet

(c) visible

(d) infra red

11. Which wave would you prefer for transmission of radio signals ?

(a)infrared wave

(b) waves longer than infrared

(c)waves shorter than infra red

(d) X-rays

12. Which of the following waves are used for radio communication?

(a) long waves

(b) micro waves

(c) ultraviolet rays

(d) standard broadcasting waves

13. If value of electric field intensity is E and the value of magnetic field intensity is B then the value of velocity of waves is given by the relation.

(a) $V = \frac{B}{E}$

(b)$V = \frac{E}{B}$

(c)$V = EB$

(d)$V = \sqrt{EB}$

14. The wave that cause sunburn is

(a)radio wave

(b) infrared

(c)ultraviolet

(d) visible

15. Which ray is used in radio therapy?

(a) infrared

(b) ultraviolet

(c) γ-ray

(d) X-ray

16. Which wave has high penetrating power ?

(a) infrared

(b) ultraviolet

(c)microwave

(d) X-ray

17. Velocity of electromagnetic wave is

(a) $\mu_0 \varepsilon_0$

(b)$\frac{1}{\mu_0 \varepsilon_0}$

(c)$\sqrt{\mu_0 \varepsilon_0}$

(d)$\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

18. Frequency of long waves are

(a) $10^5 Hz$

(b) $10^3 Hz$

(c) $50\ Hz$

(d) $10^{-3} Hz$

19. Which of the following waves are existing in A.C. power lines ?

(a) X-ray

(b) γrays

(c) long waves

(d) infrared rays

20. If frequency of an electromagnetic wave is 50 MHz, then its wavelength is

(a) 12m **(b)** 6m

(c) 120m **(d)** 60m

21. If electric field amplitude of an electromagnetic wave is $E_0 = 120$ N/C then its magnetic field amplitude is

(a) $4 \times 10^{-6} T$

(b) $4 \times 10^{-7} T$

(c) $4 \times 10^{-8} T$

(d) $4 \times 10^{-9} T$

22. The amplitude of the magnetic field part of a harmonic electromagnetic wave in vacuum is $B_0 = 420\ nT$. Then amplitude of the electric field part of the wave is.

(a) $126\ Vm^{-1}$

(b) $12.6\ Vm^{-1}$

(c) $1260\ Vm^{-1}$

(d) $1.26\ Vm^{-1}$

23. The electric field part of an electromagnetic wave in vacuum is

$$\boldsymbol{E = \left[3\frac{N}{C}\cos\left\{\left(1.8\frac{rad}{m}\right)y + \pi \times 10^8\frac{rad}{s}t\right\}\right]\hat{\imath}}$$

The wavelength of wave is

(a) $18m$

(b) $12m$

(c) $9m$

(d) $6m$

24. The order of energy in the visible radiation is

(a) $10^3 eV$ **(b)** $10^0\ eV$

(c) $10^{-3} eV$ **(d)** $10^{-6} eV$

25. If $\lambda_m T = 0.29\ cm\ K$, the characteristic temperature of the 5800 $\dot{A}$ is

(a) $2500\ K$

(b) $5000\ K$

(c) $1000\ K$

(d) $500\ K$

26. Wavelength of $10\ m$ belongs to

(a) visible radiation
(b) infrared rays
(c) microwaves
(d) radio waves

27. A wave has a wavelength of 0.003 mm and electric field associated with it has an amplitude of $30\ Vm^{-1}$. The ratio of amplitude to frequency of oscillation of the magnetic field is

(a) 10^{18} (b) 10^{4}
(c) 10^{-4} (d) 10^{-18}

***

A-II

FILL IN THE BLANKS

1. **Ozonosphere absorbs ______ rays.**
2. **If in an electromagnetic wave the electric vector is along x – direction, magnetic vector is along y – direction then the direction of propagation of wave is along ____**
3. **The electromagnetic wave is a ____ wave**
4. **The colour of visible light depends on its ____**
5. **The waves having frequency of the order of mega hertz are called as ____**
6. **____ em. waves are used for treatment of cancer.**
7. **In television signal we use ____e.m. wave.**

***

A-III

WRITE ANSWER IN ONE WORD / SENTENCE.

1. **Write wavelength range of visible light.**
2. **Which of the following has the lowest frequency microwaves, ultraviolet rays and x-rays ?**
3. **Arrange the following e.m. waves in ascending order of their wavelength.**

   Microwaves, Gamma rays, Radio waves, Ultraviolet rays
4. **What is the order of the wavelength of X rays**
5. **Which waves are used as signals through fog and why ?**
6. **Dim red light is used in film developing room why ?**
7. **Optical and radio telescopes are used in earth but X-ray telescopes are in space, why ?**

***

ANSWERS

A-I

1. b.

2. c.

3. b.

4. d.

5. c.

6. a.

7. d.

8. d.

9. b.

10. c.

11. b.

12. b.

13. b.

14. c.

15. d.

16. d.

17. d.

18. c.

19. c.

20. b.$\left(\because \lambda = \frac{c}{f} = \frac{3\times10^8}{50\times10^6} = 6m\right)$

21. b.$\left(\because B_0 = \frac{E_0}{C} = \frac{120}{3\times10^8} = 4\times10^{-7}T\right)$

22. a.($\because E_0 = CB_0 = 3\times10^8 \times 420 \times$ *10−9=126 Vm−1*

23. d.$\left(\because \lambda = \frac{c}{f} = \frac{2\pi c}{\omega} = \frac{2\pi\times3\times10^8}{\pi\times10^8} = 6m\right)$

$E = E_0\, cos\,(k\,y + wt)$

24. b.$\left(\because E = \frac{hc}{\lambda} = \frac{6.62\times10^{-34}\times3\times10^8}{6620\times10^{-8}} = \right.$ *1.6×10−19×1*

25. b.$\left(\because T = \frac{0.29\ cm\ K}{5800\,A^\circ} = \frac{0.29}{5800\times10^{-8}} = \right.$ *5000K*

26. d.

27. d.($f = \frac{C}{\lambda} = \frac{3\times10^8}{3\times10^{-3}} = 10^{11}Hz, B_0 = \frac{E_0}{C} = \frac{30}{3\times10^8} = 10^{-7}T$)

***

A-II

FILL IN THE BLANKS

1. Ultraviolet
2. Z-direction
3. Transverse
4. Wavelength
5. Radios waves
6. Gamma
7. Radio waves

A-III

1. 400nm to 800nm
2. Microwaves
3. Gamma, UV, MW, radiowaves
4. $1A^0$ to 100 A^0
5. Infrared because its wavelength is greater and hence scattering is least.
6. The energy of photons of red light is less therefore it does not affect the films.
7. Visible rays and radio waves are not absorbed by atmosphere of Earth while x –rays are absorbed. Therefore X-ray telescope can be used only in space where there is no atmosphere to absorb.

***

CHAPTER NINE

RAY OPTICS

Chose the correct answer out of the four probables.

1. **The focal length of a lens of power 5 diopter is**
   (a) 25 cm
   (b) 10 cm
   (c) 2.5 cm
   (d) 20cm.

2. **The minimum distance between an object and its real image is**
   (a) 2f
   (b) 5f
   (c) 4f
   (d)f/2

3. **Power of a lens of focal length 10cm is**
   (a) 0.1D
   (b) 10D
   (c) 0.01D
   (d) 1D

4. **A thin convex lens and thin concave less each of focal length 20cm. are place in canted The effective focal length of the combination is**
   (a) 80cm **(b)** 10cm
   (c) 20cm **(d)** ∞

5. **A well cut diamond appears bright due to**
   (a) refection
   (b) scattering
   (c) total interned reflection
   (d) None of these

6. **Critical angle of light passing from glass to air is maximum for**
   (a) red **(b)** green
   (c) yellow **(d)** violet

7. **Inside water an air bubble beavers like a**
   (a) Convex laws
   (b) concave laws
   (c) glass plate
   (d) none of these

8. **The speed of light in air is 3×10^8 m/s .What will be its speed in diamond whose refractive indux is 2.4**
   (a) $3 \times 10^8 \frac{m}{S}$
   (b) $332 \frac{m}{S}$
   (c) $7.2 \times 10^8 \frac{m}{S}$
   (d) $1.25 \times 10^8 \frac{m}{S}$

9. **In optical fibres which of the following principles is used.**
   (a) scattering
   (b) refection
   (c) total internal reflection
   (d) none of these

10. **It is possible to observe total internal reflections when a ray travels from.**
   (a) air into water
   (b) air into glass
   (c) water into glass
   (d) glass into water

11. **Refractive index of glass is greatest for**
   (a) violet colour
   (b) red colour
   (c) yellow coloru
   (d) green colour

12. **The image formed by a simple microscope is**
   (a) real and erect
   (b) real and inverted
   (c) virtual and erect
   (d) virtual and inverted.

13. **The image formed by a compound microscope is**
   (a) real and invited
   (b) virtual and inverted
   (c) virtual and erect
   (d) real and erect.

14. **Which of the following is an expression for magnifying power of a simple microscope ?**
   (a) $\frac{D}{f}$ **(b)** $\frac{f}{D}$
   (c) $1+\frac{D}{f}$ **(d)** $1+\frac{f}{D}$

15. **The least distance of distinct vision is**
   (a) 15 cm **(b)** 10 cm
   (c) 25 cm **(d)** 35 cm

16. **The magnification of a telescope is**
   (a) $fo+fe$
   (b) $fo \times fe$
   (c) $\frac{fo}{fe}$
   (d) $\frac{fe}{fo}$

17. **At sunrise and sun set, the sun appears red because**
   (a) the sun is coldest at these times
   (b) the sun is hottest at these times
   (c) of scattering of light
   (d) of the effect of reflection

18. **When a beam of red light is reflected by a prism at minimum deviation the angle of incidence is**
   (a) smaller then angle of emergence.
   (b) greater than angle of emergence.
   (c) Equal to angle of emergence.
   (d) None of these

19. **A ray of light falls as a prism of $\mu = \sqrt{2}$ with angle of prism as 60° and suffers minimum diviation. The angle of incidence for the ray is**

(a) 90°

(b) 45°

(c) 60°

(d) 30°

20. **Blue colour of the sky is due to**

(a) Red light is absorbed

(b) Blue light is scattered

(c) Blue light is absorbed

(d) It is the natural colour

21. **In absence of the atmosphere, sky will appear**

(a) red

(b) blue

(c) dark

(d) white

22. **Mirages are formed in a desert due to**

(a) interference

(b) diffraction

(c) dispersion

(d) total internal reflection.

23. **What is the focal length of a double convex lens for which radius of curvature of each suface is 40cm ($\mu = 1.5$)**

(a) 50cm **(b)** 40cm

(c) -30cm **(d)** -40cm

24. **A convex lens is dipped in a liquid of refractive index same as that of the material of the lens . The lenses behaves as**

(a) convergent lens

(b) divergent lens

(c) glass plate

(d) prism

***

A-II

FILL IN THE BLANKS

1. **The phenomenon of deviation in the path of light ray while entering form one optical medium to the other optical medium is called _______**

2. **The ratio of sine angle of incidence to the sine of angle of refraction is called as _______**

3. **If the path of light ray after multiple refractions is reversed then it retraces the path from which it came. This phenomenon is called______**

4. **The angle of incidence corresponding to which the angle of refraction becomes 90° is called as ____**

5. **The illusion of water in desert is called ____**

6. **In cold countries at the port the ship appears to be inverted in air. This illusion is called as _____**

7. **The device which is based on the total internal reflection through which the optical signal can be transmitted from one place to other place by a zig-zag path is___________.**

8. **The distance of pole from first principle focus is called ____**

9. **The ratio of angle of vision subtended by image to that subtended by object when object is kept at least distance of distinct vision is called _____ of microscope.**

10. **In a compound microscope the lens towards the object is called ____ and the lens towards the eye is called ____.**

11. **____ is an optical instrument with the help of which the fare distant object are seen.**

12. **With the help of ____ the astronomical bodies are seen.**

13. **With the help of ____ the far distant objects situated on earth are seen.**

***

A-III

ANSWER IN ONE WORD / ONE SENTENCE

1. **Which property remain unchanged in the phenomenon of refractions of light?**
2. **Which property get changed in the phenomenon of refraction of light ?**
3. **What are the conditions of total internal reflection ?**
4. **On which phenomenon optical fibre is depend ?**
5. **When the value of relative refractive index is less than one and more than one?**
6. **If a concave mirror and convex lens is dipped in water, what will be the changes in their focal lengths?**
7. **Can a lens be used in that medium from which it is made of ?**
8. **If an object is kept at focus of a concave lens where its image will formed ?**
9. **The power of which lens be positive?**
10. **The power of which lens is negative?**
11. **The power of a lens is more in water or in air ?**
12. **What is focal length and power of a rectangular slab of glass ?**
13. **Write the unit of Dispersive power.**
14. **Why sky is seen blue ?**
15. **When the light ray inside the prism is parallel ot the base of prism ?**
16. **Which microscope is used as reading lens?**
17. **The length of which telescope is more reflective or refractive telescope.**
18. **What is the nature of image in a simple microscope ?**
19. **What is the nature of final image formed in compound microscope ?**
20. **If the focal length of eye lens of a microscope is decreased then what will be the effect on its magnification?**
21. **If the focal length of objective lens of microscope and telescope is increased then what will be the effect in their magnifications ?**

***

SECTION –B

2 MARKS QUESTION

1. **A concave lens and a convex lens of same focal length is kept in contact. What will be the focal length and power of the combination ?**
2. **What do you mean by magnification ? write its formula**
3. **Draw ray diagram of image formation when an object is placed at focus of a convex lens.**
4. **A glass prism causes dispersion while a glass plate does not why ?**
5. **Sun appears red during the sunrise and sunset, why ?**
6. **Why does the light rays disperse through prism ?**
7. **What do you mean by angular dispersion ? Derive and expression for it. On "What factors does it depends?**
8. **How the magnifying power of an astronomical telescope is increased ?**
9. **Why the focal length of the objective of a compound microscope should be small ?**
10. **What is angle of minimum deviation. Draw i-D curve for a prism.**
11. **Calculate the critical angle when refractive index = $\sqrt{2}$**
12. **Find the critical angle of incidence at the glass $\left(n_g = \frac{3}{2}\right)$ and water $\left(n_\omega = \frac{4}{3}\right)$ interface.**
13. **Velocity of light in a medium is $15 \times 10^8\ m/s$. Calculate the refractive index of the medium.**
14. **Find the effective power and focal length of two lens of focal lengths 20cm and -100cm when placed in contact in air. What is the nature of combined lens.**
15. **A virtual erect and two times magnified image is formed on the same side of the lens as the object. The image is formed 15cm behind**

the object . What type of lens is used and find its focal length.

16. **Light rays are converging to a point O which is 10cm from point L. A convex lens of focal length 30cm is placed at L. Find the position of image.**

17. **Given $\mu_g = \frac{3}{2}, \mu_w = \frac{4}{3}$ if a convex glass lens of focal length 15cm is placed in water find its focal length is water.**

18. **An object is placed at a distance of 20cm from a convex lens of focal length 10cm. Find the position and nature of image.**

19. **An object in placed 20cm away from a concave lens of focal length 15cm . Find the position and nature of image.**

20. **The distance between an object and it real image is 60cm. Determine the nature and focal length of lens if the image is two times the size of object.**

***

SECTION –C

LONG QUESTION

1. **With a neat ray diagram discuss the working of a compound microscope. Derive expression for its magnifying power.**
2. **With a neat ray diagram show the refraction of light ray when incident on a prism of angle A. Derive the relation to show relation between refractive index of material of prism and angle of minimum deviation**
3. **Derive thin lens formula using a convex lens.**
4. **Derive expression for lens makers formula for a converging lens.**
5. **What is total internal reflection . Define critical angle and find its relation with refractive index of the medium.**

***

ANSWERS

A-I

MCQ

1. d
2. c
3. b
4. d
5. c
6. a
7. b
8. d
9. c
10. d
11. a
12. c
13. c
14. c
15. c
16. c
17. c
18. c
19. b
20. b
21. c
22. d
23. b
24. c

A-II

FILL IN THE BLANKS

1. refraction of light
2. refractive index
3. principle of reversibility
4. critical angel
5. desert mirage
6. cold mirage
7. optical fibre
8. focal length
9. magnifying power
10. objective lens, eyepiece
11. telescope
12. astronomical telescope
13. terrestrial telescope

***

A-III

In one word / sentence

1. frequency
2. velocity, wavelength and amplitude
3. (i) Angles of incidence should be more than critical angles.

   (ii) lights ray must enter form denser medium to rarer medium.
4. Total internal reflection.
5. Refractive index of rarer medium with respect to denser medium is less than one and refractive index of denser medium with respect to rarer medium is more than one.
6. The focal length of concave mirror will remain unchanged and that of convex lens will increase
7. No.
8. Image will be formed between focus and optical centre of the lens
9. Convex lens.
10. Concave lens
11. Air
12. f=infinity
13. $= \frac{1}{f} = \frac{1}{\infty} = 0$, Power is zero
14. It has no unit.
15. Sky is seen blue due to scattering of light
16. At angle of minimum deviation
17. Simple microscope
18. The length of refractive telescope is more.
19. Erect and larger than object.
20. Virtual, inverted and larger than object.
21. Its magnification will increase.
22. Magnifications of microscope will decrease and that of telescope will get increased.

***

SECTION –B

1. $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

$f_1 = -f \; and \; f_2 = f$

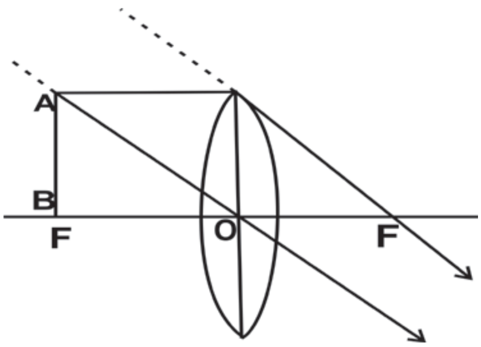
$\therefore \frac{1}{F} = -\frac{1}{f} + \frac{1}{f} = 0$

$or \; F = infinity$ and power

$p = \frac{100}{f} = \frac{100}{\infty} = 0$

2. The ratio of size of image to size of object is defined as magnifications, its formula is $m = \frac{1}{0} = \frac{v}{u}$

3. The image formed at infinity. Image is real and inverted.



4. When white light passes through a prism , it splits up into it constituent colors because refractive index of glass is different for different colours. The angular dispersion is $(\mu_y - \mu_R)$ A and angular deviation is $(\mu - 1)$ A where A is angle of Prism. The refracting faces of glass plate are parallel, so A=0. Hence, there is neither dispersion nor deviation. All the emergent rays are parallel to incident ray and do not split into colours.

5. Sunlight has to travel through the longer distance at the time of sunset and sunrise meanwhile almost all the coloured light waves get scattered except red as it wavelength is more. It is unable to scatter due to atmospheric molecules. Therefore; only red light rays reach our eyes and sun appears red.

6. White light consists of continuous range of wavelength. Refractive index of prism material is different for different colours and given by Cauchy realtion.

$\mu = a + b/\lambda + c/\lambda z$

Where a.b and c are constants. For small angle of prism, the angle of deviation is given by

$\delta = (\mu - 1)A \Rightarrow \delta \propto \mu$

Now,

$\lambda_{red} > \lambda_{violet}$

$\therefore \mu_{red} > \mu_{violet}$

$\therefore \delta_{red} > \delta_{violet}$

$i.e,$ the red colour is deviated less than the violet colour. Other colours are deviated by intermediate angles. So, different colours of white light get dispersed on refraction through prism.

7. The angle dispersion is defined as difference between angle of deviations for any two colurs. If angle of deviations for red and violet colours are δ_r and δ_v respectively then, Angular dispersion $\theta = \delta_v - \delta_r$

$\therefore \delta_v = A(\mu_v - 1), \delta_r = A(\mu_r - 1)$

$\theta = A(\mu_v - 1) - A\ (\mu_r - 1)$

Or $= \theta = A\ (\mu_v - \mu_r)$

This is the required expression for angular dispersion θ depends on :

1. Angle of prism (A) : with increase in A, θ increase.
2. Material of prism : when increase in 'μ' θ also increases.

8. The magnifying power of an astronomical telescope is given by

$m = -f_0/f_e$

Hence for greater magnifying power of the value f_0, i.e. focal length of eye lens should be small.

9. The magnifying power of a compound microscope is given by $m = \left(\frac{v_0}{u_0}\right)\left(\frac{1+d}{f_e}\right)$

For greater magnifying power U_0 should be smaller, but the object should be placed out of the

10. It has been found by the experiments that the value of angle of deviation depends of the angle of incidence. As the value of angle of incidence is increased, the value of angle of deviation decrease. For a particular value of angle of incidence the angle of deviation becomes minimum, further if the value of angle of incidence is increased, then the value of angle of deviation increases. The minimum value of angle of deviation is called angle of minimum deviation.

11. Since $= \frac{1}{n} = \frac{1}{2},\ c = 30°$

12. $n_g > n_w$ so incidence is from glass medium, where angle of incidence is

C and L of refraction in water medium =90°

$$n_g\ Sin\ C = n_w \sin 90°$$

$$\sin c = \frac{n_w}{n_g} = \frac{4\times 2}{3\times 3} = \frac{8}{9}$$

$$\Rightarrow c = \sin\frac{-18}{9} = 62.74°$$

13. $n = \frac{c}{v} = \frac{3\times10^8}{1.5\times10^8} = 2$

14. $f_1 = 20cm\ f_2 = -100cm \frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{20} - \frac{1}{100} = \frac{4}{100} = \frac{1}{25}$

$\boxed{F = 25cm}$ powr $= \frac{100}{fcm} = \frac{100}{25} = 4D$

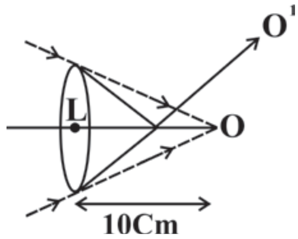
Combined lens with $F = 25cm\ P = 4D$ behave an converging lens.

15. Virtual, erect, magnified, same side as object image only in $\boxed{convex}$ lens $m = 2 = \frac{v}{u} \Rightarrow v = 24$

$$v = -u - 15 \Rightarrow 2u = -u - 15\quad u = 5cm\ v = -10cm$$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{10} - \frac{1}{-5} = \frac{1}{5} - \frac{1}{10} = \frac{1}{10} \Rightarrow \boxed{f = 10cm}$$

16.



$u = +10cm$

$f = +30cm$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{30} + \frac{1}{10} = \frac{4}{30}$

$\boxed{v = 7.5cm}$

17. $\frac{f_{an}}{f_a} = \frac{(\mu_g - 1)}{\left(\frac{\mu_g}{\mu_m} - 1\right)} = \frac{\frac{3}{2}-1}{\left(\frac{\frac{3}{2}}{\frac{4}{3}}-1\right)} = \frac{\frac{1}{2}}{\frac{9}{8}-1} = \frac{\frac{1}{2}}{\frac{1}{8}} = 4$

$$f_{medium} = f_w = 4\times f_a = 4\times 15cm = 60cm$$

18. $u = -20cm\ v = ?\ f = +10cm$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$\frac{1}{10} = \frac{1}{v} - \frac{1}{-20} \Rightarrow \frac{1}{v} = \frac{1}{10} - \frac{1}{20} = \frac{1}{20}$

$\boxed{v = 20cm.}$

$$m = \frac{v}{u} = \frac{20}{20} = 1$$

Image formed at 20cm on other side of lens. It is real inverted and of same size of object.

19. $u = -20cm$

$f = -15cm$

$v = ?$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow -\frac{1}{15} = \frac{1}{v} - \frac{1}{-20}$

$\Rightarrow \frac{1}{v} = -\frac{1}{5} - \frac{1}{20} = \frac{-7}{60}$

$v = \frac{-60}{7} cm = m = \frac{v}{u} = \frac{3}{7} < 1$

$v = -ve$ meand image is on same side as object so it is virtual, m<1so it is diminished and erect.

20. Lens – convex which produce real image given $|u| + |v| = 60cm,\ v = 2u$

So $3u = 60\ |u| = \boxed{20cm}$

$$u = -20cm$$

$$v = 40cm$$

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} = \frac{1}{40} - \frac{1}{-20} = \frac{1}{40} + \frac{1}{20} = \frac{3}{40}$

$\boxed{f = \frac{40}{3} cm}$

***

CHAPTER TEN

(WAVE OPTICS)

MULTIPLE CHOICE QUESTIONS (MCQ)

1. Two sources of waves are called coherent if

(a) Both waves same amplitude of vibration.

(b) Both produce waves of same wave length.

(c) Both produce waves of same wavelength and having a constant phase difference.

(d) Both produce waves having same velocity.

2. In Young's double slit experiment, the separation between the slits is waved. Thus the fringe with

(a) Remains same

(b) Becomes double

(c) Is halved

(d) Is quadrupled

3. The phenomenon of interference can take place

(a) In all waves

(b) In transverse wave only

(c) In longitudinal wave only

(d) In standing waves only.

4. Which of the following is the condition of bright fringes?

(a) $X = 2n.\frac{\lambda}{2}$

(b) $X = (2n+1)\frac{\lambda}{2}$

(c) $X = 2n.\frac{\lambda}{3}$

(d) $X = (2n+1)\frac{\lambda}{3}$

5. Which of the following is the condition of dark fringes?

(a) $X = 2n.\frac{\lambda}{2}$

(b) $X = 2n.\frac{\lambda}{3}$

(c) $X = (2n+1)\frac{\lambda}{3}$

(d) $X = (2n+1)\frac{\lambda}{2}$

6. Which of the following does not support the wave native of light?

(a) Interference

(b) Diffraction

(c) Polarisation

(d) Photoelectric effect

7. Light has the following wave property

(a) Transverse

(b) Longitudinal

(c) Either transverse or longitudinal

(d) None of the above.

8. In Young's double slit experiment, the separation between the slits is halved and the distance between the screen and slits is doubled, the fringes width is

(a) Unchanged

(b) Halved

(c) Doubled

(d) Quadrupled

9. When viewed in white light, soap bubble shows colour because of

(a) Interference

(b) Scattering

(c) Diffraction

(d) Dispersion

10. In Young's double slit experiment, the fringes width is

(a) $\frac{\lambda d}{D}$ **(b)** $\frac{d}{\lambda D}$

(c) $\frac{D}{\lambda d}$ **(d)** $\frac{\lambda D}{d}$

11. Phase difference between two points on a wave front is

(a) 2π

(b) π

(c) $\frac{\pi}{2}$

(d) 0

12. The amplitude ratio of the superimposing waves 2:1. The ratio of maximum and minimum intensities is

(a) 1:1

(b) 2:1

(c) 4:1

(d) 9:1

13. In Young's experiment the ratio of maximum and minimum intensities in the fringes system is 9:1. The ratio of amplitude of coherent sources is

(a) 9:1

(b) 3:1

(c) 2:1

(d) 1:1

14. A light ray is inclined to the wave front at an angle.

(a) 0

(b) $\frac{\pi}{2}$

(c) Acute angle

(d) Obtuse angle.

15. A beam of light coming parallel to itself from infinity has a wave front which is

(a) Spherical **(b)** Cylindrical

(c) Plane **(d)** None of these

16. Two waves have their intensities in the ratio 25:9. The ratio of intestines of maxima and minima is

(a) 64:4 **(b)** 34:16

(c) 25:9 **(d)** 8:2

17. Transverse nature of light is depicted by

(a) Polorisation

(b) Reflection

(c) Interference

(d) Diffraction

18. In Young's double slit experiment, the maximum intensity is I_0. Which one slit is closed, the intensity becomes.

(a) $\frac{I_0}{2}$ **(b)** $\frac{I_0}{8}$

(c) $\frac{I_0}{4}$ **(d)** I_0

19. In Young's double slit experiment the wave length of light $\lambda = 4 \times 10^{-7} m$ and separation between the slits is $d = 0.1 mm$. If the fringe width is 4mm, the separation between the slits and the screen is

(a) 100 mm

(b) 1m

(c) $10^6\ cm$

(d) 10Å

20. The phenomenon of interference follows

(a) Conservation of momentous

(b) Conservation of momentous and images

(c) Conservation of images

(d) Quentin native of light

21. In Young's double slit experiment the distance between the slits is gradually increased. The width of the fringes width.

(a) Increase

(b) Decreases

(c) Remains the same

(d) None of the above.

22. In Young's double slit experiment, if a thin glass plate is placed in the path of one of the interfering beams then

(a) Fringe width decreases

(b) Fringe width increases

(c) Fringe pattern is shifted

(d) Fringe pattern is unfitted

23. In a biprism arrangement is air is immersed completely in a liquid. The fringes width

(a) Remains same

(b) Increases

(c) Decreases

(d) None of the above

24. The penetration of light into the region of geometrical shot on is called

(a) Polarization

(b) Interference

(c) Diffraction

(d) Refraction

25. In Young's experiment fringe width was found to be 4mm. The whole apparatus is immersed in volts of refraction index $\left(\frac{4}{3}\right)$. The fringe width becomes.

(a) 0.25mm

(b) 0.30mm

(c) 0.40mm

(d) 0.53mm

***

A-II

Fill in the blanks

1. **In young's double slit experiment the intensity of the central bright spot is _______ times the individual intensities of the interfering waves .**

2. **Two waves having same wavelength and amplitude but having constant phase difference with time are known as ______.**

3. **A plane wavefront is produced if the source is at _______.**

4. **The shape of wavefront coming from a point source of light is ____**

5. **In Young's double slit experiment, the green light is replaced by red light then the fringe width will _______**

6. **The source of plane wavefront is at_____**

7. **Interference of two beams of white light produce _____ fringes.**

8. **_____ is the locus of the particles of medium that are in same medium of vibration.**

9. **_____ of wave does not change when a light wave moves from one medium to another.**

10. _____ **is the separation between two consecutive bright or consecutive dark fringes.**

11. A ray of light is _____ **to the wavefront.**

12. For constructive interference the phase difference between the two interfering becomes has to be ____ **where** $n = 0, 1, 2, 3 \dots \dots$

13. Transverse nature of light can be proved by ______ **of light**

14. In Young's double slit experiment the separation between the slits is gradually decreased. The fringe width _____**.**

15. The distance between the slits and screen in Young's double slit experiment is gradually increased. Then the fringe width ____**.**

***

A-III

Answer in one word/sentence :

1. Write the relation between phase differences δ **path difference** Δx**.**

2. What is the phase difference between two point in the same wavefront ?

3. Which phenomenon of light favours the wave nature of light?

4. Which phenomenon of light shows that light bends at the corners of an obstacle.

5. Can interference be produced by light of candle?

6. Which phenomenon establishes the transverse nature of light.

7. If the path difference is quarter wavelength what is the phase difference.

8. What is the path difference between two interfering beams if destructive interference is observed at a point?

9. **Which phenomenon of light is the interference between secondary wavelets from the same wavefront?**

10. **In Young's double slit experiment the central maxima has an intensity of I_0. What is the intensity of central maxima if one of the slits is closed. ?**

***

SECTION-B

2 marks each Question

1. **In Young's double slit experiment the slit separation is 1mm and the screen is the distance D=1m. Monochromatic light of wavelength 5000Å is used. Find out the distance of the third dark fringe from the central bright fringe.**

2. **In Young's double slit experiment d=0.8mm and D=1.0m. The second dark fringe is at a distance of 1mm from the central bright fringe. What is the fringe width.**

3. **In Young's double slit experiment if separation between slits is reduced to fifty percent and the distance between the slits and screen is increased to two hundred percent find out the relation between new fringe width w width original fringe width w_0**

4. **The intensity of two superposing waves are $4I_0$ and I_0 . The intensity of the bright fringe is $7I_0$. Find out the phase difference between the two superposing waves.**

5. **Determine waves angle of polorisation glass medium of light waves from air to glass. Refractive index of glass = 1.5.**

6. **What glass is the path difference between two particles in the medium that differ in phase by 60^o.**

7. **The fringe width obtained in a Young's double slit experiment is 0.25cm. If the apparatus in immersed in a liquid of refractive index 4/3, find out the fringe width.**

8. **Distinguish between interference and diffraction.**

***

SECTION – C

Long Questions

1. **What is meant by interference of light . Describe Young's double slit experiment and derive expression for fringes width.**

2. **What are coherent source ? How are they obtained in Young's double slit experiment ? Write four conditions for sustained interference of light.**

3. **What is polarization of light? What is a plane polarized light state and briefly explain Brewster's Law.**

4. **What do you understand by diffraction of light. Explain diffraction due to a single slit.**

***

ANSWER KEY

SECTION –A

A-I

MULTIPLE CHOICE QUESTIONS (MCQ)

1. c
2. b
3. a
4. a
5. d
6. d
7. a
8. d
9. a
10. d
11. d
12. d
13. c
14. b
15. c
16. a
17. a
18. c
19. b
20. c
21. b
22. c
23. c
24. c
25. b

***

A-II

FILL IN THE BLANKS

1. 4
2. Coherent
3. Infinity
4. Spherical wavefrong
5. Increase
6. Infinity
7. Coloured
8. Wavefront
9. Frequency
10. Fringe width
11. Parallel
12. $2n\pi$
13. Polarization
14. Increases
15. Increases.

A-III

ONE WORD

1. $S = \frac{2\pi}{\lambda} \Delta x$
2. Zero
3. Interference/diffraction
4. Diffraction
5. No, not coherent
6. Polorization
7. $\frac{\pi}{2}$
8. $(2n \pm 1)\frac{\lambda}{2}$
9. Diffraction
10. $I_0/4$

***

SECTION-B

2 MARKS

1. $y = (2n+1)\frac{\lambda}{2}\frac{D}{d}$

Here $n = 2$ for 3rd dark fringe

So $y = 5\frac{\lambda}{2}\frac{D}{d} = \frac{5}{2} \times 5000Å \times \frac{1m}{10^{-3}m}$

$= \boxed{1.25 \times 10^{-3} m}$

2. $y = \frac{3\lambda}{2}\frac{D}{d} = 1mm$ fro second dark fringe. Fringe width $= \frac{D\lambda}{d} = \frac{2}{3}mm$

Ans.$\frac{2}{3}mm$

3. $w_0 = \frac{D\lambda}{d}$ $w = \frac{2D\lambda}{d/2} = \frac{4D\lambda}{d} = 4w_0$

4. $I = a_1^2 + a_2^2 + 2a, a_2 \cos\phi = 7I_0$

$a_1^2 = 4I_0,\qquad a_2^2 = I_0, a_1 a_2 = \sqrt{4\, I_0^v I_0}$

$= 2I_0$

So $7I_0 = 4I_0 + I_0 + 2.2I_0 \cos\phi$

$\cos\phi = \frac{1}{2} = \cos\frac{\pi}{3} \Rightarrow \boxed{\phi = \frac{\pi}{3}}$

5. $\theta_p = \tan^{-1}\frac{n_2}{n_1} = \tan^{-1}\frac{1.5}{1} = 57°$

6. $60° = \frac{\pi}{3} rad =$ phase diff. path diff

$= \frac{\lambda}{2\pi} \times \frac{\pi}{3} = \frac{\pi}{6}$

7. $w_{medium} = \frac{wair}{\mu} = \frac{.25cm}{\frac{4}{3}} = \frac{.75}{4} =$

$.1875cm$

8.

Interference	Diffraction
1. Superposition between two waves from two coherent sources.	1. Superposition between secondary wavelets of same wave front.
2. Fringe width is uniform.	2. Fringes have different widths.

CHAPTER ELEVEN

Dual Nature of Matter and Radiation

A-I

MCQ

Chose the correct answer out of the four probables.

1. **A particle is dropped from a height H. The de-Broglie wavelength of the particle as a function of height is proportional to**
   (a) H
   (b) $H^{1/2}$
   (c) H^0
   (d) $H^{-1/2}$

2. **The wavelength of a photon needed to remove a proton from a nucleus which is bound to the nucleus with 1 MeV energy is nearly.**
   (a) $1.2\ nm$
   (b) $1.2 \times 10^{-3} nm$
   (c) $1.2 \times 10^{-6} nm$
   (d) $1.2 \times 10^{1}\ nm$

3. **Consider a beam of electrons (each electron with energy E_0) incident on a metal surface kept in an evacuated chamber. Then**
   (a) no electrons will be emitted as only photons can emit electrons.
   (b) electrons can be emitted but all with an energy, E_0
   (c) electrons can be emitted with any energy, with a maximum of $E_0 - \phi$ (ϕ is the work function).
   (d) electrons can be emitted with any energy, with a maximum of E_0

4. **A charge q contains n electrons each of mass m. This charge is accelerated under a potential difference V. The speed acquired by the charge is .**
   (a) $\sqrt{\frac{2eV}{m}}$
   (b) $\sqrt{\frac{2qV}{m}}$
   (c) $\sqrt{\frac{2e}{mV}}$
   (d) $\sqrt{\frac{2q}{mnV}}$

5. **A photon with energy E is characterized by wavelength given by**
   (a) E/hc^2 **(b)** $\frac{Ec^2}{h}$
   (c) E/hc **(d)** $\frac{hc}{E}$

6. The photoelectric effect is described as the emission of electrons from the surface of a metal when :

(a) it is heated to a high temperature

(b) electrons of suitable velocity impinge on it

(c) light of suitable wavelength falls on it

(d) it is placed in a strong magnetic field.

7. Photoelectric effect was discovered by :

(a) Hertz

(b) Einstein

(c) Hallwachs

(d) Millikan

8. Photoelectric effect supports:

(a) Newton's corpuscular nature of light

(b) Huygen's wave theory of light

(c) Maxwell's electromagnetic theory of light

(d) Plank's quantum theory of light

9. The phenomenon of photoelectric effect was explained by:

(a) Planck

(b) Maxwell

(c) Einstein

(d) Bohr

10. Work function of a metal is :

(a) minimum energy required to free an electron from surface against Coulomb's forces.

(b) minimum energy required to free a nucleon

(c) minimum energy required to eject an electron from electronic orbit

(d) minimum energy to ionize an atom

11. Photoelectrons emitted from a metallic surface are those which are:

(a) present inside the nucleus

(b) are orbiting very near to nucleus

(c) are generated by the decay of neutrons within the nucleus

(d) free to move within inter atomic spacing

12. In photoelectric effect:

(a) light energy is converted into heat energy.

(b) light energy is converted into electric energy.

(c) light energy is converted into sound energy.

(d) electric energy is converted into light energy.

13. The momentum of a photon of wavelength λ is

(a) $h\lambda$ **(b)** h/λ

(c) λ/h **(d)** $h/c\lambda$

14. Einstein's photoelectric equation is :

(a) $hv = hv_0 + \frac{1}{2}mv^2$

(b) $hv_0 = hv + \frac{1}{2}mv^2$

(c) $hv = \frac{1}{2}mv^2$

(d) $2hv = hv_0 + mv^2$

15. The photoelectric effect is based on the law of conservation of:

(a) energy

(b) mass

(c) liner momentum

(d) angular momentum

16. The unit of Planck's constant h is that of :

(a) work

(b) energy

(c) liner momentum

(d) angular momentum

17. For light of wavelength 5000 Å the photon energy is nearly 2.5eV. For X-rays of wavelength 1 Å, the photon energy will be close to:

(a) $2.5\ /\ 5000\ \ eV$

(b) $2.5/(5000)^2 eV$

(c) $2.5 \times 5000\ eV$

(d) $2.5 \times (5000)^2\ eV$

18. In photoelectric effect, when photons of energy hv fall on a photosensitive surface (work function hv_0) electrons are emitted from the metallic surface with a kinetic energy. It is possible to say that:

(a) all ejected electrons have same kinetic energy equal to $hv - hv_0$

(b) the ejected electrons have a distribution of kinetic energy from zero to $(hv - hv_0)$

(c) the most energetic electrons have kinetic energy equal to hv

(d) all ejected electrons have kinetic energy hv_0

19. Einstein's photoelectric equation states that:

$\boldsymbol{E_k = hv - W}$,

In this equation E_k refers to :

(a) kinetic energy of all ejected electrons

(b) mean kinetic energy of emitted electrons

(c) minimum kinetic energy of emitted electrons

(d) maximum kinetic energy of emitted electrons

20. The rest mass of a photon of wavelength λ is :

(a) $zero$ **(b)** $\frac{h}{c\lambda}$

(c) $\frac{h}{\lambda}$ **(d)** $\frac{hc}{\lambda}$

21. The dynamic mass of a photon of wavelength λ is :

(a) $zero$ (b) $\frac{h}{c\lambda}$

(c) $\frac{h}{\lambda}$ (d) $\frac{hc}{\lambda}$

22. In photoelectric effect, the number of photoelectrons emitted is proportional to:

(a) intensity of incident beam

(b) frequency of incident beam

(c) velocity of incident beam

(d) work function of photocathode

23. The threshold frequency of potassium is $3 \times 10^{14}\ Hz$. The work function is :

(a) $1.0 \times 10^{-19}\ J$

(b) $2 \times 10^{-19} J$

(c) $4 \times 10^{-19} J$

(d) $0.5 \times 10^{-19} J$

24. The threshold wavelength for photoelectric emission from a material is 5200 $A°$. Photoelectrons will be emitted when this material is illuminated wit h monochromatic radiation from a :

(a) 50 watt infrared lamp

(b) 1000 watt infrared lamp

(c) 1 watt ultraviolet lamp

(d) 1 watt infrared lamp

25. Sodium surface is illuminated by ultraviolet and visible radiation successively and the stopping potential determined. This stopping potential is:

(a) equal in both cases.

(b) more with ultraviolet light

(c) more with visible light

(d) varies randomly

26. X-ray are used to irradiate sodium and copper surfaces in two separate experiments and stopping potential determined. This stopping potential is :

(a) equal in both cases.

(b) greater for sodium

(c) greater for copper

(d) infinite in both cases

27. A photo-sensitive material would emit electrons if excited by photons beyond a threshold. To cross the threshold you would increase:

(a) intensity of light

(b) wavelength of light

(c) frequency of light

(d) the voltage applied to light source

28. The strength of a photoelectric current depends upon:

(a) frequency of incident radiation

(b) intensity of incident radiation

(c) angle of incident radiation

(d)distance between anode and cathode.

29. Photoelectrons are being obtained by irradiating zinc by a radiation of 3100 $\dot{A}$. In order to increase the kinetic energy of ejected photoelectrons:

(a) the intensity of radiation should be increased

(b)the wavelength of radiation should be increased.

(c) the wavelength of radiation should be decreased.

(d) both wavelength and intensity of radiation should be increased.

30. A photo cell is illuminated by a small bright source placed 1 m away . When the same source of light is placed 0.5m away, the electrons emitted by the photo cathode would.

(a) increase by a factor of 4

(b) decrease by a factor of 4

(c) decrease by a factor of 2

(d) increase by a factor of 2

31. The frequency and the intensity of a beam of light falling on the surface of photoelectric material are increased by a factor of two. This will.

(a)increase the maximum kinetic energy of the photoelectrons, as well as the photoelectric current by a factor of two.

(b)increase the maximum kinetic energy of the photoelectrons and would increase the photoelectric current by a factor of two.

(c)increase the maximum kinetic energy of the photoelectrons by a factor of two and will have no effect on the magnitude of the photoelectric current produced.

(d)not produce any effect on the kinetic energy of the emitted electrons but will increase the photoelectric current by a factor of two.

32. A photoelectric cell is illuminated by a point source of light 1 m away. The plate emits electrons having stopping potential *V*. Then:

(a) *V* decreases as distance increase

(b) *V* increase as distance increase

(c) *V* is independent of distance (*r*)

(d)*V* becomes zero when distance increase of decreases

33. In a photoelectric experiment, the stopping- potential for the incident light of wavelength 4000 Å is 2 volt. If the wavelength be changed to 3000 Å. The stopping – potential will be.

(a) 2volt

(b) less than 2 volt

(c) zero

(d) more than 2 volt

34. In photoelectric effect, the work-function of a metal is 3.5 eV. The emitted electrons can be stopped by applying a potential of – $1.2V$:

(a) the energy of the incident photons is 4.7 eV

(b) the energy of the incident photons is 2.3 eV

(c) if higher-frequency photons be used, the photoelectric current will rise

(d) When the energy of photons is 3.5 eV, the photoelectric current will be maximum.

35. Photoelectric cell:

(a) converts electricity into light

(b) converts light into electricity

(c) stores light

(d) stores electricity

36. The work-function for a metal is 3eV. To emit a photoelectron of energy 2 eV from the surface of this metal, the wavelength of the incident light should be.

(a) 6187 Å

(b) 4125 Å

(c) 12375 Å

(d) 2875Å

37. Ultraviolet radiation of 6.2 eV falls on an aluminium surface (work-funct ion 4.2 eV) . The kinetic energy (in joule) of the fastest electron emitted is approximately :

(a) 3×10^{-21} **(b)** 3×10^{-19}

(c) 3×10^{-17} **(d)** 3×10^{-15}

38. The work-function of a photoelectric materials is 3.3 eV. Its threshold frequency will be.

(a) $8 \times 10^{14} Hz$ **(b)** $5 \times 10^{33} Hz$

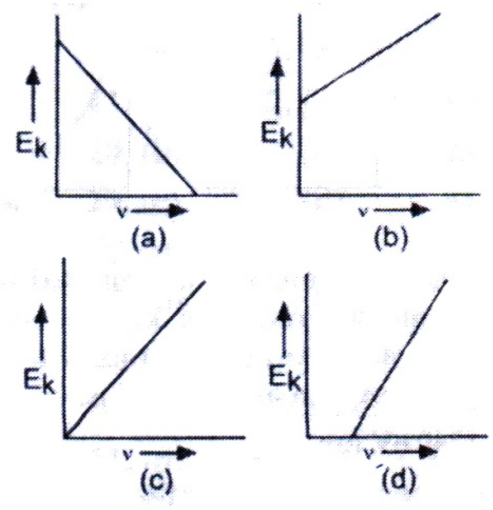
(c) $8 \times 10^{10} HZ$ **(d)** $4 \times 10^{11} Hz$

39. The work-function of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectrons emission from the substance is approximately.

(a) 540 nm **(b)** 400 nm

(c) 310 nm **(d)** 220 nm

40. According to Einstein's photoelectric equation, the graph between the kinetic energy (E_k) of photoelectrons ejected and the frequency (v) of incident radiation is:



41. The work-function of a surface of a photosensitive material is 6.2 eV. The wavelength of incident radiation for which the stopping potential is 5V lies in.

(a) ultraviolet region

(b) visible region

(c) infrared region

(d) X-ray region

42. The number of photoelectrons emitted for light of frequency v (higher than the threshold frequency v_0) is proportional to:

(a) threshold frequency v_0

(b) intensity of light

(c) frequency of light

(d) $v - v_0$

43. A 0.66 mg ball is moving with a speed of 100 m/s. The associated wave length will be $(h = 6.6 \times$ *10–34* is

(a) $6.6 \times 10^{-34} m$

(b) $1.0 \times 10^{-29} m$

(c) $1.0 \times 10^{-32} m$

(d) $6.6 \times 10^{-32} m$

44. The de Broglie wavelength of an electron accelerated through a p.d. V is directly proportional to V^n . Then n must be equal to $n =$

(a) 1 **(b)** -1

(c) 0.5 **(d)** -0.5

45. For a given kinetic energy which of the following has smallest de Broglie wavelength.

(a) electron **(b)** proton

(c) deuteron **(d)** α $-$particle

***

A-II

FILL IN THE BLANKS

1. **Photoelectric effect can be explained by _________ theory of light.**
2. **The minimum frequency of incident light for photoelectric effect is known as ____**
3. **Ratio between K.E of photon to frequency of light is equal to ____**
4. **The application of photoelectric effect is _____**
5. **The energy of a photon is ____**
6. **Photoelectric effect is an ____ process.**
7. **Threshold frequency is ____ for different metals.**
8. **S.I. Unit of work function is ___**
9. **Stopping potential depends on ___ of incident light.**
10. **Photoelectric current depends on ___ of the incident light.**
11. **The rest mass of photon is always ___**
12. **Energy of photon = ___ $\times$ speed of light .**
13. **De-Brogli's wave length depends on _______ and _______ of a particle**
14. **Increasing the work function of a metal, the K.E. of Photoelectrons ___**
15. **Wavelength of an electromagnetic radiations ___ to the wavelength of its photon.**
16. **Photons are electrically ____**
17. **______ waves can travel faster than light**
18. **The frequency of a photon remain the ___ in different media.**
19. **Matter waves are associated with material particles only if they are in _____.**

***

A-III

ANSWER IN ONE WORD / SENTENCE

1. **What are matter waves ?**
2. **What is meant by work function of a metal**
3. **What is photoelectric effect ?**
4. **How does photocurrent very with the frequency of incident light ?**
5. **How is stopping potential related to maximum kinetic energy of photoelectrons?**
6. **What is the name given to frequency below which no photoelectrons are emitted.**
7. **Photoelectric effect depicts which nature of light?**
8. **What is name of a light quanta?**
9. **What is the rest mass of photon?**
10. **Write the relation between do Broglie wavelength and momentum of a particle .**

***

SECTION –B

2 MARKS QUESTION

1. **What are matter waves. What is its De-Broglie wavelength ?**
2. **What is meant by wave particle duality ?**
3. **Write Einstein's photoelectric equation and justify that there is a threshold frequency below which photoemission does not occur.**
4. **Find de Broglie wavelength of electrons which are accelerated by 1000V**
5. **Calculate the wavelength of a photon of energy 10eV .**
6. **The work function of silver is 5.26×10^{-19}J. Calculate its threshold wavelength.**

7. **Define stopping potential and threshold frequency in photoelectric effect.**

8. **Why the wave nature of matter is not observed in daily life.**

9. **Write two uses of photocell.**

10. **Draw graph showing dependence of stopping potential on frequency of incident light. In the graph what are the**
    - **(i) Intercept on frequency axis**
    - **(ii) Intercept on stopping potential axis**
    - **(iii) The slope of the graph**

11. **How does the kinetic energy and photocurrent change with frequency of incident light.**

12. **How does the kinetic energy and photocurrent change with intensity of incident light.**

***

SECTION –C

LONG QUESTIONS

1. **What is photoelectric effect. State the Laws of photoelectric emission**

2. **Write the Einstein photoelectric equation and explain the laws of photoelectric effect on the basis of it.**

3. **Describe briefly the experimental set up of photoelectric effect. Explain what is stopping potential and how it changes with frequency of incident light.**

4. **In photoelectric effect with the help of graph explain effect of collector potential on photocurrent (i) at different intensities (ii) at different frequencies.**

5. **What is matter wave ? Write de Broglie relation. Explain why matter wave is not observed for a body of mass 10kg.**

***

ANSWERS

A-1

1. d
2. b
3. c
4. a
5. d
6. c
7. a
8. d
9. c
10. a
11. d
12. b
13. b
14. a
15. a
16. d
17. c
18. b
19. d
20. a
21. b
22. a
23. b
24. c
25. b
26. b
27. c
28. b
29. c
30. a
31. a
32. c
33. d
34. a
35. b
36. d
37. b
38. a
39. c
40. d
41. a
42. b
43. b
44. d
45. d

***

A-II

Fill in the blanks

1. quantum theory
2. threshold frequency
3. Planck constant
4. Solar cell
5. Hv
6. Instantaneous
7. Different
8. J
9. Frequency
10. Intensity
11. Zero
12. Momentum of photon
13. Momentum, kinetic energy
14. Decreases
15. Equal
16. Natural
17. Matter
18. Same
19. Motion

***

A-III

1. A moving material particle is associated with a wave called matter wave.

De Broglie wavelength $= \lambda = \frac{h = planc\ k'sconstant}{momentum \quad p}$

2. Wave particle duality refers to the fact that matters and radiation exhibit both particle and wave characters.

3. $\frac{1}{2} m v_{max}^2 \ = hv - hv_0 = h(v - v_0)$

Since m is +ve, v_{max}^2 is the always LHS is +ve .

$\Rightarrow$ only when $v > v_0$ the equation is meaningful so when $v > v_0$no emission.

4. $\lambda_{de\ Broglie} = \frac{12.3\ A°}{\sqrt{v}} = \frac{12.3A°}{\sqrt{1000}}$

5. $E_{photon} = \frac{hc}{\lambda} \Rightarrow \lambda_{photon} = \frac{hc}{Energy}$

$$= \frac{hc}{E} = \frac{6.6 \times 10^{-34} \times 3 \times 1068}{10 \times 1.6 \times 10^{-19}}$$

$$= 1242A°$$

6. $W = \phi_0 = 5.26 \times 10^{19} J.$

$\phi_0 = hv_0 = \frac{hc}{\lambda_0} = 5.26 \times 10^{-19}$ J

$$\lambda_0 = \frac{hc}{5.26 \times 106^{-19}}$$

$$= \frac{6.6 \times 10^{-13} \times 3 \times 10^8}{5.26 \times 10^{-19}} = 3764A^\circ$$

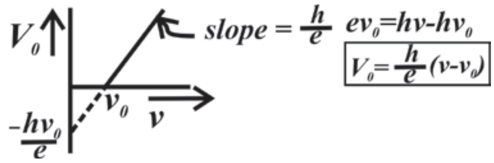
7. Stopping potential is the potential difference applied across the electrodes of photocell to just stop photo emission.

Threshold frequency is the minimum frequency of incident light below which no photoemission takes place.

8. $\lambda_{matter} = \frac{h}{p} = \frac{h}{mv}\ \lambda \propto \frac{1}{m},$ for large m, λ is very small.

9. (i) solar cell (ii) burglar alarm.

10.



11. K.E. $\propto v - v_0$

Photocurrent independent of v

12. K.E. independent of intensity photocurrent $\propto$ intensity.

***

CHAPTER TWELVE

ATOMS

A-I

MCQ

1. **The nuclear model of atom was proposed by**
   (a) J.J. Thomosn
   (b) E. Rutherford
   (c) Niel Bohr
   (d) Somerfield

2. **The ratio of the energies of the hydrogen atom in its first to second excited state is**
   (a) $\frac{1}{4}$
   (b) $\frac{4}{9}$
   (c) $\frac{9}{4}$
   (d) 4

3. **The speed of an electron in the orbit of the hydrogen atom in the ground state is** :
   (a) c
   (b) $\frac{c}{2}$
   (c) $\frac{c}{10}$
   (d) $\frac{c}{137}$

4. **If the electron in a hydrogen atom jumps from an energy level $n_1 = 3$ to an orbit with level $n_f = 2$, the emitted radiation has a wavelength given by**
   (a) $\lambda = \frac{36}{5R}$
   (b)$\lambda = \frac{5R}{36}$
   (c) $\lambda = \frac{6}{R}$
   (d) $\lambda = \frac{R}{6}$

5. **The ratio of the radio of the first three Bohr orbit of hydrogen atom is**
   (a) $1{:}\frac{1}{2}{:}\frac{1}{3}$
   (b) $1{:}\,2{:}\,3$
   (c) 1:4:9
   (d) 1:8:27

6. **Which series of hydrogen atom lie in the infrared region.**
   (a) Lyman
   (b) Balmer
   (c) Brackett, Paschen and P fund
   (d) all the above

7. **The difference in angular momentum associated with the electron in the two successive orbits of hydrogen atom is**

(a) $\frac{h}{\pi}$

(b) $\frac{h}{2\pi}$

(c) $\frac{h}{2}$

(d) $(n-1)\frac{h}{2\pi}$

8. **The ionization potential of hydrogen atom is 13.6ev . The energy required to remove an electron from the second orbit of hydrogen is**

(a) 3.4ev

(b) 6.8ev

(c) 13.6ev

(d) 27.2ev

9. **According to classical theory the proposed path of an electron in Rutherford atom model will be**

(a) Circular

(b) straight line

(c) parabolic

(d) spiral

10. **The radius of the atom is of the order of**

(a) $10^{-6}m$ **(b)** $10^{-8}m$

(c) $10^{-10}m$ **(d)** $10^{-12}m$

11. **According to Bohrs postulates which of the following quantities take discrete values.**

(a) Kinetic energy

(b) momentum

(c) potential energy

(d) angular momentum

12. **Electrons in the atom are held in the atom by**

(a) coulomb forces

(b) nuclear forces

(c) van der waal's forces

(d) Gravitational forces

13. **The radius of the first Bohr orbit of electron in hydrogen atom is : $(\boldsymbol{e = 1.6 \times 110^{-19} c}), \boldsymbol{m = 9.1 \times 10^{-31} kg}$ h= $\boldsymbol{6.6 \times 10^{-34} J - s})$**

(a) 5.3Å

(b) .53Å

(c) 53Å

(d) .53 mm

14. **In which region of electromagnetic spectrum does the lyman series of hydrogen atom lie.**

(a) Ultraviolet

(b) infrared

(c) Visible

(d) x-ray

15. **The $\propto -$ray scattering experiment due to Rutherford**

(a) Established the existence of nucleus

(b) Led to the discovery of electrons

(c) Explained the hydrogen spectrum

(d) Led to the discovery of neutrons.

16. **The Rydberg constant for an atom is**

(a) $1.097 \times 10^8 m^{-1}$

(b) $1.097 \times 10^7 m^{-1}$

(c) $1.097 \times 10^6 m^{-1}$

(d) $1.097 \times 10^5 m^{-1}$

17. **Atomic hydrogen is excited to the nth energy level. The maximum number of spectral lines it can emit while returning to the ground state is**

(a) $\frac{1}{2} n(n-1)$

(b) $\frac{1}{2} n(n+1)$

(c) $n(n-1)$

(d) $n(n+1)$

18. **If n is principal quantum number the energy of hydrogen atom is**

(a) $\frac{13.6ev}{n}$

(b) $\frac{-13.6ev}{n}$

(c) $-\frac{13.6ev}{n^2}$

(d) $\frac{-n^2}{13.6} ev$

19. **The energy required to raise an electron from first Bohr orbit to second Bohr orbit in hydrogen atom is**

(a) $3.4ev$ **(b)** $-3.4ev$

(c) $-10.2ev$ **(d)** $+10.2ev$

20. **Give $\frac{1}{R} = 612$Å the series limit of Balmer series is**

(a) 912 Å

(b) 3648Å

(c) $1824A°$

(d) 27.36Å

21. **In Bohr's model the atomic radius of first orbit is r_0. Then the radius of the third orbit is**

(a) $\frac{r_0}{9}$ **(b)** r_0

(c) $9r_0$ **(d)** $3r_0$

22. **The longest wavelength of Lyman series is**

(a) 1216Å

(b) 1824Å

(c) 6536Å

(d) 8208Å

23. **The series limit of lyman series is**

(a) $1216A°$

(b) $1824A°$

(c) $6536A°$

(d) $912A°$

24. **Paschen series of hydrogen atom is observed when electron jumps from higher orbit to the orbit of number.**

(a) 3 **(b)** 4

(c) 2 **(d)**5

25. **Brackett series of hydrogen atom is observed when electron jumps from higher orbit to the orbit of number.**

(a) 3

(b) 4 m

(c) 2

(d)5

26. **What is deduced from the fact that when alpha particles are fired at a fine gold leaf it is found that most of them pass through with little or no deflection ?**

(a) Alpha particles have high penetrating power

(b) Alpha particles are positively charged

(c) Gold atoms are nearly all empty space

(d) Alpha particles cause gold atoms to disintegrate

27. **If the electron in a hydrogen atom jumps from an orbit with level $n_i = 3$ to an orbit with level $n_f = 2$, the frequency of the emitted radiations**

(a) $v = \frac{36c}{5R}$ **(b)** $v = \frac{CR}{6}$

(c) $v = \frac{5Rc}{36}$ **(d)** $v = \frac{6C}{R}$

28. **The angular momentum of electron is nth orbit is given by**

(a) nh **(b)** $\frac{nh}{2\pi}$

(c) $\frac{h}{2\pi n}$ **(d)** $\frac{n^2h}{2\pi}$

29. **As the quantum number increases, the difference of energy between consecutive energy levels.**

(a) remains the same

(b) decrease

(c) increases

(d) first decreases then increase

30. **The number of times the electron goes round the first bohr orbit of hydrogen in one second is**

(a) 6.57×10^5

(b) 6.57×10^{15}

(c) 6.57×10^{10}

(d) 6.57×10^{13}

***

A-II

FILL IN THE BLANKS

1. **Rutherford's model suggest atom should exhibit ____ spectrum**

2. **The lowest energy state of the atom is also known as ____state**

3. **The time for which an electron can remain in the excited state in nearly ____ s.**

4. **The ratio of kinetic energy of electron in n^{th} orbit to the total energy in that orbit in H-atom is ______.**

5. **The minimum energy required to excite a hydrogen atom from it ground state is ____**

6. **The total energy of an electron in the atom is always ____**

7. **Rutherford's $\propto -particle$ scattering experiment proves the existence of ____ charged nucleus.**

8. **A classical atom based on ___ model is doomed to collapse.**

9. **In a Bohr orbit the ratio of magnetic moment and angular momentum of an electron is _____**

10. **The ratio of wavelength of series limit of Balmer series to that of Lyman-series is ____**

11. **The ratio of largest and shortest wavelength limits of Lyman series of H spectrum is ____**

12. **If an electron of a given hydrogen atom goes from energy level $n = 3$ to $n = 1$, the maximum number of photons emitted is ___.**

13. **The value of the principal quantum number n is equal to ____ for the second excited state.**

14. **The only series of H-atom for which the spectral lines lies in the visible region is ____ series.**

15. **The potential energy of an electron is an atom has to be ___than the kinetic energy.**

***

A-III

ONE WORD ANSWER

1. **What was discovered in the Rutherford's $\propto -ray$ scattering experiment?**
2. **What is the order of the size of an atom ?**
3. **What is the name given to the amount of energy needed to be given from outside to bring an electron from its ground state H-atom to outside ?**
4. **What is the ground state energy of H-atom ?**
5. **What does electron volt measure ?**
6. **What is the kinetic energy of electron of H-atom in the ground state ?**
7. **Name a spectral series of H-altom that lies in infrared region ?**
8. **How does the kinetic energy of an electron is Bohr atom change on increasing the radius of the orbit ?**
9. **How does the potential energy of stationary Bohr orbit change on increasing the radius of the orbit ?**
10. **When an orbital electron of an atom jumps from a higher orbit to lower orbit name the particle it emits.**

***

SECTION –B

Answer briefly

EACH QUESTION CARRIES 2 MARKS

1. **The wavelength of first line of Balmer series of Hydrogen atom in 6560Å. Find out the wavelength of the second line of the series.**
2. **Write any two shortcomings of Bohr's theory**
3. **Write a Bohr postulate which depicts quantization of a physical quantity of electron**
4. **What was the limitation of Rutherford model of atom.**
5. **Write two salient observation of $\propto -ray$ scattering experiment.**
6. **The radius of electrons' second stationary orbit in Bohr's atom is r. find out the radius of the third orbit.**
7. **Compare the shortest wavelengths of Brackett and Balmr series of H-atom.**
8. **Draw the energy level diagram showing Paschen series of H-atom.**
9. **Explain why the Balmer lines are not usually seen in absorption spectra of hydrogen atom while Lyman lines are seen.**
10. **In hydrogen atom, the electron is revolving in an orbit of 2.12A°. What is its angular momentum ?**

***

SECTION –C

LONG QUESTION

1. **Describe briefly the $\propto -particle$ scattering experiment of Rutherford. What is the significance of the results of the experiment.**
2. **State Bohr's postulates**

   Derive expression for radius and total energy of the electron in H-atom.
3. **Explain hydrogen spectra using Bohr's theory.**

***

ANSWERS

A-I

1. c
2. c
3. d
4. a
5. c
6. c
7. b
8. a
9. d
10. c
11. d
12. a
13. b
14. a
15. a
16. b
17. a
18. c
19. d
20. b
21. c
22. a
23. d
24. a
25. b
26. c
27. c
28. b
29. b
30. b

***

A-II

FILL IN THE BLANKS

1. Continuous
2. Ground
3. 10^{-18}
4. -1
5. 10.2ev
6. $negetive$
7. Positively
8. Rutherford's
9. e/2m
10. 4:1
11. 4:3
12. 3
13. Three
14. Balmer
15. More

A-III

ONE WORD ANSWER

1. Nucleus
2. $10^{-10}m$
3. Rydberg
4. -13.6ev
5. Energy
6. +13.6ev
7. Paschen / Brackett/ pfund
8. Decreases
9. Increases
10. Photon

***

SECTION –B

1. $\frac{1}{\lambda_{balmer}} = R\left[\frac{1}{1^2} - \frac{1}{3^2}\right] = \frac{R5}{36}$

$\Rightarrow \lambda_{balmer\ 1} = \frac{36}{5R} = 6461A°$

$\frac{1}{\lambda_{balmer\ \ 2^{nd}}} = R\left[\frac{1}{2^2} - \frac{1}{4^2}\right] = \frac{3R}{16}$

$\Rightarrow \lambda_{balmer\ \ 2} = \frac{16}{3R} = \frac{16}{3} \times \frac{6561 \times 5}{36}$

$= \frac{20}{27} \times\ 6561A°$

$= 4860A°$

2. (i) could not explain fine structure of spectral line

(ii) Could not explain splitting of spectral lines in magnetic field

3. $mvr = nh/2\pi$

4. Unstable accelerated electron will lose energy and will spiral into nucleus.

5. (i) atom is empty

(ii) central positive nucleus with most mass.

6. $r_n = n^2 a_0$

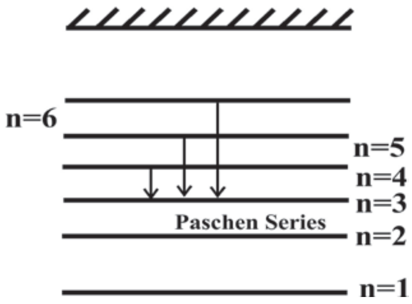
$r_2 = 4a_0 = 9.\frac{R}{4} = 2.25R$

7. $\frac{1}{\lambda_{brackett}} = R\left[\frac{1}{5^2} - \frac{1}{\infty}\right] \lambda_{brackett} = \frac{25}{R}$

$\frac{1}{\lambda_{balmer}} = R\left[\frac{1}{2^2} - \frac{1}{\infty}\right] \lambda_{balmer} = \frac{4}{R}$

Ratio = $\frac{\lambda_{brackett}}{\lambda_{balmer}} = \frac{25}{4}$

8. D



9. At room temperature practically all atoms are in ground state when external radiation is supplied electron from n=1 state go to higher state orbits so radiation corresponding to Lyman series are absorbed . Only a negligible fraction of atom are in state n=2 at room temperature. So radiation corresponding to Balmer lines are not observed.

10. Since $r_n = n^2 r, and\ r_1 = .53A°$

Here $\frac{r_n}{r_1} = \frac{2.12A°}{.53A°} - 4 \Rightarrow n^2 =, n = 2$

So angular momentum of electron in 2nd orbit $2.\frac{h}{2\pi}$

***

CHAPTER THIRTEEN

NUCLEUS

A-I

MCQ

1. The ‘nucleon’ is the name used for

(a) All light nuclei

(b) Hydrogen nuclei only

(c) Neutron only

(d) Protons and Neutrons both

2. The atomic number of a nucleus is equal to the number of

(a) Electrons it contains

(b) **Protons** it contains

(c) Neutrons it contains

(d) Nucleons it contains

3. The difference between $92^{U^{235}}$ and $92^{U^{238}}$ atoms is that

(a) U^{238} contains 3 more protons

(b) U^{238} contains 3 more protons and 3 more electrons

(c) U^{238} contains 3 more neutrons and 3 more electrons

(d) U^{238} contains 3 more neutrons

4. In the nucleus of $11^{Na^{23}}$, the number of protons, neutrons and electrons is respectively .

(a) 11,12,0 **(b)** 23,12,11

(c) 12,11,0 **(d)** 23,11,12

5. The ratio of the radii of the nuclei $13^{Al^{27}}$ and $52^{T^{125}}$ is approximately

(a) 6:10

(b) 13:52

(c) 40:177

(d)14:73

6. Consider the following nuclear reaction

$$2^{He^4} + 5^{B^{11}} \longrightarrow 7^{N^{14}} + (\ )$$

The particle represented by the parenthesis is

(a) Proton

(b) Deuteron

(c) Neutron

(d) Electron

7. If A is the mass number of a nucleus then its volume V is found to vary as

(a) $V \propto A^{\frac{1}{3}}$

(b) $V \propto A^{\frac{1}{2}}$

(c) $V \propto A$

(d) $V \propto A^3$

8. **Of the following atoms $6^{C^{14}}, 7^{N^{13}}$, $86^{Ra^{236}}$, $7^{N^{14}}, 8^{O^{16}}, 86^{Rn^{232}}$ a pair of isobar is**

(a) $6^{C^{14}}, 7^{N^{13}}$

(b) $7^{N^{13}}, 7^{N^{14}}$

(c) $6^{C^{14}}, 7^{N^{14}}$

(d) $6^{C^{14}}, 8^{O^{16}}$

9. **Of the following atoms $6^{C^{14}}, 7^{N^{13}}$, $86^{Ra^{236}}$, $7^{N^{14}}, 8^{O^{16}}, 86^{Rn^{232}}$ a pair of istone is**

(a) $6^{C^{14}}, 7^{N^{13}}$

(b) $7^{N^{13}}, 7^{N^{14}}$

(c) $6^{C^{14}}, 7^{N^{14}}$

(d) $6^{C^{14}}, 8^{O^{16}}$

10. **Of the following atoms $6^{C^{14}}, 7^{N^{13}}$, $86^{Ra^{236}}$, $7^{N^{14}}, 8^{O^{16}}, 86^{Rn^{232}}$ a pair of isotope is**

(a) $6^{C^{14}}, 7^{N^{13}}$

(b) $7^{N^{13}}, 7^{N^{14}}$

(c) $6^{C^{14}}, 7^{N^{14}}$

(d) $6^{C^{14}}, 8^{O^{16}}$

11. **The density of nucleus is of the order of**

(a) $10^3\ kg/m^3$

(b) $10^{12} kg/m^3$

(c) $10^{17} kg/m^3$

(d) $106^{27} kg/m^3$

12. **The nuclei $6^{C^{13}}$ and $7^{N^{14}}$ can be described as**

(a) istones

(b) Isobors

(c) isotopes of carbon

(d) Isotopes of nitrogen.

13. **Two elements are said to be isobars if their**

(a) Z- numbers are equal and A-numbers are equal

(b) Z- numbers are equal but A-numbers are unequal

(c) Z- numbers are unequal but A-numbers are equal

(d) Both Z and A number are unequal

14. **Two elements are said to be isotopes if their**

(a) Both Z and a numbers equal

(b) Z- numbers are equal but A-numbers are unequal

(c) Z- numbers are unequal but A-numbers are equal

(d) Both Z and A number are unequal

15. **Isotopes have**

(a) Same physical and chemical properties

(b) Different physical and chemical properties

(c) Same physical but different chemical properties.

(d) Different physical but same chemical properties

16. Isobars have

(a) Same physical but different chemical properties.

(b) Same chemical but different physical properties.

(c) Same physical and chemical properties

(d) Different physical but same chemical properties

17. Two elements are said to be isotones if their

(a) Z and A numbers are equal

(b) Z and A numbers as well as (A-Z) number are unequal

(c) Z numbers are unequal but A numbers are equal

(d) Z and A numbers are unequal but (A-Z) numbers are equal

18. Which of the following can be added to the nucleus of an atom without changing its chemical properties.

(a) electron **(b)** neutron

(c) positron **(d)** $\propto -$ particle

19. Neutron was discovered by

(a) Rutherford

(b) Chadwick

(c) Hahn and St**rassman**

(d) Milikan

20. Proton was discovered by

(a) Rutherford

(b) Chadwick

(c) Hahn and Strassman

(d) Becquerrel.

21. A nucleus represented by Z^{X^A} has

(a) Z neutrons and A-Z protons

(b) Z protons and (A-Z) neutron**s**

(c) Z protons and A neutrons

(d) A protons and Z-A neutrons

22. If the nuclear radius of 27_{Al} is 3.6 fermi ; the approximate radius of 64_{Cu} in fermi is

(a) 2.4

(b) 1.2

(c) 4.8

(d) 3.6

23. The radius of germanium (Ge) nuclide is measured to be twice the radius of $_4^9Be$. The number of nucleons in Ge are

(a) 72 **(b)** 73

(c) 74 **(d)** 75

24. The volume occupied by an atom is greater than the volume of the nucleus by a factor of about

(a) 10^1

(b) 10^5

(c) 10^{10}

(d) 10^{15}

25. Nuclear fusion in possible

(a) Only between light nuclei

(b) Only between heavy nuclei

(c) Between both light and heavy nuclei

(d) Only between nuclei which are stable against beta delay

26. Of the following the good moderator is

(a) Cadmium

(b) Graphite

(c) Helium

(d) ordinary water

27. The reaction responsible for the production of light energy from the sun is

(a) Fission

(b) Fusion

(c) Explosion

(d) Combustion

28. If Alpha, Beta, Gamma rays carry some momentum, which has the longest wavelength.

(a) Alpha rays

(b) Beta rays

(c) Gamma Rays

(d) None all have same wavelength

29. If the binding energy per nucleon of a nuclide is high then

(a) it should be abundantly available in nature

(b) it will decay instantly

(c) it will have a large disintegration constant

(d) it has a small half life

30. in the nuclear reaction $\boldsymbol{{}^{6}_{4}C \rightarrow {}^{14}_{7}N + X}$ the particle X is

(a) and electron

(b) a proton

(c) a neutron

(d) $\boldsymbol{\gamma}$-ray photon

31. One requires an energy $\boldsymbol{E_n}$ to remove a nucleon from nucleus and an Energy Ee to remove an electron from an atom. Then

(a) $E_n = E_e$ (b) $E_n > E_e$

(c) $E_n > E_e$ (d) $E_n \geq E_e$

32. The mean binding energy per nucleon in the nucleus of an atom is nearly

(a) 8eV

(b) 8 Kev

(c) 8MeV

(d) 9GeV

33. One atomic mass unit is the mass of

(a) One atom

(b) One proton

(c) One neutron

(d) One twelfth of mass of ${}^{12}_{6}C$ atom

34. Mass of 1a.m.u is equivalent to energy of

(a) 0.931 MeV

(b) 9.31 MeV

(c) 931MeV

(d) 93.1 Mev

35. The Binding energy per nucleon is maximum for

(a) ${}^{56}_{26}Fe$

(b) ${}^{92}_{36}Kr$

(c) ${}^{141}_{56}Ba$

(d) ${}^{235}_{92}U$

36. The binding energy of nucleus is a measure of its

(a) mass

(b) stability

(c) charge

(d) momentum

37. The antiparticle of electron is

(a) Positron

(b) α- Particle

(c) β- particle

(d) Proton

38. For a nucleus $\boldsymbol{{}^{A}_{Z}X}$ if mas deflect is $\boldsymbol{\Delta m}$ then packing fraction is

(a) $\frac{\Delta m}{Z}$

(b) $\frac{\Delta m}{A}$

(c) $\frac{\Delta m}{A-Z}$

(d) $\frac{\Delta mZ}{A}$

39. A radioactive elements $\boldsymbol{{}^{A}_{Z}X}$ emits an $\boldsymbol{\alpha}$- Particle and changes into

(a)γ^{A}_{z-2}

(b) $\gamma\,{}^{A-4}_{Z}$

(c) γ^{A-4}_{z-2}

(d) γ^{A}_{z+2}

40. Gamma rays are

(a) Singly ionized gas atoms
(b) Helium nuclei
(c) Fast moving electrons
(d) Electromagnetic waves

41. Electric and magnetic fields cannot deflect

(a) Alpha rays
(b) Beta rays
(c) Gamma rays
(d) Positrons

42. Ionising power is maximum for

(a) Alpha particle
(b) Beta particle
(c) Gamma particle
(d) Neutrons

43. The penetrating power is maximum for

(a) Alpha particle
(b) Beta particle
(c) Gamma particle
(d) Positrons

44. In a radioactive disintegration beta emission is always accompanied by emission of

(a) gamma particle
(b) alpha particle
(c) positron
(d) neutron

45. The atomic number and mass number of a nucleus remain unchanged when it emits.

(a) an alpha particle
(b) a beta particle
(c) a gamma particle
(d) a neutron

46. In Beta decay the z-number and A-number of a decaying nucleus changes respectively to

(a) Z and A+1
(b) (Z+1) and A
(c) Z and A
(d) (Z-1) and A+1

47. The half life period and mean life period of a radioactive element are denoted respectively by T_h the T_m. Then

(a) $T_h = T_m$ **(b)** $T_h < T_m$
(c) $T_h > T_m$ **(d)** $T_h \geq T_m$

48. The half life of a radioactive radon is 3.8 days. The time at the end of which 1/20 th of the radon sample will remain undecayed is (given $\boldsymbol{ln\ 10 = .4343}$)

(a) 1.6 days
(b) 16.4 days
(c) 20 days
(d) $3.8 \times 20\ days$

49. **Half life of Radium is $1600\ years$. Fraction of sample of radium that is present after 4800 years is**

(a) $\frac{1}{8}$ **(b)** $\frac{1}{16}$

(c) $\frac{7}{8}$ **(d)** $\frac{15}{16}$

50. **When the radioactive isotope $^{228}_{88}Ra$ decays in series by the emission of 3 alpha particles and a beta particle, the isotope finally formed is**

(a) $^{229}_{89}X$

(b) $^{222}_{56}X$

(c) $^{216}_{83}X$

(d) $^{215}_{83}X$

51. **The radioactivity of an element becomes $\frac{1}{64}th$ of its original value in 60 seconds. Then the half life period is**

(a) 5s

(b) 10s

(c) 20s

(d) 30s

52. **After a time equal to four half lives, the amount of radioactive material undecayed is**

(a) 6.25%

(b) 12.50%

(c) 25.0%

(d) 50.0%

53. **The decay constant of a radioactive element is defined as the reciprocal of the time interval after which the number of atoms of the radioactive element falls to nearly**

(a) 50% of its original number

(b) 36.8% of its original number

(c) 63.2% of its original number

(d) 75% of its Original number

54. **The activity of a given sample of radioactive material is reduced to $\frac{1}{32}$ of its initial value in 25 days . The half life in days is**

(a) $\frac{25}{32}$

(b) $\frac{25}{4}$

(c) 5

(d) 10

55. **$\left(\frac{3}{4}\right)$th of a radioactive sample decays in 10 days . The half life in days is**

(a) 5 **(b)** 10

(c) 15 **(d)** $\frac{20}{3}$

56. The number of disintegrations per second of a radioactive sample is also called

(a) half life

(b) mean life

(c) disintegration constant

(d) activity

57. The energy released in a typical fusion reaction is

(a) 50 MeV

(b) 200 MeV

(c) 25 MeV

(d) 100 MeV

58. Half life of a radioactive sample depends on

(a) Temperature

(b) pressure

(c) amount of element present before decay

(d) none of the above

59. The equation $4{}_{1}^{1}H \longrightarrow {}_{2}^{4}He + 2{}_{+1}^{0}e + 2v + energy$ is an example of

(a) fission

(b) Fusion

(c) β decay

(d) $\alpha - decay$

***

A-II

FILL IN THE BLANKS

1. **The number of neutrons in ${}_{11}^{31}cl$ is ______**

2. **The substances ${}_{92}^{238}U$ and ${}_{92}^{235}U$ are _______**

3. **The average binding energy per nucleon for the nuclei lying in the middle of the periodic table is nearly _________**

4. **The yield of U^{235} from any natural uranium sample is not greater than _________ percent.**

5. **The average energy released per fission of ${}_{92}^{235}U$ is approximately _________ MeV.**

6. **The size of nucleus varies as _________ power of mass numbers**

7. **The source of stellar energy is __________ process.**

8. **In a nuclear reactor heavy water is used as _________**

9. **If M is atomic mass, A is mass number, then $(M-A)/A$ is called ___________.**

10. **The more readily fissionable isotope is uranium has an atomic mass of ___________**

11. **If the decay constant of a radioactive sample is 2×10^{-6} per second, the everage life of the sample is ___________ Sec.**

12. **If the fraction of total amount of radioactive element that will decay in 20 hours is 15/16; the half life period of the element is _______ hrs.**

13. **In a sample of radioactive element the number of nucleons initially was 16×10^6. The number of remaining nucleons after three half life periods is ____________.**

14. **Neither mass nor charge of a nucleus change by the emission of _____________ ray.**

15. **In 6hrs the activity of a radioactive substance is reduced from 1024 to 128. Its half life is ____________ hrs.**

16. **Mean life of a radioactive sample =__________× half life of sample.**

***

A-III

ONE WORD ANSWER

1. **What is the other name given to rate of disintegration**

2. **What constant is rate of integration per atom.**

3. **What is the decay constant of a stable element**

4. **What is the maximum energy of α-paticles.**

5. **How does the activity of a radioactive substance change with time ?**

6. **Which is heavier a neutron or a proton**

7. **Name a short range force**

8. **Which energy is $931 \times \Delta m$ MeV where Δm is mass defect in amu?**

9. **In which reaction a heavy nuclei is split into two lighter ones.**

10. **Name a uncontrolled chain reaction.**

***

SECTION -B
2 MARKS EACH QUESTION

1. **States the reason why heavy water is generally used as moderator in a nuclear reactor.**

2. **State two properties of nuclear force**

3. **Two nuclei have mass numbers in the ratio of 1:2 what is the ratio of their nuclear densities.**

4. **Two nuclei have mass numbers in the ratio 1:8 What is the ratio of their nuclear radii ?**

5. **Two nuclei have mass number in the ratio of 27:125. What is the ratio of their nuclear radii.**

6. **Define the activity of a given radioactive substance. Write its SI unit.**

7. **Why is the ionizing power of α-particles greater than that of r rays.**

8. **A nucleus X initially at rest undergoes alpha decay according to the equation .**

$$ {}^{A}_{92}X \longrightarrow {}^{228}_{Z}Y + \alpha $$

Find the values of A and Z

9. **There are 10^6 radioactive nuclei is given sample its half life is 20s . How many nuclei will remain after 10s.**

10. **The half life of radium is 1600yrs. What fraction of a sample of radium will be disintegrated after 6400 yrs.**

***

SECTION –C

LONG QUESTION

1. **Draw the Binding Energy curve and describe its salient features.**

2. **Distinguish between controlled and uncontrolled chain reaction giving example.**

3. **How is energy generated in sun?**

4. **State four important properties of (i) $\alpha - rays$ (ii) β rays (iii) $r\ rays$**

5. **What is a nuclear reactor ? Briefly explain the nuclear reaction involved.**

6. **State the laws of radioactivity.**

   Define half life, mean life and decay constant Establish relation between the three.

***

ANSWERS

A-I

1. d
2. b
3. d
4. a
5. a
6. c
7. c
8. c
9. d
10. b
11. c
12. a
13. c
14. b
15. d
16. a
17. d
18. b
19. b
20. a
21. b
22. c
23. a
24. d
25. a
26. b
27. b
28. d
29. a
30. a
31. c
32. c
33. d
34. c
35. a
36. b
37. a
38. b
39. c
40. d
41. c
42. a
43. c
44. a
45. c
46. b
47. b
48. b
49. a
50. c
51. b
52. a
53. b
54. c
55. a
56. d
57. c
58. d
59. b

***

A-II

FILL IN THE BLANKS

1. 20
2. Isotopes
3. 8.5 MeV
4. 0.7
5. 200
6. $\frac{1}{3}$
7. Fusion
8. Moderator
9. Packing fraction
10. 235
11. 5×10^5
12. 5
13. 2×10^6
14. Gamma
15. 2
16. 1.44

***

A-III

1- Activity

2- Decay

3- Zero

4- 11 MeV

5- Decreases

6- Neutron

7- Nuclear / weak

8- Binding

9- Fission

10- Fusion

***

SECTION –B

1. Neutrons produced during fisson get slowed down if they collide with nucleus of same mass. As ordinary water contains hydrogen atoms Whose mass nearly equal to that of neutrons. Os it can be used as moderator. But it absorbs neutrons at a fast rate via reaction.

$n + p \longrightarrow$d+r

D is deuteron . To overcome this difficulty heavy water is used which has negligible cross section for neutron absorption.

2. Any two pros – (i) charge independent (ii) attractive, short range (iii) strongest force, saturated forces.

3. Nuclear density

$$f = \frac{Mass\ of\ nucleus}{Volume} = \frac{mA}{\frac{4}{3}\pi R^3}$$

$m = mass\ of\ a\ nucleon$

$A = No. of\ nucleons$

$$= \frac{mA}{\frac{4}{3}\pi R_0^3 A} \quad \left(R = R_0\ A^{\frac{1}{3}}\right)$$

$$= \frac{m}{\frac{4}{3}\pi R_0^3}$$

f is independent of A (mass numbers) so ratios of density will be 1:1

4. $R = R_0 A^{\frac{1}{3}}$

$R_1 : R_2 = \left(R_0\ 1^{\frac{1}{3}}\right) : R_0 8^{\frac{1}{3}} = 1:2$

5. $\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{\frac{1}{3}} = \left(\frac{27}{125}\right)^{\frac{1}{3}} = \frac{3}{5}$ ratio is 3:5

6. rate of disintegrations Becquerel.

7. Because α –particles are heavy particles and their sped is comparatively small, so they collide more frequently with atoms of the medium and ionize them.

8. α is ${}_{2}^{4}He$ so A = 228+4=232 mass no. conservation

$Z = 92 - 2 = 90$ charge conservation

9. No. of nuclei left after n half lives in $N = \frac{1}{2^n}\ N_0$.

N_0 =intial numbrs

Here number of half lifes $= n = \frac{10}{20} = \frac{1}{2}$ and $N_0 = 10^6$

$$N = \frac{1}{2^{1/2}} \times 10^6 = \frac{10^6}{\sqrt{2}} = 7 \times 10^5$$

10. The no. of half lives : $\frac{6400}{1600} = 4$

Then $\frac{N}{N_0} = \left(\frac{1}{2}\right)^n = \left(\frac{1}{2}\right)^4 = \frac{1}{16}$

Fraction of atom disintegrated $= 1 - \frac{1}{16} = \frac{15}{16}$

***

CHAPTER FOURTEEN

(SEMICONDUCTOR ELECTRONICS)

SECTION –A

MULTIPLE CHOICE QUESTIONS (MCQ)

1. In a semiconductor

(a)there are no free electrons at 0 K

(b)there are no free electrons at any temperature

(c)the number of free electrons increases with pressure

(d)the number of free electrons is more than that in a conductor

2. Let n_h and n_e be the number of holes and conduction electrons in an intrinsic semiconductor. Then

(a) $n_h > n_e$ **(b)** $n_h = n_e$

(c) $n_h < n_e$ **(d)** $nh \neq n_e$

3. A n-type semiconductor is

(a) positively charged

(b) negatively charged

(c) uncharged

(d)uncharged at OK but charged at higher temperatures

4. Electric conduction in a semiconductor takes place due to

(a) electrons only

(b) holes only

(c) both electrons and holes

(d) neither electrons nor holes

5. The impurity atoms with which pure silicon may be doped to make it a p-type semiconductor are those of

(a) phosphorus

(b) boron

(c) antimony

(d) nitrogen

6. The electrical conductivity of pure germanium can be increased by

(a) increasing the temperature

(b) doping acceptor impurities

(c) doping donor impurities

(d) All of the above

7. The resistivity of a semiconductor at room temperature is in between

(a) $10^{-2} to 10^{-5} \Omega\, cm$

(b) 10^{-3} *to* $10^{6}\ \Omega\, cm$

(c) 10^{6} *to* $10^{8}\ \Omega\, cm$

(d) $10^{10} to\ 10^{12} \Omega\, cm$

8. Number of electrons in the valence shell of a pure semiconductor is

(a)1 **(b)**2

(c)3 **(d)**4

9. In a semiconductor, the forbidden energy gap between the valence band and the conduction band is of the order of

(a) 1 MeV

(b) 0.1 Mev .

(c) 1 eV

(d) 5 eV

10.The forbidden energy gap for germanium crystal at 0 K is

(a) 0.071 eV.

(b) 0.71 eV

(c) 2.57 eV

(d) 6.57 eV

11.In an insulator, the forbidden energy gap between the valence band and conduction band is of the order of

(a) 1 MeV

(b) 0.1 MeV

(c) 1 eV

(d) 5 eV

12. What is the resistivity of a pure semiconductor at absolute zero ?

(a) Zero

(b) Infinity

(c) Same as that of conductors at room temperature

(d) Same as that of insulators at room temperature

13.Temperature coefficient of resistance of semiconductor is

(a) zero

(b) constant

(c) positive

(d) negative

14.In a p-type semiconductor, the acceptor valence band is

(a) close to the valence band of the host crystal

(b) close to conduction band of the host crystal

(c) below the conduction band of the host crystal

(d) above the conduction band of the host crystal

15. In an n-type semiconductor, donor valence band is

(a) above the conduction band of the host crystal

(b) close to the valence band of the host crystal

(c) close to the conduction band of the host crystal

(d) below the valence band of the host crystal

16. The PIV of a full wave rectifiex whose input is $E_0\ sin\ \omega t$

(a) $\frac{E_0}{\sqrt{2}}$

(b) E_0

(c) $\sqrt{2}\ E_0$

(d) $2E_0$

17. P type semiconductor is obtained by doping silicon with

(a) Indium

(b) Arsenic

(c) Gold

(d) Silver

18. In semiconductors, at room temperature

(a) the conduction band is completely empty

(b) the valence band is partially empty and the conduction band is partially filled

(c) the valence band is completely filled and the conduction band is partially filled

(d) the valence band is completely filled

19. At absolute zero, Si acts as

(a) non-metal

(b) metal

(c) insulator

(d) None of these

20.One serious drawback of semi-conductor devices is

(a)they do not last for long time.

(b)they are costly

(c)they cannot be used with high voltage.

(d)they pollute the environment.

21. When an impurity is doped into an intrinsic semiconductor, the conductivity of the semiconductor

(a) increases

(b) decreases

(c) remains the same

(d) becomes zero

22. The resistance of the p-n junction diode with forward biasing few

(a) nano ohms

(b) ohm

(c) kilo-ohm

(d) meg ohm

23.If a small amount of antimony is added to germanium crystal

(a) it becomes a p-type semiconductor

(b) the antimony becomes an acceptor atom

(c) there will be more free electrons than holes in the semiconductor

(d) its -resistance is increased

24. By increasing the temperature, the specific resistance of a conductor and a semiconductor

(a) increases for both

(b) decreases for both

(c) increases, decreases

(d) decreases, increases

25. A strip of copper and another of germanium are cooled from room temperature to 80K. The resistance of

(a) each of these decreases

(b) copper strip increases and that of germanium decreases

(c) copper strip decreases and that of germanium increases

(d) each of these increases

26. The resistance of $p-n$ junction diode with reverse biasing is of the order of

(a) nano ohms

(b) ohm

(c) kilo-ohm

(d) meg ohm

27. A semiconductor device is connected in a series -circuit with a battery and a resistance. A current is found to pass through the circuit. If the polarity of the battery is reversed, the current drops to almost zero. The device may be a/an

(a) intrinsic semiconductor

(b) p-type semiconductor

(c) n-type semiconductor

(d) p-n junction diode

28. If the two ends of a p-n junction are joined by a wire

(a) there will not be a steady current in the circuit

(b) there will be a steady current from the n-side to the p side

(c) there will be a steady current from the p-side to the n side

(d) there may or may not be a current depending upon the resistance of the connecting wire

29. The magnitude of potential barrier for Ge diode is

(a) 0.7V

(b) 0.1V

(c) 0.3.V

(d) 0.6V

30. The value of α

(a) is always less than 1

(b) is always greater than 1

(c) may be less or greater than 1

(d) None of the above.

31. In a transistor the value of β is 100. The value of α is

(a) .01

(b) 0.1

(c) 0.99

(d) 1

32. A transistor npn or pnp cannot be used as

(a) a rectifier

(b) amplifier

(c) modulator

(d) oscillator

33. The correct relation between 'α' and 'β' in a transistor is

(a) $\alpha = \frac{\beta}{1-\beta}$

(b) $\alpha = \frac{\beta}{1+\beta}$

(c) $\alpha = \frac{1-\beta}{\beta}$

(d) $\alpha = \frac{1+\beta}{1-\beta}$

34. The phase difference between input voltage and output

(a) $\frac{\pi}{2}$

(b)π

(c)$\frac{3\pi}{2}$

(d) 2π

35. For the transistor to act properly the emitter and collector junctions have to be biased respectively as

(a) 'forward' and 'forward'

(b) 'reverse' and reverse

(c) 'forward' and reverse

(d) 'reverse' and 'forward'

36.Reverse bias applied to a junction diode

(a)increases the minority carrier current

(b) lowers the potential barrier

(c) raises the potential barrier

(d)increases the majority carrier current

37.In forward biasing of the p-n junction

(a) the positive terminal of the battery is connected to p-side and the depletion region becomes thick

(b) the positive terminal of the battery is connected to n-side and the depletion region becomes thin

(c) the positive terminal of the battery is connected to n-side and the depletion region becomes thick

(d) the positive terminal of the battery is connected to p-side and the depletion region becomes thin

38. When p-n junction diode is forward biased then

(a) both the depletion region and barrier height are reduced

(b) the depletion region is widened and barrier height is reduced

(c) the depletion region is reduced and barrier height is increased

(d) both the depletion region and barrier height are increased

39. The cause of the potential barrier in a p-n junction diode is

(a) depletion of positive charges near the junction

(b) concentration of positive charges near the junction

(c) depletion of negative charges near the junction

(d) concentration of positive and negative charges near the junction

40. The ratio of forward biased to reverse biased resistance for p-n junction diode is

(a) $10^{-1}:1$

(b) $10^{-2}:1$

(c) $10^{4} : 1$

(d) $10^{-4} : 1$

41. In the middle of the depletion layer of a reverse- biased p-n junction, the

(a) electric field is zero

(b) potential is maximum

(c) electric field is maximum

(d) potential is zero

42. Centre tapped fullwave rectifier uses

(a) four diodes **(b)** six diodes

(c) two diodes **(d)** one diode

43. The average value of output direct current in a half wave rectifier is

(a)

(b)

(c)

(d)

44. The average value of output direct current in a full wave rectifier is

(a)

(b)

(c)

(d)

45. In a half wave rectifier, the r.m.s. value of the a.c. component of the wave is

(a) equal to d.c. value

(b) more than d.c. value

(c) less than d.c. value

(d) zero

***

A-II

FILL IN THE BLANKS

1. **A single junction diode is used in _______wave rectifier circuit.**
2. **The minority charge carries in *p* type semiconductors are _____.**
3. **The reception is noisy in case of _____ modulation .**
4. **Space waves propagate through_____.**
5. **The carrier to transmit video signal in TV is ____ modulated.**
6. **The highest energy level occupied by an electron at zero Kelvin is called ____.**
7. **The conductivity of intrinsic semiconductors____ with increases in temperature .**
8. **Electron vacancies are called____**
9. **In any circuit using NPN transistor the emitter junction is ____ biased.**
10. **In most circuits using NPN transistor the collector junction is _____ biased.**
11. **The output of a _____ wave rectifier contains more a.c. than d.c.**
12. **The output current in a full wave rectifier is _____dc.**
13. **All logic gates have _____output.**
14. **For_______ gate all the inputs have to be 1 to get 1 as output.**
15. **In ______ gate the logic operation is that of addition .**
16. **_____ is a universal gate.**
17. **The majority charge carriers in *p* type semiconductor is_____.**
18. **The ripple factor of a full wave rectifier is _____**
19. **The maximum rectification efficiency of a half wave rectifier is _____**
20. **The valency of an impurity element added to germanium crystal to prepare one n-type semiconductor is ____.**
21. **A_____ circuit is designed to convert ac to unidirectional current.**
22. **_____ gate has only one input.**
23. **The emitter of a bipolar transistor is _______ doped.**

***

A-III

WRITE THE ANSWER IN ONE WORD/SENTENCE :

1. **How does the energy gap in the intrinsic semiconductor varies on introducing a penta valent impurity in it?**
2. **Whose drift velocity is greater holes or electrons.**
3. **On increasing the reverse bias in P - N junction diode how does the width of depletion layer vary?**
4. **In which bias the resistance of P - N junction diode is very high?**
5. **A transistor is used as an amplifier in common emitter mode rather that in common base mode why?**

***

SECTION-B

2 MARKS EACH QUESTION

1. **What do you understand by intrinsic and extrinsic semiconductors?**
2. **Calculate the reverse resistance of a junction diode for which the reverse current increase from $20\mu A$ to $100\mu A$ when the reverse voltage is increases from 2V to 10V.**
3. **Explain the meaning of word "Transistor".**
4. **Why the base is designed thin in comparison to emitter and collector in a transistor'?**
5. **Draw symbols of P - N - P and N -- P - N transistors.**
6. **What is difference between transformer and transistor?**
7. **Draw symbol of NAND and NOR gate.**
8. **What is Universal gate? Why they are called so ?**
9. **Write down the truth tables of 2 input NAND and NOR gates.**
10. **Draw the circuit diagram of half wave rectifier.**
11. **What is meant by valence band and conduction band.**
12. **What is doping? Why it is necessary?**

13. **What is meant by forbidden energy gap and Fermi level.**

14. **Explain the following terms with reference to a P - N junction :**

    1. **Depletion layer**

    a. **2.Potential barrier.**

15. **What is P - N diode? Explain the formation of depletion layer in it.**

16. **In a P - N junction diode if the potential is changed by 0.12 volt then current changes by 1 .5 mA. Find out dynamic resistance of diode.**

17. **The current gain of a transistor in CB mode is 0.987. What will be its current gain in CE mode?**

18. **Mention two advantages of full wave rectifier in comparison to a half wave rectifier.**

19. **For a transistor $\beta = 100$. $I_b = 100\mu A$. Find**

    (i) I_C and (ii) I_e

20. **Write down the Truth tables of 2input OR and AND gates.**

21. **Draw the output characteristics of a npn tranistor in CE connection.**

***

SECTION-C

LONG QUESTION

1. **With a neat circuit diagram explain V-I characteristic of a PN junction diode.**

2. **With a neat circuit diagram explain the input and output characteristics of a npn transistor in common emitter configuration.**

3. **With a neat circuit diagram explain the working of a centre tapped full wave rectified using pn junction diodes.**

***

ANSWER KEY

SECTION –A

A-I

MULTIPLE CHOICE QUESTIONS (MCQ)

1. a
2. b
3. c
4. c
5. b
6. d
7. b
8. d
9. c
10. b
11. d
12. b
13. d
14. a
15. c
16. d
17. a
18. b
19. c
20. c
21. a
22. b
23. c
24. c
25. c
26. c
27. d
28. a
29. c
30. a
31. c
32. a
33. b
34. b
35. c
36. c
37. d
38. a
39. d
40. d
41. c
42. a
43. a
44. d
45. b

***

A-II

FILL IN THE BLANKS

1. half
2. electrons
3. amplitude
4. troposphere
5. amplitude
6. fermi
7. increase
8. holes
9. forward
10. reverse
11. half
12. pulsating
13. one
14. and
15. or
16. nand or nor
17. holes
18. 0.48
19. 40.6%
20. 5
21. rectifier
22. not
23. heavily

***

A-III

ONE WORD

1. The energy gap decreases
2. The drift velocity of electrons is great than that of holes
3. The width of depletion layer increases.
4. Reverse bias
5. Because in common emitter amplifier the voltage gain and power gain is more

***

SECTION-B

2 MARKS

1. Intrinsic semiconductors;

Pure semiconductors are called intrinsic semiconductors example germanium and silicon. The number of electrons and holes are equal in it.

Extrinsic semiconductors

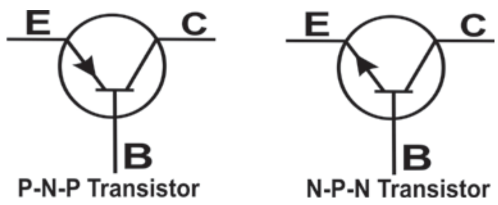
The semiconductors containing impurities of pentabvalent of trivalent substances are called extrinsic semiconductors. The electron density is not equal to hole density

2. $r = \frac{(10 - 2)V}{(100-20)\mu A} = \frac{8}{10} \times 10^6$ohm = 10^5ohm

3. Transistor is short form of transformation of resistance. The low resistance of forward biased function is transformed to high resistance of reverse biased junction. Therefore it is called as transistor.

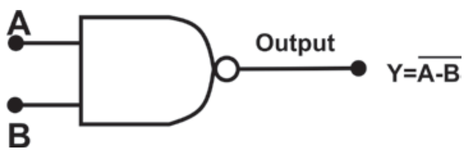
4. A thin and lightly doped base region will contain a smaller number of majority charge carriers. This will reduce the recombination rate of electrons and holes when majority charge carriers more from emitter to collector.

5. P-N_P Transistor N-P-N Transistor

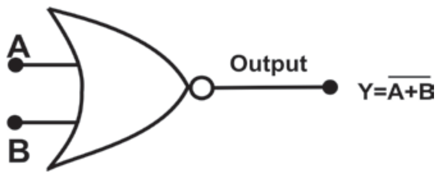


6. The transformer changes alternating voltage but the power remains same. Amplifier increases power of alternating voltage.

7.



Symbol of NAND gate



Symbol of NOR gate

8. Nor and NAND gates are called as universal gates because by the combination of these gates other gates can be formed.

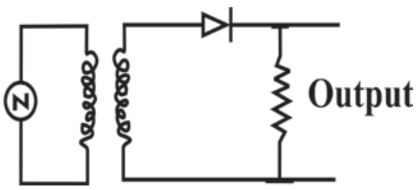
9. NAND

Input		Output
A	**B**	**A (NAND) B**
0	0	1
0	1	1
1	0	1
1	1	0

NOR

Input		Output
A	**B**	**A (NOR) B**
0	0	1
0	1	0
1	0	0
1	1	0

10.



11. $VB -$ group of energy levels of valence electrons forming the band.

$CB -$ energy band next to VB lowest unfilled band.

12. The process of introducing the impurities in a pure semiconductor is called doping To from N- type and P- type semiconductors dopping is necessary.

13. The region between VB & CB which is devoid of permissible energy level.

14. 1. Uncovered charge. The positive immobile ions present on N- region and negative immobile ions present in P –region near the junction are called uncovered charge.

2. Depletion layer : The layer on either side of P-N Junction which does not contain any charge carrier (neither positive charge carrier nor negative charge carrier) is called depletion layer

2. Potential barrier : The potential difference developed across the depletion layer is called the potential barrier.

15. When P- type semiconductor by some special techniques as etching or sandwiching, then the junction formed is called P-N diode. Hence it is called P-N junction diode. When P-N junction diode is made, then free electrons present in N- type get diffused across the boundary into P-type and few number of holes diffuse into N- type from P-type. Thus a thin film (less than 10^3 cm) at the junction becomes free from holes and electrons. This thin film is called depletion layer.

16. Given : $\Delta V = 0.12\ volt.\ \Delta I = 1.5mA = 1.5 \times 10^{-3}A$

Formula : $r_d = \Delta V \Delta d$

Or $r_d = 0.121\ \ 5 \times 10^{-3}$

$= 0.121.5 \times 10^3 = 80\ ohm$

17. Given : $\alpha = 0.987$

Formula :$\beta = \alpha 1 - \alpha$

$\beta = 0.9871 - 0.987 = 75.93$

18. More efficiency

Ripple is low.

19. $\alpha = \frac{\beta}{\beta+1} = \frac{100}{101}$

$$\beta = \frac{I_c}{I_b} \rightarrow I_c = \beta I_B = 100 \times 100\mu A$$

$$= 10^{-2}A$$

$$I_e = \frac{I_c}{\alpha} = \frac{10^{-2}A}{100} \times 101 = 1.01 \times 10^{-2}A$$

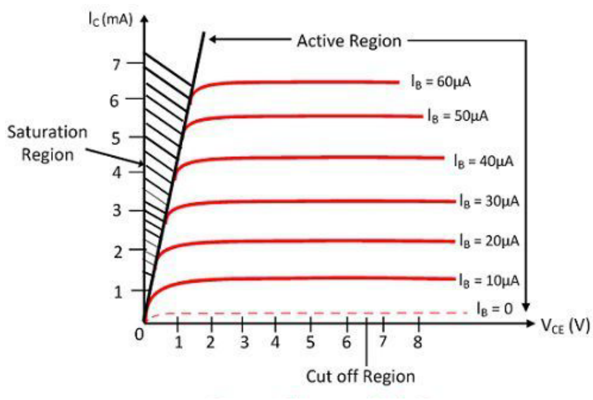
20. OR gate

Input		Output
A	**B**	
0	0	0
0	1	1
1	0	1
1	1	1

AND gate

Input		Output
A	**B**	
0	0	0
0	1	0
1	0	0
1	1	1

21.



CHAPTER FIFTEEN

(COMMUNICATION SYSTEM)

SECTION –A

A-I

MULTIPLE CHOICE QUESTIONS (MCQ)

1. **The waves that propagate through troposphere is**
   (a) ground waves
   (b) Space wave
   (c) sky wave
   (d) around waves.

2. **Sound wave are not directly transmitted after converting them into electric signals because .**
   (a) They propagates with speed of sound
   (b) Their frequency does not remain constant
   (c) For their transmission very high antenna is needed.
   (d) Their energy is very high

3. **The superimposing of audio waves with carrier wave is called.**
   (a) Transmission
   (b) Reception
   (c) Modulation
   (d) Defection

4. **The frequency range used for T.V. transmission is**
   (a) 30-300 MHz
   (b) 30-300 GHz
   (c) 30-300 KHz
   (d) 30-300 Hz

5. **The periodic time of communication satellite is**
   (a) 1year
   (b) 1 day
   (c) 12 hours
   (d) 12 minuets

6. **T.V. Signals are reflected by**
   (a) Mesosphere
   (b) Ionosphere
   (c) Troposphere
   (d) None of the above

7. **The short wave band of radio waves are transmitted through**
   (a) Sky wave propagation
   (b) Ground wave propagation
   (c) Artificial satellite

(d) Direct sending from transmitter to receiver.

8. The size of the antenna is of the order of

(a) λ

(b) 10λ

(c) $10^2\lambda$

(d) $10^{-2}\lambda$

9. The audio carrier in case of TV transmission is

(a) AM

(b) FM

(c) Phase modulated

(d) Not modulated

10. The frequency range of sky waves is

(a) 1 to 2 MHz

(b) 2 to 30 MHz

(c) 3 to 30 MHz

(d) 30 to 300 Hz

11. The height of a geostationary satellite is

(a) 300 km

(b) 6400km

(c) 36000km

(d) 42400km

12. The bandwidth in AM transmission is

(a) 5 KHz

(b) 100 KHz

(c) 1 MHz

(d) 10KHz

13. Satellite communication takes place in frequency range

(a) 5 KHz to 1500 KHz

(b) 340 khz to 440 KHz

(c) 2000khz to 2500 KHz

(d) above 2500 KHz

14. The waves which get reflected from ionosphere is

(a) ground wave

(b) sky wave

(c) space wave

(d) line of sight waves

15. In case of TV communication video signal is

(a) Frequency modulated

(b) Amplitude Modulated

(c) Phase modulated

(d) Not modulated

***

A- II

FILL IN THE BLANKS

1. **The range of audio signals is ______**
2. **The frequency of carrier waves is of order of _________**
3. **The order of frequency of radio waves which can be transmitted by total internal reflection through ionosphere is ____________**
4. **The band width of AM waves is _________**
5. **The band width of FM transmission _____________**
6. **Channel width of TV broadcast is ____________**
7. **Satellite communication takes place in the in the frequency band of ______ to ______**
8. **Carrier waves are wave of _____ frequency**
9. **In terms of wavelength λ, the minimum size of antenna is______-**
10. **The reception is noisy in case of _____ modulation**
11. **_____ modulation is preferred for high fidelity radio reception.**
12. **The operating frequency of communication satellites lies in the __________region of e.m. spectrum.**

***

A-III

WRITE THE ANSWER IN ONE WORD/ SENTENCE

1. **What is modulation ?**
2. **Define modulation index in AM.**
3. **Define modulation index in FM.**
4. **What type of modulation is used in audio and video transmission of TV signals.**
5. **Define critical frequency for sky waves.**
6. **What is skip distance**
7. **Give are reason for necessity of modulation.**

***

SECTION-B

COMMUNICATION SYSTEM VERY SHORT ANSWER TYPE QUESTION : 2 MARKS EACH

1. **What is importance of modulation index?**
2. **Which device is used to transmit the T.V. signals upto long distances ?**
3. **What is modulation ?**
4. **F.M signals are less sensitive as compared to AM signals. Why ?**
5. **Write limitation of frequency modulation.**
6. **Write any two reasons for necessity of modulation**
7. **Distinguish between sky wave propagation and space wave propagation.**
8. **Differentiate AM and FM (Any two points)**
9. **What is the role of satellite in communication?**

***

SECTION – C

LONG QUESTION

1. **What is modulation ? Explain need of modulation**
2. **Explain AM and FM.**
3. **What are limitations of amplitude modulation ?**
4. **Write advantage and disadvantage of frequency modulation ?**

ANSWER KEY

SECTION –A

A-I

MULTIPLE CHOICE QUESTIONS (MCQ)

1. b
2. c
3. c
4. a
5. b
6. d
7. a
8. a
9. b
10. c
11. c
12. d
13. a
14. b
15. b

***

A-II

FILL IN THE BLANKS

1. 20Hz to 20000 Hz
2. MHZ
3. 30-300MHz
4. 10kHz
5. 200 kHz
6. 6MHz
7. 3.7GHz to 6.5GHz
8. High
9. $\lambda/4$
10. Amplitude
11. Frequency
12. Microwave

***

A-III

WRITE THE ANSWER IN ONE WORD / SENTENCES

1.	**6**
2	**7**
3	**8**
4	**9**
5	**10**

***

SECTION-B

2 MARKS QUESTIONS

1. The modulation index determines the strength and quality of the transmitted signals if the modulation index is small the amount of variation in the carrier amplitude will be small.

2. Communication satellites are used transmit the T.V signals upto long distances.

3. Modulation is process in which the signal of low frequency (audio signals) are superimposed over a signal of high frequency (carrier signals)

4. In FM transmission the information (message) in the carrier waves is in the form of variation (change) in frequency in the AM the noise get amplitude modulated. Hence the amplitude carrier wave varies . That is why the FM signals are less sensitive as compared to AM signals.

5.
1. Area of reception of FM is much smaller.
2. About 10 times wider channel is required by FM.
3. FM receives and transmitters are very complex and costly.

***

SECTION-C
LONG QUESTIONS ANSWER:

1. Modulation

Modulation is a process in which the signal of low frequency (audio signals) superimposed over a signals of high frequency (carrier signal) . Such that same properties of carrier wave like amplitude frequency or phase varies in accordance with the instantaneous value of audio signals.

Need of Modulation

Modulation is necessary for a low frequency signal when it is to be sent to a distant place so that the information may not die out in the way itself as well as for proper identification of a signal and to keep the height of antenna small also.

For the transmission of electromagnetic waves the length of antenna should be of order of wavelength of the transmitted waves. Since, $\lambda = cv$ therefore the required length of antenna for the audible range should be equal to $3 \times 10820{,}000 = 1.5 \times 10^4 m\ to\ 3 \times 10820 = 1.5 \times 10^7$.

This length of antenna is not possible in practical. Now if the waves of 300kHz or more than it are to be transmitted then the required length of antenna will be $3 \times 1083{,}00{,}000 = 100\ m$ or less than it. The antenna of the size can be constructed easily. Hence to transmit the audio signals they are superimposed with the radio waves of frequency of order of Mega Hertz. These waves are called carrier waves and this process is called modualtin.

2. The equation of carrier wave is given as

$e_c = E_c\ Cos\ (\omega_e t + \theta)$

Where e_c is instantaneous value of carrier signal. E_c is amplitude of carrier wave. ω_e is angular frequency and θ is phase angle. Thus , there are three types of modulation corresponding to $E_c\ m_e\ and\ \theta$.

1. Amplitude modulation

When an audio frequency (modulating) signal is superimposed that the amplitude of modulated wave is liner function of instantaneous value of modulating signal, then this type of modulation is called as amplitude modulation.

2. Frequency modulation

   Frequency modulation is that modulation in which the frequency of carrier wave varies in accordance with the instantaneous value of modulating signal. In this modulation the amplitude and phase of modulating signals are equal to that of carrier. Wave.

3. The information (disadvantages) of amplitude modulation are as follows.

1. Efficiency of Amplitude modulation is smaller.

   An modulation the message signals are contained in side bands, but not contained in the carrier wave. It is found that in amplitude modulation only one third power is contained inside bands. Remaining power is contained in carrier wave. Hence efficiency decreases.

2. Amplitude modulation is more likely to suffer from noise

3. In Amplitude modulation the fidelity of reception is less.

   The range of audio signal is20 Hz to20 kHz . Hence the bandwidth must be 40 kHz. But the disturbance created by the nearby radio station should be taken into account and hence the bandwidth is kept only of about 20 kHz.

4. It s transmission range is low. Due to less power it is not possible to transmit the signals up to long distance inspite of these limitations the AM is mostly used for the transmission of audio signals.

4. Advantages

1. Frequency modulation is inherently and practically free from the effects of noise

2. In frequency modulation, noise can further be decreased by increasing the diviation8

3. FM receiver can further be improved with the help of limiters to remove amplitude changes, if any which controls the noise level

4. In FM it is possible to operate many independent transmitters on same frequency without interference.

Disadvantages

1. About 10 times wider channel is required by FM.
2. Area of reception for FM is much smaller.
3. FM receivers and transmitters are very complicated and costly.

-----x------