# PHYSICS

# MODEL PAPER – 1

**Time : 3 Hours + 15 Minutes ]** **[ Total Marks : 70**

**INSTRUCTIONS TO THE CANDIDATES :**

1. Candidates are required to give their answers in their own words as far as practicable.
2. Figure in the right hand margin indicate full marks.
3. While answering the questions, candidate should adhere to the word limit as far as practicable.
4. 15 Minutes of extra time has been allotted for the candidates to read the questions carefully.
5. This question paper is divided into two sections—**SECTION – A** and **SECTION – B** .
6. In **SECTION – A** there are **70 Objective Type Question** , out of which only 35 objective questions be answered. Darken the circle with blue/black ball pen against the correct option on OMR Sheet provided to you. Do not use Whitener/Liquid/Blade/ Nail on OMR paper; otherwise the result will be invalid.
7. In **SECTION – B** , there are **20 Short Answer Type Question** (each carrying 2 marks), out of which any 10 questions are be answered.

   Apart from this, there are **6 Long Answer Type Question** (Each Carrying 5 marks), out of which 3 questions are to be answered.
8. Use of any electronic device is prohibited.

## SECTION – A : Objective Type Questions

**Directions :** *There are 70 Objective Type Questions, out of which only 35 objectives questions to be answered. For each question, mark the correct option on the* **OMR** *answer sheet.*

35 × 1 = 35

1. Capacity of any condenser does not depend upon :
   (A) shape of plates (B) size of plates
   (C) charges on plates (D) distance between plates
2. The device which works of both modulation and demodulation is called :
   (A) Laser (B) Radar
   (C) Modem (D) Fax
3. A magnet is situated near a closed conductor. Current can be produced in the conductor, if :
   (A) only magnet is in motion
   (B) only conductor is in motion
   (C) both magnet and conductor are in motion
   (D) there is relative motion between magnet and conductor
4. Picofarad is the unit of :
   (A) electric charge (B) intensity of electric field
   (C) electric capacity (D) electric flux
5. To convert a galvanometer into an ammeter, one needs to connect a :
   (A) low resistance in parallel
   (B) low resistance in series
   (C) high resistance in parallel
   (D) high resistance in series
6. An electron of charge $e$ moves parallel to uniform lines of force in magnetic field $B$ with velocity $v$. Force acting on electron is :
   (A) $evB$ (B) $ev/B$
   (C) zero (D) $Bv/e$
7. The nature of electron beams moving with uniform velocity in the same direction will be :
   (A) converging (B) diverging
   (C) parallel (D) none of these
8. The fringe width in interference of light due to two coherent sources is :
   (A) proportional to wavelength
   (B) inversely proportional to wavelength
   (C) proportional to square of wavelength
   (D) inversely proportional to square of wavelength
9. Photocell is based on :
   (A) chemical effect of current
   (B) photo-electric effect
   (C) magnetic effect of current
   (D) electro-magnetic induction
10. If in a logic gate output ($Y$) is obtained by the product of its both inputs ($A.B$), then the gate is :
    (A) AND (B) OR
    (C) NOR (D) NOT
11. The motion of electron inside the conductor is :
    (A) Uniform (B) Accelerated
    (C) Drifting (D) Decelerated
12. If any ammeter is shunted, then the total resistance of the circuit :
    (A) increases (B) decreases
    (C) remains same (D) none of these
13. In visible spectrum, which colour has larger wavelength ?
    (A) Red (B) Yellow
    (C) Blue (D) Violet
14. Which one of the following electromagnetic radiations has minimum wavelength ?
    (A) Ultraviolet (B) X-rays
    (C) Microwaves (D) $\gamma$-rays

15. The concept of secondary wavelets was given by :
(A) Fresnel (B) Maxwell
(C) Huygens (D) Newton

16. Quantisation of charge indicates that :
(A) Charge, which is a fraction of charge on an electron, is not possible
(B) A charge cannot be destroyed
(C) Charge exists on particles
(D) There exists a minimum permissible charge on a particle

17. X-rays are :
(A) moving electron (B) moving positive ion
(C) moving negative ion (D) electromagnetic waves

18. Surface density of charge is :
(A) $\sigma = \frac{Q}{A}$ (B) $\sigma = \frac{Q}{l}$
(C) $\sigma = \frac{Q}{V}$ (D) $\sigma = Q \cdot A$

19. Colour code of carbon resistance for blue colour is :
(A) 3 (B) 4
(C) 5 (D) 6

20. Ampere-hour is the unit of :
(A) power (B) charge
(C) energy (D) potential difference

21. Energy of photon is equal to :
(A) $h\nu$ (B) $\frac{h}{\nu}$ (C) $\sqrt{h\nu}$ (D) $\sqrt{\frac{h}{\nu}}$

22. 1 V equals to :
(A) 1 J (B) 1 $JC^{-1}$ (C) 1 $CJ^{-1}$ (D) 1 JC

23. Potential energy of a charged conductor is :
(A) $CV^2$ (B) $\frac{1}{2}CV^2$ (C) $\frac{1}{3}CV^2$ (D) $\frac{1}{4}CV^2$

24. The resistance of Ammeter is :
(A) small (B) large
(C) very small (D) very large

25. Source of solar energy is :
(A) nuclear fission (B) nuclear fusion
(C) Both 'A' and 'B' (D) None of these

26. The electrical resistance of a conductor depends upon :
(A) size of conductor
(B) temperature of conductor
(C) geometry of conductor
(D) all of above

27. Ohm's law is valid when the temperature of conductor is :
(A) very low (B) very high
(C) varying (D) constant

28. The specific resistance of a conductor increases with :
(A) increase in temperature
(B) increase in cross-sectional area
(C) decrease in length
(D) decrease in cross-sectional area

29. EMF of a cell is measured by
(A) Voltmeter (B) Ammeter
(C) Galvanometer (D) Potentiometer

30. The angle of magnetic dip at magnetic equator is :
(A) 0° (B) 90°
(C) 45° (D) 60°

31. The working of dynamo is based on the principle of :
(A) heating effect of current
(B) electromagnetic induction
(C) magnetic induction
(D) electric induction

32. Dimension of permeability is :
(A) $MLT^{-2}I^{-2}$ (B) $MLT^2I^{-2}$
(C) $MLT^2I^2$ (D) $MLT^{-2}I$

33. What is the angle of dip at the magnetic poles ?
(A) 30° (B) 0°
(C) 45° (D) None of these

34. Earth's magnetism was discovered by :
(A) Gauss (B) Oersted
(C) Ampere (D) Gilbert

35. Which of the following has a low value in ferrites ?
(A) Conductivity (B) Permeability
(C) Magnetic susceptibility (D) All the above

36. Energy density of a magnetic field $\vec{B}$ is :
(A) $\frac{B^2}{\mu_0}$ (B) $\frac{B^2}{2\mu_0}$ (C) $\frac{B^2}{3\mu_0}$ (D) $\frac{B^2}{4\mu_0}$

37. Which quantity decreases in step-down transformer ?
(A) Current (B) Voltage
(C) Power (D) Frequency

38. Lenz's law is a consequence of the law of conservation of :
(A) charge (B) energy
(C) induced emf (D) induced current

39. The unit of reactance is :
(A) Farad (B) Mho
(C) Ohm (D) ampere

40. A choke is used as a resistance in :
(A) dc circuits (B) ac circuits
(C) both ac and dc circuits (D) neither 'A' nor 'B'

41. In a step-up transformer, no. of turns in primary and secondary coils are $N_1$ and $N_2$ then :
(A) $N_1 > N_2$ (B) $N_2 > N_1$
(C) $N_1 = N_2$ (D) $N_1 = 0$

42. If $N_1$ and $N_2$ are numbers of primary and secondary coils of a step-up transformer, then :
(A) $N_1 > N_2$ (B) $N_2 > N_1$
(C) $N_1 = N_2$ (D) $N_1 = 0$

43. The convert a galvanometer into volmeter requirement is of :
(A) high resistance (B) low resistance
(C) condenser (D) inductor

44. Electromagentic waves can be deflected by :
(A) Electric field only (B) Magnetic field only
(C) Both 'A' and 'B' (D) None of these

45. EMW are produced by :
(A) charge in uniform motion only
(B) charge at rest only
(C) accelerated or deccelerated charge only
(D) all of the above

46. The unit of Poynting vector is :
(A) $W/m^2$ (B) $J/m^2$
(C) T/m (D) Hertz

47. The unit of ratio of magnetic field *B*and electrical field *E*(*B*/*E*) is
(A) $ms^{-1}$ (B) $sm^{-1}$
(C) ms (D) $ms^{-2}$

48. When we see an object, then the image formed on retina is :
(A) real and erect (B) real and inverted
(C) virtual and erect (D) virtual and inverted

49. A biconvex lens ($\mu = 1.5$) has equal curvature each of 20 cm. The power of the lense is :
(A) 5D (B) 10D
(C) 2.5D (D) 20D

50. Which of the following is correct for refractive index of mean colour (yellow colour) ?
(A) $\mu = \frac{\mu_r + \mu_v}{2}$ (B) $\mu = \frac{\mu_r - \mu_v}{2}$
(C) $\mu = \frac{\mu_r}{2}$ (D) $\mu = \frac{\mu_v}{2}$

51. The minimum orbital angular momentum of an electron in a hydrogen atom is :
(A) $h$ (B) $\frac{h}{2}$ (C) $\frac{h}{2\pi}$ (D) $\frac{h}{\lambda}$

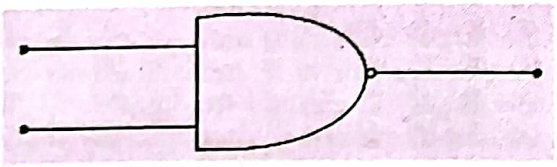
52. The atomic number and mass number for a specimen are Z and A respectively. The number of neutrons in the atom will be :
(A) $A$ (B) $Z$
(C) $A + Z$ (D) $A - Z$

53. Which of the relations is correct for radioactive atom ?
(A) Half-life = Average life
(B) Half-life = 2 × Average life
(C) Half-life = 1.6931 × Average life
(D) Half-life = 0.6931 × Average life

54. Which one of the following has maximum penetraing power :
(A) X-rays (B) cathode rays
(C) α-rays (D) γ-rays

55. In full wave rectification, if input frequency is 50 Hz, then output frequency will be :
(A) 50 Hz (B) 100 Hz
(C) 25 Hz (D) 200 Hz

56. The given symbol represent the Gate :



(A) AND (B) OR
(C) NAND (D) NOR

57. The decimal number of binary number $(1001)_2$ is :
(A) $(12)_{10}$ (B) $(18)_{10}$
(C) $(9)_{10}$ (D) $(25)_{10}$

58. With the increases of temperature the resistivity of semiconductor :
(A) increases (B) decreases
(C) remains constant. (D) becomes zero

59. Boolean expression for NAND gate is :
(A) $\overline{A \cdot B} = Y$ (B) $\overline{A + B} = Y$
(C) $A \cdot B = Y$ (D) $A + B = Y$

60. Sky wave communication is based upon :
(A) reflection by ionosphere
(B) absorption by ionosphere
(C) transmission through ionosphere
(D) none of these

61. Which of the following eye defects is removed by convex lens?
(A) Nearsightedness (B) Farsightedness
(C) Presbyopia (D) Astigmatism

62. Focal length of eye-lens of a healthy man is about :
(A) 1 mm (B) 2 cm
(C) 25 cm (D) 1 m

63. Rainbow is formed due to combination of :
(A) refraction and absorption
(B) dispersion and focusing
(C) refraction and scattering
(D) dispersion and total internal reflection

64. When concave lense of glass is immersed in water it works as :
(A) Less convergent (B) More convergent
(C) Less divergent (D) More divergent

65. The resolving power of human eye (in minute) is :
(A) $\frac{1}{60}$ (B) 1 (C) 10 (D) $\frac{1}{2}$

66. Cathode rays were discovered by :
(A) Maxwell Clerk James (B) Heinrich Hertz
(C) William Crookes (D) J. J. Thomson

67. Millikan's oil drop experiment makes use of :
(A) Stokes' law (B) Boyle's law
(C) Gas equation (D) Bernoulli' theorem

68. When light enters into glass its wavelenght :
(A) Decreases (B) Increases
(C) Remains the same (D) None of these

69. γ-rays are similar to :
(A) α–rays (B) β–rays
(C) cathode rays (D) X–rays

70. The number of neutrons in an atom of $_{90}Th^{230}$ is :
(A) 90 (B) 140
(C) 230 (D) 320

## SECTION – B : Non-Objective Type Questions

### SHORT ANSWER TYPE QUESTIONS

**Directions :** *Questions Nos. 1 to 20 are of short answer type. Each question carries 2 marks. Answer any ten question on your copy.* $10 \times 2 = 20$

1. What are ohmic and non-ohmic resistances ? Write down one example of both.
2. Explain polarisation of light.
3. Write difference between diamagnetic and paramagnetic materials.
4. Write down two uses of potentiometer.
5. Distinguish among resistance, reactance and impedence for a.c. circuit.
6. State Faraday's law of electromagnetic induction.
7. Write two main features of laser rays.
8. Define Critical angle and write its conditions.
9. Mention three different modes of Propagation used in communication system.
10. What will be the path followed by charged particle moving along magnetic field.
11. What is Doping ?
12. Give the symbol and truth table for AND GATE.
13. What is de-Broglie Wave ? Write an expression for its wavelength ?
14. What is electric charge ?
15. Which are the differences between a real and a virtual image ?
16. Write the definition of wavefront.
17. What do you mean by capacity of a conductor?
18. Define volume density of charge. Write its S.I. unit.
19. Define capacitance. What is its S.I. unit ?
20. What do you mean by equivalent capacitor ?

### LONG ANSWER TYPE QUESTIONS

**Directions :** *Questions Nos. 21 to 26 are Long Answer Type Questions. Answer any 3 out of them.* $3 \times 5 = 15$

21. Define wavefront and Secondary wavelets. Varify laws of reflection or laws of refraction on the basis of Huygene wave theory.
22. Define radioactivity. Write the nature properties and differences among $\alpha$, $\beta$ and $\gamma$ rays.
23. Define Alternating Current (AC), its peakvalue and its R. M. S valve. Derive relation between them after evaluating the expression for R.M.S value ?
24. What do you understand by capacity of any conductor ? Find an expression for the capacity of a cylindrical condenser.
25. Briefly explain the principle of a capacitor. Derive an expression for the capacitance of a parallel plate capacitor, whose plates are separated by a dielectric medium.
26. What is photoelectric emission effect ? What are the laws of photoelectric effect ? How did Einstein explain the observed fact of photo electric effect?

## ANSWER WITH EXPLANATION

### SECTION – A

### OMR ANSWER-SHEET

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 36. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 2. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 37. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 3. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 38. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 4. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 39. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 5. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 40. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 6. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 41. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 7. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 42. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 8. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 43. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 9. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 44. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 10. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 45. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 11. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 46. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 12. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 47. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 13. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 48. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 14. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 49. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 15. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 50. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 16. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 51. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 17. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 52. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 18. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 53. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 19. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 54. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 20. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 55. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 21. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 56. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 22. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 57. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 23. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 58. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 24. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 59. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 25. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 60. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 26. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 61. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 27. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 62. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 28. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 63. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 29. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 64. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 30. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 65. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 31. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 66. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 32. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 67. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 33. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 68. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 34. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 69. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 35. | Ⓐ | Ⓑ | Ⓒ | Ⓓ | 70. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |

## ANSWER

| | | | | |
|---|---|---|---|---|
| 1. (C) | 2. (C) | 3. (D) | 4. (C) | 5. (A) |
| 6. (C) | 7. (C) | 8. (A) | 9. (B) | 10. (A) |
| 11. (C) | 12. (B) | 13. (A) | 14. (D) | 15. (C) |
| 16. (A) | 17. (D) | 18. (A) | 19. (D) | 20. (B) |
| 21. (A) | 22. (B) | 23. (B) | 24. (C) | 25. (B) |
| 26. (D) | 27. (D) | 28. (A) | 29. (D) | 30. (A) |
| 31. (B) | 32. (B) | 33. (D) | 34. (D) | 35. (A) |
| 36. (B) | 37. (B) | 38. (B) | 39. (C) | 40. (B) |
| 41. (B) | 42. (B) | 43. (A) | 44. (C) | 45. (C) |
| 46. (A) | 47. (A) | 48. (A) | 49. (A) | 50. (A) |
| 51. (C) | 52. (D) | 53. (D) | 54. (D) | 55. (B) |
| 56. (C) | 57. (C) | 58. (B) | 59. (A) | 60. (A) |
| 61. (B) | 62. (B) | 63. (D) | 64. (C) | 65. (B) |
| 66. (C) | 67. (A) | 68. (A) | 69. (D) | 70. (B) |

## SECTION – B

1. A resistor is 'ohmic' if as voltage across the resistor is increased, a graph of voltage versus current shows a straight line (indicating a constant resistance). The slope of the line is the value of the resistance. Example—Wire, resistor.

   A resistor is 'non-ohmic' if the graph of voltage versus current is not a straight line. Example—Vaccum tubes, thermistros.

2. Polarization of light refers to the orientation of the oscillations of electromagnetic waves as they propagate. In unpolarized light, the electric field vector oscillate in all possible directions perpendicular to the direction of propagation. Polarized light, however, has its electric field vector ascillating prediominatly in a specific direction. This can occur naturally through scattering or reflection, or artificially through filters or other optical elements.

3. Difference between paramagnetic and diamagnetic substances :

| Paramagnetic Substance | Diamagnetic Substance |
|---|---|
| 1. Those substances, which when placed in magnetic field are feebly magnetized in the direction of the magnetising field. | 1. Those substances, which when placed in a magnetic field are feebly magnetised in a direction opposite to that of the magnetising field. |
| 2. The causes of Paramagnetism is the spin motion of electron. | 2. The causes of diamagnetism is the orbital motion of electrons. |
| 3. Paramagnetic substances obey curie's law. | 3. Diamagnetic substances don't obey curie's law. |

4. **Uses of potentiometer :**
   (i) to measure the potential difference in a circuit.
   (ii) to measure displacement in any direction.
   (iii) to controlling audio equipment using volume controls.
   (iv) to measuring position on a gaming joystick, etc.

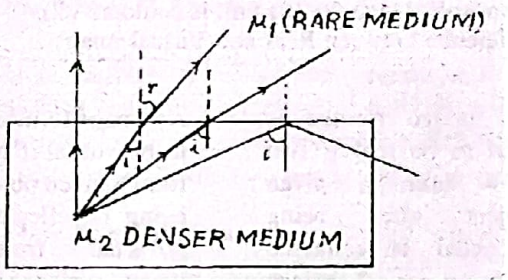
5. **Resistance :** The opposition offered by resistive circuit during flow of current is called resistance.
   **Reactance :** The analogy of resistance in inductive and capacitive circuit is reactance.
   **Impedence :** The analogy of resistance in a LCR circuit is impedence.

6. **Faraday's law :**
   **First Law :** If there is a change in flux linked with a coil then there will be an induced current in that coil.
   **Second law :** The induced current produced in coil be directly proportional to the rate of change of magnetic flux linked with that coil.

7. Laser rays (characteristics) :
   (i) Laser rays is highly directional with Parallel beam.
   (ii) Laser is monochromatic and coherent.
   (iii) Laser light can be sharply focussed.
   (iv) Laser has higher brightness than any other light source.
   (v) It has tunability character, used in communication.

8. **Critical angle**—The angle of incidence in the denser medium for which the angle of refraction is 90° is called critical angle. It is denoted by $i_c$ or C.

   When the angle of incidence is increased to a value greater than $i_c$, there is no refracted ray. The reflected light becomes as bright as the incident light. This is because the whole of the incident light energy is now totally internally reflected. The surface of separation of two media behave like a mirror.




   Condition for 'Total internal reflection'
   (i) Light should travell from denser medium to rarer medium
   (ii) For total internal reflection, angle of incidence must be greater than critical angle

9. There are three modes of propagation used in communication system such as :
   (i) space communication
   (ii) sattelite communication
   (iii) line communication

10. When a charge passes through a magnetic field, it experiences a force called Lorentz Force = $qv\ B \sin\theta$
    When the charge particle moves along the direction of a uniform magnetic field $\theta = 0°$ or 180°.
    $\therefore \quad F = qv\ B = 0$
    Thus the charged particle would continue to move along the line of magnetic field, i.e., straight path.

11. **Doping**—The most convenient and efficient method of generating free electrons and holes is to deliberately impurity to be added in semiconductor is called doping.

12. **AND Gate:**


| Input | | Ouput |
|---|---|---|
| A | B | Y |
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

13. **De-Broglie wave**—In 1924, Louis de Broglie, wrote a doctoral dissertation in which he proposed that since photons have wave and particle nature, perhaps all forms of matter have wave as well as particles properties.
According to De-Broglies, "A matter particle moving with velocity can be treated as wave."
**Expression for De-broglie wavelengths**—If any matter moves with velocity $V$. Then its wavelength ($d$) is given as

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

Where $h$ = Planks constant, $m$ = mass of matter, $v$ = velocity of matter.

14. Electric charge is the basic properties of particle by virtue of which it produces electric field and other phenomenon. It is a scalar quantity. Its unit is coulomb (C).

15. Difference between Real and Virtual image :

| Real image | Virtual image |
|---|---|
| (i) An image formed is said to be real if two rays from a given object after being reflected or refracted from an optical surface actually meet at a point. | (i) An image formed is said to be virtual if two rays from a given object after being reflected or refracted from the optical surface appear to meet or come from a point. |
| (ii) It is always inverted. | (ii) It is always erect. |
| (iii) It may be enlarged, diminished or of same size depending upon the position of the object. | (iii) It is always of bigger (enlarged) size. |

16. **Wavefront**—Wavefront is defined as the imaginary surface constructed by the locus of all points of a wave that have the same phase, i.e. have the identical path length from the source of that wave.
There are three types of wavefront—
(i) Spherical wavefront
(ii) Plane wavefront
(iii) Cylindrical wavefront

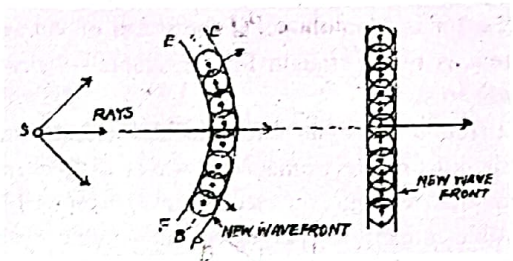
17. **Capacity of a Conductor**—It is defined as the ability of a conductor to store charge. It is also defined as the ratio of electric charge on it to its electric potential. S.I. unit of capacitance is farad (F).

18. **Volume density of charge**—The charge flowing per unit volume is called volume density of charge. S.I. unit of it is $c/m^3$.

19. It is defined as the ability of a conductor to store charge. It is also defined as the ratio of electric charge on it to its electric potential. S.I. unit of capacitance is farad (F).

20. A combination of capacitors in an electric circuit can be replaced by a single capacitor that has the same capacitance as the actual combination of the capacitors. Such a capacitor is called equivalent capacitor.

21. **Wave front**—All points arround a source which vibrates in some plane are known as wavefront.
**Secondary wavelets**—Such wave front obtained after refraction or reflection through a surface is known as secondary wavelets.
**Huygen's Principle**—Christian Huygen's Principle are following :
(i) Each point on a wavefront acts as a fresh source of disturbance. The disturbances from these points are called secondary wavelength.
(ii) The new wave front at any later time is obtained by talking the forward envelope of the secondary wavelets at that distance.




**Reflection of light**—PQ Consider a reflecting surface on which a plane wavefront AB is to find the reflected wavefront, with point A as centre, draw a sphere of radius AD (=BC). From point C. draw a plane CD tangent to the sphere. Then CD represents the reflected wavefront $r$ is the angle of reflection.
Now consider a point $E$ on the incident wavefront as shown in figure when the disturbance from $E$ *reaches* G via point $R$ on the reflecting surface. $CD$ is reflected wavefront, therefore, the time taken by light to travel from any point on the incident wavefront to the corresponding point on the reflected wavefront should always be the same.
If $C$ be the velocity of light, then the time taken by light to go from $E$ to $G$ is given by :

$$t = \frac{EF}{C} + \frac{FG}{C}$$

In right-angled $\Delta AEF$,

$$\sin i = \frac{EF}{AF} \text{ or } EF = AF \sin i$$

In right-angled $\Delta FGC$,

$$\sin r = \frac{FG}{FC} \text{ or } FG = FC \sin r$$

$$r = \frac{AF \sin i}{C} + \frac{FC \sin r}{C}$$

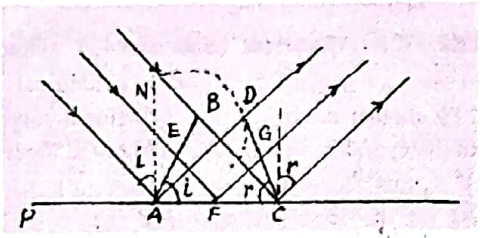
$$t = \frac{AF\sin i}{C} + \frac{(AC - AF)\sin r}{C}$$

or $$t = \frac{AF\sin i + (AC - AF)\sin r}{C}$$

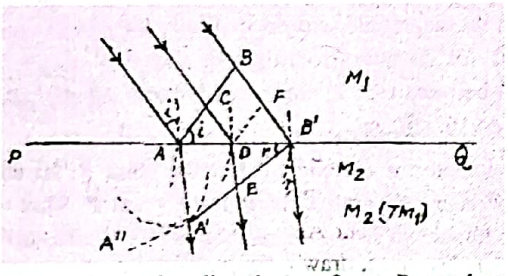
or $$t = \frac{AC\sin r + AF(\sin i - \sin r)}{C}$$

For rays of light from different Points on the incident wavefront, the value of $AF$ are different. But light from different points of the incident wavefront should take the same time to reach the corresponding points on the reflected wavefront. So $t$ should not depend upon $AF$. This is possible if $\sin i - \sin r = 0$ or $\sin i = \sin r$.

or, $\boxed{i = r}$




**Refraction of light**—Let a plane wavefront $AB$ be incident on a refracting plane surface $PQ$ separating a rarer medium of refractive index $M_2$ ($7M_1$).




During the time the disturbance from $B$ reaches $B'$, the disturbance from $A$ must have travelled a distance $AA' = C_2t$ where $C_2$ is the velocity of light in denger medium and $t$ is the time taken by disturbance to travel from $B$ to $B'$. Also $BB' = C_1t$. Where $C_1$ is the velocity of light in the rarer medium. With A as centre and $AA'$ as radius, draw a sphere. Draw a tangent to the sphere. From point $B'$ $B'A'$ will be the refracted wavefront.

Now for $A'EB'$ to be the true refracted wavefront, the following equation should be satisfied.

$$\frac{CD}{C_1} = \frac{DE}{C_2} = \frac{AA'}{C_2} = \frac{BB'}{C_1} \quad \text{... (1)}$$

From $D$, draw $DF$ parallel to $ACB$.

Now $BF + FB' = BB'$

or $$\frac{BF}{C_1} + \frac{FB'}{C_1} = \frac{BB'}{C_1} \quad \text{... (2)}$$

From eqn. (1) and (2)

$$\frac{CD}{C_1} + \frac{DE}{C_2} = \frac{BF}{C_1} + \frac{FB'}{C_1}$$

or $$\frac{BF}{C_1} + \frac{DE}{C_2} = \frac{BF}{C_1} + \frac{FB'}{C_1}$$

or $$\frac{DE}{C_2} = \frac{FB'}{2} \quad [\because CD = BF]$$

$\Delta SABB'$ and $DFB'$ are similar

$$\therefore \frac{B'D}{B'A} = \frac{FB'}{B'B} \quad \text{... (3)}$$

$\Delta SAA'B'$ and $DEB'$ are similar

$$\therefore \frac{B'D}{B'A} = \frac{DE}{AA'} \quad \text{... (4)}$$

From eqn. (4) and (3)

$$\frac{DF}{AA'} = \frac{FB'}{B'B} \quad \text{or} \quad \frac{DF}{C_2t} = \frac{FB'}{C_1t} \quad \text{or} \quad \frac{DE}{C_2} = \frac{FB'}{C_1}$$

This confirm that $A'EB'$ is the true refracted wavefront Now

$$\sin i = \frac{BB'}{AB'} \text{ and } \sin r = \frac{AA'}{AB'}$$

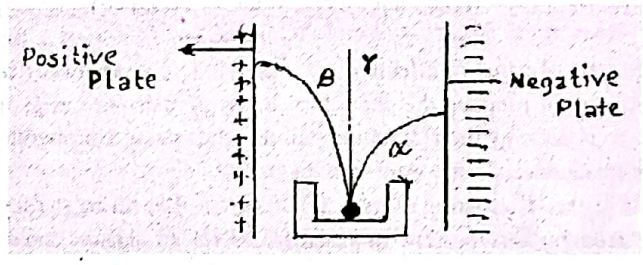
$$\therefore \frac{\sin i}{\sin r} = \frac{BB'}{AB'} \times \frac{AB'}{AA'} = \frac{BB'}{AA'} = \frac{C_1t}{C_2t} = \frac{C_1}{C_2} = \text{Const.}$$

$$\therefore \frac{\sin i}{\sin r} = \text{constant}$$

This constant is refractive index.

**22. Radio-activity**—Henry Bequerel discovered the phenomenon of radioactivity in 1896. He found that certain compound of uranium emitted inivisible radiations which affect on photographic plates. Later on thorium and its compound were also found to behave in a similar way piere curie and madam curie discovered a new element called radium, which showed these property. This phenomena is called radioactivity.

The radiation emitted by a radioactive body are not homogeneous but consist of three distinct types of radiation. These are called $\alpha$, $\beta$ and $\gamma$-rays. Which is shown in following figure.




**Properties, nature and difference are following :**

**α-Particle :**

(i) These are positively charged particles

(ii) These are deflected by electric and magnetic field.

(iii) These affect photographic plates and cause fluorescence.

(iv) These produce strong ionisation

(v) These move with comparatively small velocities.

**β-Particle :**

(i) These are negatively charged particles, each having a mass and a charge equal to that of an electron.

(ii) These are deflected by electric and magnetic fields.

(iii) These affect photographic plates and cause fluorescence.

(iv) These produce less ionisation than α-particle.

(v) These move with greater velocities.

**γ-rays :**

(i) These are electromagnetics wave like light of X-rays.

(ii) These are undeflected by electric or magnetic fields.

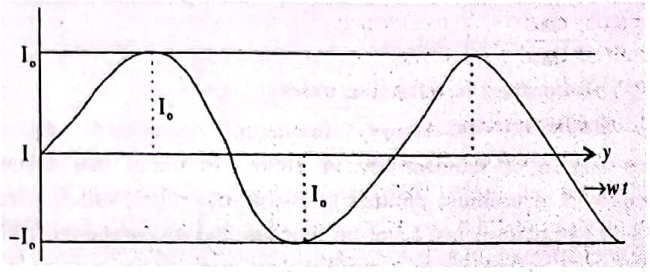
(iii) These produce little or no ionisation.

(iv) These have the strongest penetrating power.

(v) These can pass through many centimetre of lead.

(vi) These effect Photographic plates and cause fluorescence.

**23. Alternative Current (A.C.)**—The current in the coil flows in one direction and for the other half of the period. The current flow in the reverse direction. Such a current is called the alternating current or A.C. It Shown in following graph.




It is given by $I = I_0 \sin(\omega t + \phi)$

where, $I_0$ = current amplitude

$t$ = Time Period

$$\omega = \frac{2\pi}{T}$$

**Peak Value**—$I_0$ is called peak value of Alternative current.

**Root mean square value of AC (RMS)**—RMS value is also called virtual value of effective value of AC is that steady current which would produce the some heat in given resistance in given time as is done by the alternating current when passed through the same resistance for the same time.

Let the Alternating current $T = I \sin \omega t$. Let $d\theta$ be the heat produced by this current in resistance $R$ is an infinitesionally small $dt$

then $d\theta = I^2 R dt$

The total quantity of heat produced over one complete cycle of alternating current is given by

$$\theta = \int_0^T I^2 R dt$$

where $T$ is the time period of AC

$$\text{Now } \theta = \int_0^T (I_0 \sin \omega t)\ R dt = \int_0^T I^2_0 \sin^2 \omega t$$

$$dt = I^2_0\ R \int_0^T \sin^2 \omega t$$

$$\text{But } \int_0^T \sin^2 \omega t\, dt = \int_0^T \frac{1-\cos 2\omega t}{2} dt = \frac{T}{2}$$

$$\theta = I_0^2 R \times \frac{T}{2} \qquad \ldots (1)$$

If $I_v$ be the virtual value of alternating current, then

$\theta = I_0^2 RT$ equating (2) & (1)

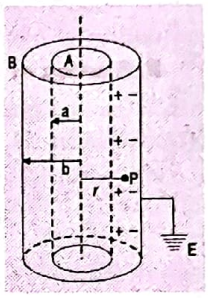
$$I_v^2 RT = I_0 P \frac{T}{2}$$

$$\text{or, } I_v = \frac{I_0}{\sqrt{2}}$$

$$\boxed{I_v = 0.707\ I_0}$$

the virtual value of alternating current is 0.707 times the peak value of alternating current.

**24. Capacity of a cylindrical condenser**—A cylindrical capacitor consists of a solid or a hollow cylindrical conductor surrounded by another coaxial hollow cylindrical conductor. Let the length of the cylinders be $l$ and the radii of the inner and outer cylinders be $R_1$ and $R_2$ respectively. Suppose, a positive charge $Q$ is placed on the inner cylinder and a negative charge $-Q$ is placed on the outer cylinder. If the cylinders are long as compared to the separation between them, the electric field at a point between the cylinders will be radial and its magnitude will depend only on the distance of the point from the axis. Let $P$ be a point between the cylinders at a distance $r$ from the axis (figure).




To calculate the electric field at the point $P$, let us draw a coaxial cylinder of length $x$ through the point $P$. This cylinder together with its two cross sections forms a Gaussian surface. The flux through the cross sections is zero because the electric field is radial wherever it exists and hence is parallel to the cross sections. The flux through the curved part is

$$\Phi = \int \vec{E}.d\vec{S}$$

$$= \int E\, dS$$

$$= E \int dS = E 2\pi r x.$$

The charge enclosed by the Gaussian surface is

$$Q_{in} = \frac{Q}{l} x$$

Thus, from Gauss's law,

$$E 2\pi r x = \left(\frac{Q}{l} x\right) / \varepsilon_0$$

$$\text{or, } E = \frac{Q}{2\pi\varepsilon_0 r l}$$

The potential difference between the cylinders is

$$V = V_+ - V_-$$

$$= -\int_A^B \vec{E}.d\vec{r} = -\int_{R_2}^{R_1} E\,dr$$

$$= -\int_{R_2}^{R_1} \frac{Q}{2\pi\varepsilon_0 rl} dr$$

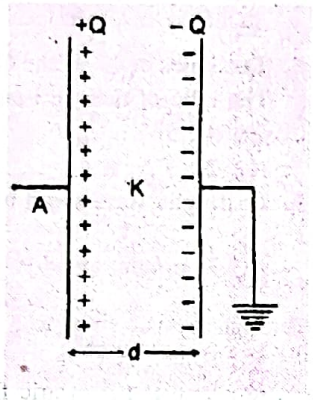
$$= \frac{Q}{2\pi\varepsilon_0 l} \ln \frac{R_2}{R_1}$$

The capacitance is

$$C = \frac{Q}{V} = \frac{2\pi\varepsilon_0 l}{\ln (R_2 / R_1)}$$

**25. Principle of a Capacitor :** A capacitor works on the principle that the capacitance of a conductor increases appreciably when an earthed conductor is brought near it. Thus a capacitor has two plates separated by a distance having equal and opposite charges.

**Parallel Plate Capacitor :**




Consider a parallel plate capacitor having two plane metallic plates A and B, placed parallel to each other (fig). The plates carry equal and opposite charges $+Q$ and $-Q$ respectively.

In general, the electric field between the plates due to charges $+Q$ and $-Q$ remains uniform, but at the edges, the electric lines of force deviate outward. If the separation between the plates is much smaller than the size of plates, the electric field strength between the plates may be assumed uniform.

Suppose $A$ be the area of each plate, '$d$' the separation between the plates, $K$ the dielectric constant of medium between the plates. If $\sigma$ is the magnitude of charge density of plates, then

$$\sigma = \frac{Q}{A}$$

The electric field strength between the plates

$$E = \frac{\sigma}{K\varepsilon_0}$$

where $\varepsilon_0$ = permittivity of free space ... (1)

The potential difference between the plates,

$$V_{AB} = Ed = \frac{\sigma d}{K\varepsilon_0} \quad \text{... (2)}$$

Putting the value of $\sigma$, we get

$$V_{AB} = \frac{(Q/A)\,d}{K\varepsilon_0} = \frac{Qd}{K\varepsilon_0 A}$$

∴ Capacitance of capacitor,

$$C = \frac{Q}{V_{AB}} = \frac{A}{(Qd / K\varepsilon_0 A)}$$

or $$C = \frac{K\varepsilon_0 A}{d} \quad \text{... (3)}$$

This is a general expression for capacitance of parallel plate capacitor. Obviously, the capacitance is directly proportional to the dielectric constant of medium between the plates.

For air capacitor ($K = 1$); capacitance $C = \frac{\varepsilon_0 A}{d}$. This is expression for the capacitance of a parallel plate air capacitor. Obviously, the capacitance of parallel plate (air) capacitor is :

(a) directly proportional to the area of each plate.

(b) inversely proportional to the distance between the plates.

(c) independent of metal of plates.

**26. Phenomena of Photo electric emission**—When light of Suitable frequency illuminates a metal surface, electrons are emitted from the metal surface. These Photo (light) generates electrons are called photo electrons.

**Explanation**—When an electron attempts to come out of a metal the metal surface acquires a positive charge and pulls the electron back to the metal. The free electron is thus held inside the metal surface by the attractive force of the ions. A certain amount of energy (as form of light) is required by an electron to escape from the metal surface. This energy is called work function is denoted by $\phi_0$.

Law of photoelectric effect are following :

(i) For a given material there is a certain minimum frequency of radiation known as the threshold frequency such that if the incident radiation has a frequency below this threshold, no photo electric emission ever take place.

(ii) For the incident frequency *r greater* than the threshold frequency $v_0$, the photoelectric current is directly proportional to the intensity of radiation.

(iii) The maximum kinetic energy of the photoelectrons is directly proportional to only the frequency of incident radiation.

**Einstein Photo electric equation**—Einstein developed this theory and applied it to photon electric emission. According to him, light has photon in form of "Energy pocket is called photon".

Energy of photon; $E = h\upsilon$

Where, $h$ = Plank's constance when photon falls on electron with Energy ($h\nu$), it causes an electron to be ejected out of the metal instantaneously. The electron must first over come the work function $\phi_0$ (inner force) and leave the surface barrier with some velocity (Kinetic energy)

Thus $$E = h\nu = \phi_0 + \frac{1}{2} m v_{max}^2$$

or $$K_{max} = \frac{1}{2} m v_{max}^2 - h\nu - \phi_0$$

or $$[K_{max} = h\nu - h\nu_0]$$

Where $v_0$ = Thresholds frequency

❑❑❑