MODEL PAPER – 4

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. If the distance between the two charges is increased, then the electrostatic potential energy of the charges :
(A) decreases (B) increases
(C) may increase or decrease (D) remains the same

2. The net charge on a charged capacitor is :
(A) zero (B) 1 μC
(C) 1 C (D) infinite

3. When the distance between source of light and screen is increased, then fringe width :
(A) increases (B) decreases
(C) remains same (D) none of these

4. The unit of radioactivity is :
(A) MeV (B) curie
(C) a.m.u. (D) joule

5. Unit of amplification factor of transistor is :
(A) volt (B) ampere
(C) ohm (D) no unit

6. The law, governing the force acting between two electric charges is known as :
(A) Ampere's law (B) Ohm's law
(C) Faraday's law (D) Coulomb's law

7. The value of electric potential at a distance r from a point charge is :
(A) proportional to r
(B) inversely proportional to r
(C) proportional to r^2
(D) inversely proportional to r^2

8. Magnetic moment of the earth is :
(A) 8.0 JT^{-1} (B) 11.5 JT^{-1}
(C) π JT^{-1} (D) 8.0×10^{22} JT^{-1}

9. The phase difference between current and voltage in only capacitive alternating current circuit is :
(A) 0° (B) 90°
(C) 180° (D) 45°

10. The width of diffraction fringes is ..... to the width of interference fringes.
(A) equal (B) unequal
(C) similar (D) none of these

11. The dimensional formula for $\frac{1}{2}\epsilon_0 E^2$ is identical to that of :
(A) $\frac{B^2}{2\mu_0}$ (B) $\frac{1}{2}B^2\mu_0$ (C) $\frac{\mu_0^2}{2B}$ (D) $\frac{1}{2}B\mu_0^2$

12. The Quantum of electric charge in e.s.u. is :
(A) 4.78×10^{-10} (B) 1.6×10^{-19}
(C) 2.99×10^{9} (D) -1.6×10^{-10}

13. If +q charge is placed inside any spherical surface then total flux coming out from whole surface will be :
(A) $q \times \epsilon_0$ (B) $\frac{q}{\epsilon_0}$ (C) $\frac{\epsilon_0}{q}$ (D) $\frac{q^2}{\epsilon_0}$

14. The SI units of electric dipole moment are :
(A) C (B) Cm^{-1}
(C) Cm (D) Nm^{-1}

15. The relative permittivity (ϵ_r) of a medium is :
(A) $\frac{\epsilon}{\epsilon_0}$ (B) $\epsilon \times \epsilon_0$
(C) $\epsilon + \epsilon_0$ (D) $\epsilon - \epsilon_0$

16. Which of the following relations is correct ?

(A) $\vec{E}=\frac{\vec{F}}{q}$ (B) $\vec{E}=q\vec{F}$

(C) $\vec{E}=\frac{q}{\vec{F}}$ (D) $\vec{E}=\frac{1}{4\pi\epsilon_0}\frac{q}{\vec{F}}$

17. Electric-potential is equal to :

(A) $\frac{q}{w}$ (B) $\frac{w}{q}$

(C) wq (D) $\sqrt{wq}$

18. Electrical permitivity of free space is equal to ?
(A) $9 \times 10^9\ Fm^{-1}$ (B) $1.6 \times 10^{-9}\ C$
(C) $8.85 \times 10^{-12}\ Fm^{-1}$ (D) $8.85 \times 10^{-9}\ Fm^{-1}$

19. The value of red colour in colour code of carbon resistance is :
(A) 0 (B) 1
(C) 2 (D) 3

20. The electrical resistance of a healthy man is :
(A) 50,000 Ω (B) 10,000 Ω
(C) 1,000 Ω (D) 10 Ω

21. The value of yellow colour in colour code of carbon resistance is :
(A) 1 (B) 2
(C) 3 (D) 4

22. The resistance of a human body is about :
(A) 12 Ω (B) 120 Ω
(C) 12 KΩ (D) 120 MΩ

23. Siemen is the unit of :
(A) resistance (B) conductance
(C) specific conductance (D) None of these

24. 1 kilowatt hour is commonly known as :
(A) unit (B) 1 faraday
(C) 1 curie (D) None of these

25. Which of the following is the best conductor of electricity ?
(A) Silver (B) Copper
(C) Gold (D) Zinc

26. Unit of eletromotive force is :
(A) newton (B) joule
(C) volt (D) newton/ampere

27. Wheat stone's bridge is used in measuring :
(A) High resistance
(B) Low resistance
(C) Both high and resistance
(D) Potential difference

28. If δ is the angle of dip at a place, then expression for tan δ is :
(A) B_V/B_H (B) B_H/B_V

(C) $B_V B_H$ (D) $\left(\frac{B_V}{B_H}\right)^2$

29. A charge moving with uniform velocity produces :
(A) only an electric field (B) only a magnetic field
(C) electromagnetic field (D) none of these

30. Lorentz force is given by :

(A) $q(\vec{E}+\vec{B})$ (B) $q(\vec{E}+\vec{V}\cdot\vec{B})$

(C) $q(\vec{E}+\vec{B}\times\vec{V})$ (D) $q(\vec{E}+\vec{V}\times\vec{B})$

31. According to Ampere's Circuital law,

(A) $\oint\vec{B}\times\vec{dl}=0$ (B) $\oint\vec{B}.\vec{dl}=\mu_0 I$

(C) $\oint\vec{B}\times\vec{dl}=0$ (D) $\oint\vec{B}.\vec{dl}=\frac{\mu_0 I}{4\pi}$

32. The SI unit of magnetic dipole moment is :
(A) Ampere (B) Ampere metre^2
(C) Tesla (D) None of these

33. The magnetic moment per unit volume is called :
(A) magnetising field (B) magnetic induction
(C) magnetisation (D) magnetic permeability

34. S.I. unit of flux is :
(A) Ohm (B) Weber
(C) Tesla (D) None

35. Which of the following substance have negative and very large value of permeability ?
(A) ferromagnetic (B) paramagnetic
(C) diamagnetic (D) None of these

36. S.I. Unit of pole strength is
(A) N (B) N/A-m
(C) A-m (D) T

37. A bar magnet of magnetic moment M is cut into two parts of equal length. The magnetic moment of either part is :
(A) M (B) M/2
(C) 2M (D) Zero

38. If ϕ is the phase difference between a.c. current and e.m.f., then the value of power factor is :
(A) tan ϕ (B) $\cos^2\phi$
(C) sin ϕ (D) cos ϕ

39. The phase difference ϕ is related to path difference Δx by :

(A) $\frac{\lambda}{\pi}\phi$ (B) $\frac{\pi}{\lambda}\phi$ (C) $\frac{\lambda}{2\pi}\phi$ (D) $\frac{2\pi}{\lambda}\phi$

40. The dimensional formula of L/R is similar to that of :
(A) frequency (B) time
(C) length (D) none of these

41. The dimensional formula of induced emf is :
(A) $[ML^2T^{-2}A^{-1}]$ (B) $[ML^2T^{-3}A^{-1}]$
(C) $[ML^2T^{-3}A^{-2}]$ (D) $[ML^2T^{-2}A^{-2}]$

42. Which of the following is correct for transformer?
(A) It converts A.C. into D.C.
(B) It converts D.C. into A.C.
(C) It increases or decreases D.C. voltage
(D) It increases or decreases A.C. voltage

43. Skin effect is associated with :
(A) a.c. only (B) d.c. only
(C) a.c. and d.c. both (D) None of these

44. The relation between peak current I_0 and root mean square current I_{rms} is :
(A) $I_0 = \sqrt{2} I_{rms}$ (B) $I_0 = I_{rms}$
(C) $I_0 = 2 I_{rms}$ (D) $I_0 = \frac{I_{rms}}{\sqrt{2}}$

45. Nature of electromagnetic waves is :
(A) transverse
(B) longitudinal
(C) both transverse and longitudinal
(D) mechanical

46. The transmission and detection of EMW was first achieved by :
(A) Hertz (B) Maxwell
(C) Marconi (D) Forest

47. Ampere-hour is unit of :
(A) Power (B) Charge
(C) Energy (D) Potential difference

48. Path difference in destructive interference is equal to :
(A) $(n + 1)\lambda$ (B) $(2n + 1)\lambda$
(C) $(2n+1)\frac{\lambda}{2}$ (D) $\left(\frac{n+1}{\lambda}\right)$

49. Width of interference fringe is :
(A) $\beta = \frac{D\lambda}{d}$ (B) $\beta = \frac{d}{D\lambda}$
(C) $\beta = \frac{d\lambda}{D}$ (D) $B = d \cdot D\lambda$

50. SI unit of power of a lens is :
(A) Joule (B) Dioptre
(C) Candela (D) Watt

51. The colour of a thin film is due to :
(A) Scattering (B) Interference
(C) Dispersion (D) Diffraction

52. A unit of which physical quantity is light year ?
(A) Distance (B) Time
(C) Energy (D) Intensity of Light

53. Cylindrical lenses are used to correct the eye defect called :
(A) myopia (B) hypermetropia
(C) astigmatism (D) presbyopia

54. Light owes its colour to its :
(A) frequency (B) velocity
(C) phase (D) amplitude

55. The application of Doppler effect are :
(A) Doppler spectrometer (B) Doppler radius
(C) Doppler velocimeter (D) All of these

56. The electromagnetic wave theory of light fails to explain :
(A) compton effect (B) photoelectric effect
(C) neither (A) nor (B) (D) Both 'A' and 'B'

57. When the tube length of microscope is increased, its magnifying power :
(A) increases (B) decreases
(C) becomes zero (D) remains unchanged

58. The angel of minimum deviation for thin prism of refractive index (μ) is :
(A) $(1 - \mu) A$ (B) $(\mu - 1) A$
(C) $(\mu + 1) A$ (D) $(\mu + 1) A^2\ ms^{-2}$

59. The maximum value of photoelectric current is called :
(A) base current (B) saturation current
(C) collector current (D) emitter current

60. β-rays are deflected in :
(A) gravitational field
(B) only in magnetic field
(C) only in electric field
(D) both in magnetic and electric fields

61. The critical angle of light passing from glass to air is minimum for :
(A) Red colour (B) Green colour
(C) Yellow colour (D) Violet colour

62. Life of a fossil in estimated by :
(A) carbon dating (B) X-ray
(C) γ-ray (D) laser

63. Electron-volt (eV) is the measure of :
(A) charge (B) potential difference
(C) current (D) energy

64. The solar spectrum is :
(A) Continuous (B) Line spectrum
(C) Spectrum of black lines (D) Spectrum of black bands

65. The least stable nucleus is :
(A) ^4_2He (B) $^{12}_6C$
(C) $^{16}_8O$ (D) $^{56}_{26}Fe$

66. Which one of following is charge less?
(A) Alpha particle (B) Beta particle
(C) Photon particle (D) Proton

67. A *p*-type semiconductor is :
(A) positively charged
(B) negatively charged
(C) uncharged
(D) uncharged at absolute zero temperature but charged at higher temperatures

68. Boolean expression of OR gate is :
(A) $A + B = C$ (B) $A \cdot B = 0$
(C) $\overline{A} = A$ (D) $C = \overline{AB}$

69. The decimal number 27 can be written in binary number as :
(A) 110011 (B) 10111
(C) 11001 (D) 10011

70. The modulation index in amplitude modulation :
(A) is always zero (B) lies between 0 and 1
(C) lies between 1 and ∞ (D) can never exceed 0.5

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 is carbon dating ?
2. How can you tell that Lenz's law is a consequence of principle of conservation of energy ?
3. Derive an expression for energy stored in an inductor or capacitor.
4. How can you distinguish between an unpolarised light and a linearly polarised light beam using a polaroid ?
5. Differentiate between interference and diffraction of light.
6. Write change in position of atom of an elements in periodic table due to emission of α and β particles from its Nucleus.
7. Explain Modulation and write types of modulation.
8. Mention some properties of X-rays.
9. How many electrons pass through the lamp in 2 minutes if the current is 300 mA?
10. Give Difference between A.C. and D.C.
11. Define radioactivity and half-life a nuclei.
12. Two long and parallel straight wires A and B carrying currents of 8.0 A and 5.0 A in the same direction are separated by a distance of 4.0 cm Estimate the force on a 10 cm section of the wire.
13. What do you mean by power of accommodation of eye?
14. Explain secondary rainbow.
15. Explain use of 2nd plate in a parallel-plate capacitor.
16. What is the effect of introducing dielectric on capacitance and energy stored per unit volume of a capacitor.
17. State any two similarity and any two dissimilarity between electrostatic and gravitational force.
18. Using theory of drift velocity, express Ohm's law.
19. State principle of potentiometer and define its sensitivity.
20. Write expression for Magnetic field $\vec{B}$ on axis and equator of a short bar magnet.

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. What is interference of light ? Write two essential conditions for obtained interference pattern. Explain young's double slit experiment find the fridge width.
22. Deduce Coulomb's law from Gauss's Theorem?
23. What is Biprism ? Explain Measurement of wavelength of monochromiatic light using biprism.
24. What is the purpose of a transformer? Explain its construction, types and working. Write expression for secondary to primary voltage in terms of the no. of terms in the two coils.
25. What is induced emf ? Write Faraday's law of electromagnetic induction. Express it mathematically.
26. Draw the path of monochromatic light passing through the prism having angle 'A'. Make a diagram showing the variation of angle of deviation with angle of incident.

Establish the relation is $= \frac{\sin i}{\sin r} = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$

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

SECTION – B

1. Carbon dating is one of the archaeology's methods for dating organic objects up to 50,000 years old. This method is based on the idea of radiactive decay of Carbon–14 isotopes over thousands of years.

2. When a North pole of a bar magnet brings near the coil the direction of current in that coil be such that the coil behaves as a North pole.

   And when north-pole brings away the coil the current in coil be such that it behaves as south pole.

   So, this shows that Lenz's law is a direct consequence of the law of conservation of energy because mechanical energy transforms in electrical energy.

3. **Energy stored in capacitor :** Let charge dq be given to capacitor. Then the work done in giving charge dq

   $dW = vdq$

   $\because \quad v = \frac{Q}{C} \quad \therefore \quad dW = \frac{Q}{C}dq$

   Now the total work in giving charge Q.

   $$\int_0^W dW = \frac{1}{C}\int_0^Q Qdq$$

   $$W = \frac{Q^2}{2C}$$

   This work done will store in form of energy in capacitor.

4. **Distinction of unpolarised and polarised light :** The given beam of light is made incident on a polaroid and the polaroid is rotated slowly and the intensity of transmitted beam is observed. If there is no variation in intensity, the given beam is unpolarised, but if the intensity varies with minimum intensity zero twice in a rotation, the given beam is linearly polarised.

5. **Difference between interference and diffraction :**

Interference	Diffraction
(i) It is due to the superposition of two waves coming from two coherent sources.	(i) It is due to the superpositioin of secondary wavelets originating from different parts of the same wavefront.
(ii) The width of the interference bands is equal.	(ii) The width of the diffraction bands is not the same.
(iii) The intensity of all maxima (fringes) is same.	(iii) The intensity of central maximum is maximum and goes on decreasing rapidly with increase of order of maxima.

6. When a α–particle is emitted by the nucleus of any atom then its atomic number is reduced by 2 unit and mass number is reduced by 4 unit.

   Again when β–particle is emitted by the nucleus of an atom, it's atomic number increased by 1 and mass number remains unchanged.

7. The mixing up of the original signal with the eletro-magnetic waves (carrier signal) is called modulation.

   There are three types of modulation.

   1. Amplitude modulation
   2. Frequency Modulation
   3. Phase Modulation

8. (i) They can undergo reflection, refraction, interference diffraction and polarisation.
   (ii) they affect photo graphic plates.
   (iii) They cast shadows of the objects falling in their path due to the reason that they travel in a straight line.
   (iv) They can penetrate the materials that are opaque to visible or UV light.
   (v) They can cause photoelectric effect.
   (vi) They can cause flourescence in certain materials like zinc sulhide, calcium tungstate etc.
   (vii) They ionise the gas through which they pass.
   (viii) They produce secondary X-rays when fall on certain metals. They secondary X-rays are accompanied by fast moving electrons.
   (ix) They are em. waves of very short wavelength and thus earth's atmosphere opaque for X-rays.

9. Here $I = 300\ \text{mA} = 300 \times 10^{-3}\ \text{A}$;
   $e = 1.6 \times 10^{-19}\text{C}$
   $t = 2\ \text{minute} = 120\ \text{sec.}$
   The charge passing through the lamp in 2 min.
   $q = ne \quad (\because \ q = it)$

   $$n = \frac{q}{e} = \frac{300\times10^{-3}\times120}{1.6\times10^{-19}} = 2.25 \times 10^{20}$$

10. Difference between A.C. and D.C. :

A.C.	D.C.
1. It is that current whose magnitude and direction changes with respect to time.	1. It is that current whose magnitude and direction remains same with respect to time.
2. It can't be used in electro-plating.	2. It is used in electro-plating.
3. It is measured by hot wire galvanometer.	3. It is measured by voltmeter.

11. Radioactivity : The phenomenon of emission of invisible radiation from certain elements is called radioactivity.
Half-life period : Half-life of a radio-active element is the duration of time in which half of the nuclei disintegrated.

12. $I_1 = 8.0$ A, $I_2 = 5.0$ A $r = 4$ cm $= 0.04$ m

Now, $F = \frac{\mu_0}{4\pi} \cdot \frac{2I_1I_2}{r}$

$= 10^{-7} \times \frac{2\times8\times5}{0.04}$

$= 10^{-7} \times 100 \times 20$

$F = 2 \times 10^{-5}$ N (Attractive)

13. Power of Accommodation of Eye—The image of near and far objects can be formed on the retina by self adjustment of curvature i.e., focal length of the eye lens. This power of self adjustment of the eye is called the power of accommodation of the eye.

14. A secondary rainbow appears outside of a primary rainbow and develops when light entering a raindrop undergoes two internal reflections instead of just one (as is the case with a primary rainbow). The intensity of light is reduced even further by the second reflection, so secondary rainbows are not as bright as primary rainbows. The colour scheme of the secondary rainbow is opposite of the primary rainbow.

15. The use of second plate in a parallel-plate capacitor is to generate an uniform electric field inside the capacitor and for increase the charge on capacitor.

16. When we introduce dielectric in capacitor, the capaci-tance of capacitor increases by dielectric constant times.
The energy stored per unit volume of a capacitor decreases by $\frac{1}{K}$ times. where K is dielectric constant.

17. Similarities between electrostatic and Gravitational force :
(i) Both forces are conservative in nature.
(ii) Both forces are inversely proportional to the square of distance.
Dissimilarity between electrostatic and gravitational force.
(i) Electrostatic force arises due to charge of body. But Gravitational force arise due to mass of the body.
(ii) Electric force depends on medium between two charges, but Gravitational force doesn't depends on medium between two masses.

18. It is defined as the average velocity with which free electron in a conductor get drifted in a direction opposite to the direction of applied electric field and is given by

$$V_d = \frac{-e\vec{E}\tau}{m}$$

Current density $J = neV_d$

Now $J = \frac{ne^2E\tau}{m} = \frac{E}{\frac{m}{ne^2\tau}} = \frac{E}{\rho}$

Here $\rho = \frac{m}{ne^2\tau}$ = resistivity $\because$ $\frac{1}{\rho} = \sigma$ = conductivity

$\vec{J} = \sigma\vec{F}$, It is microscopic from of ohm's law.

19. The principle of potentiometer : The potential difference across any length of a wire of uniform cross-section and uniform composition is proportional to its length when a constant current flows through it.
Sensitivity : Sensitivity of potentiometer depends on the value of potential gradient 'K'. Sensitivity increases with increase of length of potentiometer wire.

20. $B_{axial} = \frac{\mu_0}{4\pi} \cdot \frac{2m}{r^3}$

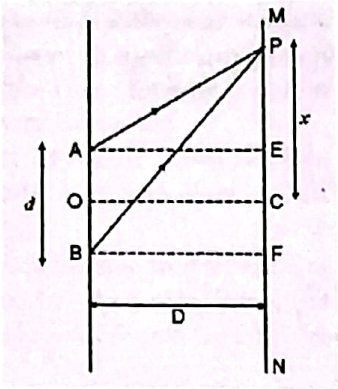
$B_{equatorial} = \frac{\mu_0}{4\pi} \cdot \frac{M}{r^3}$

21. When two light wave from coherent source moves in same direction with same velocity superimpose on each other interference takes place.
Condition for interference :
(i) Source of light should be coherent.
(ii) Light should be monochromatic.
The two wave should be in same plane.
As we know fringe pattern be given as

$$\beta = \frac{D\lambda}{d}$$

(i) When screen moves towards the source D decreases hence width of fringe decreases.
(ii) Due to the increase of separation between the two sites d increases and due to increase in d fringe width decreases.

Coherent source of light are those source of light which emit light wave of same wavelength, same frequency and in same phase or having constant phase difference.
Young's Double Slit Experiments : Suppose in figure A and B are two fine slits, a small distance d apart. Let these are illuminated by a strong source of monochromatic light of wavelength λ. MN is a screen at a distance D from the slits.



The two waves starting from A and B superimpose upon each other, resulting in interference pattern on the screen, placed parallel to slits A and B, O is centre of distance between the slits A and B. Draw AE, BF and OC perpendicular to MN.

The intensity of light at a point on the screen will depend upon the path difference between the two waves arriving at that point. The point C on the screen is at equal distance from A and B. Therefore, the path difference between two waves reaching C is zero and the point C is of maximum intensity. i.e., a central bright fringe is obtianed at C.

Consider a point P at a distance x from C. The path difference between two waves arriving at P

$$= BP - AP \quad \ldots (1)$$

Let O be the mid-point of AB, and

$$AB = EF = d,\ AE = BF = D$$

In given fig.,

$$PE = PC - EC = x - d/2$$

and $$PF = PC + CF = x + d/2$$

In Δ BPF,

$$BP = [BF^2 + PF^2]^{1/2}$$
$$= [D^2 + (x + d/2)^2]^{1/2}$$
$$= D\left[1+\frac{(x+d/2)^2}{D^2}\right]$$

Expanding Binomially, we get

$$BP = D\left[1+\frac{1}{2}\frac{(x+d/2)^2}{D^2}\right] \quad \ldots (2)$$

In ΔAPE,

$$AP = [AE^2 + PE^2]^{1/2}$$
$$= [D^2 + (x - d/2)^2]^{1/2}$$
$$= D\left[1+\frac{(x-d/2)^2}{D^2}\right]^{1/2}$$

On Expanding Binomially

$$AP = D\left[1+\frac{1}{2}\frac{(x+d/2)^2}{D^2}\right] \quad \ldots (3)$$

Hence path difference :

$$(BP - AP) = D\left[1+\frac{(x+d/2)^2}{2D^2}-1-\frac{(x-d/2)^2}{2D^2}\right]$$
$$= \frac{D}{2D^2}[(x+d/2)^2-(x-d/2)^2]$$

$$\Rightarrow (BP - AP) = \frac{1}{2D}\left[4x\frac{d}{2}\right]=\frac{xd}{D} \quad \ldots (4)$$

Now the intensity at point P is maximum or minimum according as the path difference (BF – AP) is an integral multiple of wavelength or an odd integral multiple of half wavelength.

Thus for bright fringes (maxima) :

Path difference : $\frac{xd}{D}=n\lambda$ (where n = 0, 1, 2, 3, ...)

$$\Rightarrow \quad x = n\left(\frac{D\lambda}{d}\right) \quad \ldots (5)$$

The separation between the centres of two consecutive bright fringes is the width of a dark fringe.

$$\beta = x_n - x_{n-1}$$

$$\beta = n\frac{D\lambda}{d}-(n-1)\frac{D\lambda}{d},\ \beta=\frac{D\lambda}{d} \quad \ldots (6)$$

For dark fringe (minima) :

$$\frac{xd}{D}=\frac{(2n-1)}{2}\lambda \Rightarrow x=\frac{(2n-1)\,D\lambda}{2d}$$

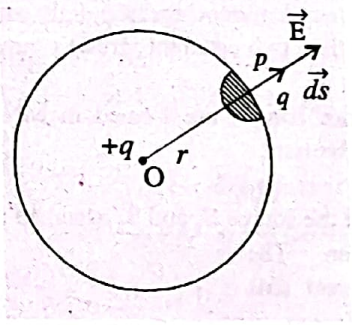
Hence, the separation between the centres of two consecutive dark fringes is the width of a dark fringe.

$$\beta' = x_n - x_{n-1}$$

$$= \left[(2n-1)\frac{D\lambda}{d}-[2(n-1)-1]\frac{a}{2}\frac{D\lambda}{d}\right] \quad \ldots (7)$$

$$\Rightarrow x = \frac{D\lambda}{d}$$

22. Let us consider point O has charge q_1 there is a point P at a distance r from it. we assume a Gaussian surface in the form of sphere of radius r. The electric field at point P due to charge q at O is $\vec{E}$ and area vector $\vec{ds}$ is also in its direction.



Hence the angle between $\vec{E}$ and $\vec{ds}$ is O°

According to definition of Electric flux

$$\phi = \oint \vec{E}.\vec{ds} = \oint Eds \cos 0°$$

$\therefore \quad \phi = E\oint ds$

$\therefore \quad \phi = E \times 4\pi r^2$ (Total surface Area of shpere)

According to Gauss's theorem

$$\phi = \frac{q}{\varepsilon_0}$$

$$\Rightarrow \quad E \times 4\pi r^2 = \frac{q}{\varepsilon_0}$$

$$\therefore \quad E = \frac{q}{4\pi\varepsilon_0 r^2}$$

Since the charge at point is q_1 and if the force acted on it due to electric field E is

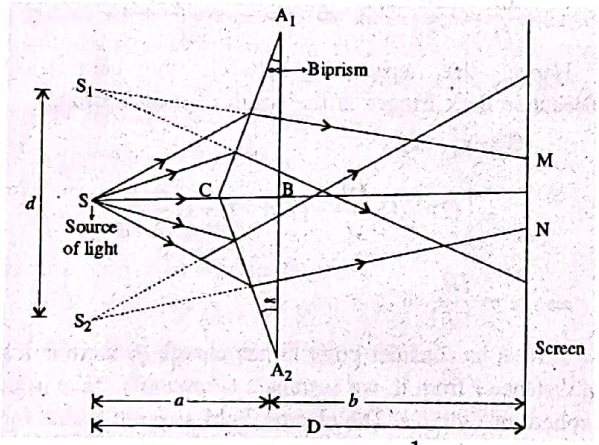
$$F = q_1 \cdot E$$

$$= q_1 \times \frac{q}{4\pi\varepsilon_0 r^2}$$

$$\therefore \quad F = \frac{q \cdot q_1}{4\pi\varepsilon_0 r^2}$$

This is the required Coulomb's law obtained by Gauss's theorem.

23. Fresnel's Biprism—It is an optical device (instrument) of producing interference of light. It is made by joining base to base two thin prism (A_1BC and A_2BC as shown in figure).

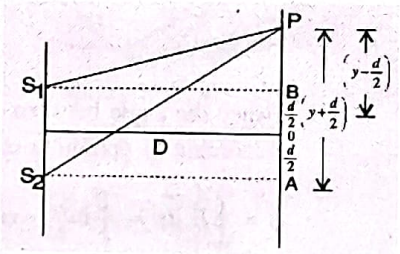


The acute angle (α) of prism is about $\frac{1}{2}°$ and obtuse angle is about 179°. When a monochromatic light source S is kept infront of biprism then two coherent virtual source S_1 and S_2 are produced.

The interference fringes are formed in MN region on the screen behind the biprism.

Determination of wavelength :

The light from the source S_1 and S_2 assumed to meet at point P on the screen. The distance between two slits are d, and the screen is placed a distance D from the sources S_1 and S_2. The point P is at a distance y from the central maxima O.



$\therefore \quad OP = y, OA = OB = \frac{d}{2}, AP = \left(y + \frac{d}{2}\right),$

$$BP = \left(y - \frac{d}{2}\right)$$

In $\Delta\ S_2AP$

$$(S_2P)^2 = \left(y + \frac{d}{2}\right)^2 + D^2$$

In $\Delta\ S_1BP$

$$(S_1P)^2 = \left(y - \frac{d}{2}\right)^2 + D^2$$

$$\therefore \quad (S_2P)^2 - (S_1P)^2 = \left(y + \frac{d}{2}\right)^2 + D^2 - \left(y - \frac{d}{2}\right)^2 - D^2$$

$$\Rightarrow \quad (S_2P - S_1P)\,(S_2P + S_1P) = 4 \times y \times \frac{d}{2}$$

[As $(a + b)^2 - (a - b)^2 = 4ab$

$a^2 - b^2 = (a - b)\,(a + b)$]

$\because\ S_2P - S_1P$ = path difference = x

$$x = \frac{2yd}{S_2P + S_1P}$$

If point P is very near to point O (i.e. central maxima) then $S_1P \approx S_2P = D$

$$x = \frac{2yd}{2D}$$

$$\therefore \quad x = \frac{yd}{D}$$

For constructive interferecne

$$x = n\lambda$$

$$\therefore \quad n\lambda = \frac{yd}{D} \Rightarrow y = \frac{n\lambda D}{d}$$

If distance of n^{th} and $(n-1)^{th}$ fringes are y_n and y_{n-1} then frings width = $\beta = y_n - y_{n-1}$

$$= \frac{n\lambda D}{d} - \frac{(n-1)\lambda D}{d} = \frac{\lambda D}{d}(n - n + 1)$$

$$\Rightarrow \quad \beta = \frac{\lambda D}{d}$$

$$\Rightarrow \quad \lambda = \frac{\beta d}{D}$$

Here, $D = a + b$

and $d = 2a\,(\mu - 1) \propto$

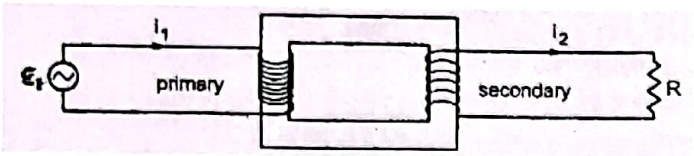
Where, μ = R.I. of biprism

so $$\boxed{\lambda = \frac{\beta[2a(\mu - 1) \propto]}{(a + b)}}$$

24. Transformer is broadly used electrical device and it is used for many purposes. It is necessary to change an alternating voltage from one to another of greater or smaller value. It is based on principal of mutual induction.

Construction : It consist of two coil wounded on soft iron core. Which is made up by thick sheet of a material having very small loss of energy.

The coil in which supply an electrical emf is called primary coil (P) & the coil by which obtained emf is called secondary coil (S). These, two coils & core is made insulated from each other.



Types of Transformer : Transformers are following two types :

(a) Step-up : If no. of turns in secondary coil is more than that of primary coil transformer is called step-up.

(b) Step down : If no. of turns in secondary coil is less than that of primary coil is step-down.

Working : When the primary coil of the transformer is connected to an emf. Then there is an induced emf in that of coil Due to this magnetic flux through the core passes by secondary coil since direction of alternating emf changes continuously. Hence, there will be change in flux through the secondary coil hence an induced emf produced in secondary coil.

$$\boxed{\frac{V_S}{V_P}=\frac{N_S}{N_P}=r}$$

where V_S = emf in secondary coil

V_P = emf in primary coil.

N_S = No. of terms in secondary coil.

N_P = No. of terms in primary coil.

$\therefore$ r = Transformer ratio.

25. Induced emf : The emf developed in a coil due to change in magnetic flux linked with the coil is called the induced emf.

Faraday's Law of Electromagnetic Induction : On the basis of experiments Faraday gave two laws of electromag-netic induction :

1. When the magnetic flux linked with a coil or circuit changes, an emf is induced in the coil. If coil is closed, the current is also induced. The emf and current last so long as the change in magnetic flux lasts. The magnitude of induced emf is proportional to the rate of change of magnetic flux linked with the circuit. Thus if $\Delta\phi$ is the change in magnetic flux linked in time Δt, then rate of change of flux is $\frac{\Delta\phi}{\Delta t}$.

So emf induced $\varepsilon \propto \frac{\Delta\phi}{\Delta t}$

The emf induced in the coil (or circuit) opposes the cause, producing it.

$\therefore$ i.e. $\varepsilon \propto -\frac{\Delta\phi}{\Delta t}$

Here the negative sign shows that the induced emf 'ε' opposes the change in magnetic flux.

$$\varepsilon = -k\frac{\Delta\phi}{\Delta t}$$

Where k is a constant of proportinality which depends on units chosen for ϕ, t and ε. In S.I. system the unit of flux ϕ is weber; unit of time t is second and unit of emf 'ε' is volt and $k = 1$.

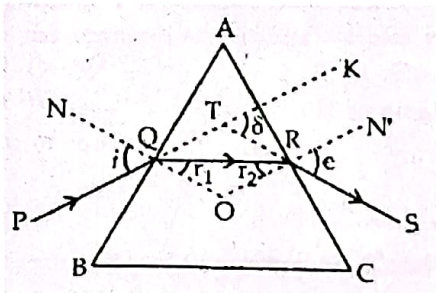
$$\varepsilon = -\frac{\Delta\phi}{\Delta t} \quad \ldots (1)$$

If the coil contains N-turns of insulated wire, then the flux linked with each turn will be same and the emf induced in each turn will be in the same direction, hence the emfs of all turns will be added. Therefore the emf induced in the whole coil.

$$\varepsilon = -N\frac{\Delta\phi}{\Delta t} = \frac{\Delta(N\phi)}{\Delta t} \quad \ldots (2)$$

$N\phi$ is called the effective magnetic flux or the number of flux linkages in the coil and may be denoted by ϕ.

26. Let a ray of light PQ be incident on the face. AB of the prism at angle of incidence i. Let it gets refracted along QR at angle r_1. The refracted ray QR suffers refraction along RS at face AC. So RS is called emergent ray.



Let e = angle of emergence.

r_2 = angles of refraction of face AC = $\angle QRO$ when RS is produced backward it meets PQ at point T at angle δ. So δ = angle of deviation = $\angle KTS$.

$r_1 = OQR$

$\therefore$ $\angle TQR = i - r_1$ and $\angle TRQ = e - r_2$

Now, ΔTQR

$$\angle KTR = \angle TQR + \angle TRQ$$

or $$\delta = i - r_1 + e - r_2 = i + e - (r_1 + r_2) \quad \ldots (i)$$

Also ΔQRO,

$$\angle QOR + r_1 + r_2 = 180^\circ \quad \ldots (ii)$$

and in quadrilateral $AQOR$,

$$\angle A + \angle O + \angle AQO + \angle ARO = 360^\circ$$

$\therefore$ $$\angle A + \angle O + 90^\circ + 90^\circ = 360^\circ$$

$\therefore$ $$\angle A + \angle O = 180^\circ \quad \ldots (iii)$$

$\therefore$ from (ii) and (iii), we get

$$\angle r_1 + \angle r_2 + \angle O = \angle A + \angle O$$

or $$A = r_1 + r_2 \quad \text{... (iv)}$$

$\therefore$ from (i) and (iv), we get

$$\delta = i + e - A$$

or $$A + \delta = i + e$$

When the prism is set in the position of minimum deviation, i.e., when $\delta = \delta_m$, $i = e$, $r_1 = r_2 = r$ (say)

Also we know that

$$A = r_1 + r_2 = r + r = 2r$$

$$r = \frac{A}{2} \quad \text{... (i)}$$

and $$A + \delta = i + e$$

or $$A + \delta_m = i + i = 2i$$

$\therefore$ $$i = \frac{A + \delta_m}{2} \quad \text{... (ii)}$$

If μ be the refractive index of the material of the prism, then according to Snell's law.

$$\mu = \frac{\sin i}{\sin r} = \frac{\sin\left(\frac{A + \delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

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