GOVERNMENT OF KARNATAKA

KARNATAKA SCHOOL EXAMINATION AND ASSESSMENT BOARD

MODEL QUESTION PAPER – 3 2024 – 25

II PUC – PHYSICS (33)

Time: 3 hours **Max Marks: 70** **No. of questions : 45**

GENERAL INSTRUCTIONS:

1. ***All PARTS (A to D) are compulsory. PART-E is only for visually challenged students.***
2. ***For PART – A questions, first written-answer will be considered for awarding marks.***
3. ***Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.***
4. ***Direct answers to numerical problems without relevant formula and detailed solution will not carry any marks.***

PART – A

I. Pick the correct option among the four given options for ALL of the following questions: 15 × 1 = 15

1. The SI unit of surface charge density is _____ .

(A) C m^{-1} (B) C m^{-2} (C) C m^{-3} (D) kg m^{-3}

2. The values of electric field (E) and electric potential (V) at any point on the equatorial plane of an electric dipole are such that

(A) E = 0, V = 0 (B) E = 0, V ≠ 0 (C) E ≠ 0, V = 0 (D) E ≠ 0, V ≠ 0

3. If the potential difference across a capacitor is doubled, then the energy stored in it

(A) is doubled (B) is quadrupled (C) is halved (D) remains same

4. A wire has a non-uniform cross-sectional area as shown in the figure. A steady current I flows through it. Which one of the following statements is correct?

(A) The drift speed of electron is constant.

(B) The drift speed of electron increases while moving from *A* to *B.*

(C) The drift speed of electron decreases while moving from *A* to *B.*

(D) The drift speed of electron varies randomly.

5. A charged particle of charge q is moving in a uniform magnetic field. The angle between the velocity(v) of the charged particle and magnetic field(B) is θ. The trajectory of the charged particle varies with angle θ. Match the following table by choosing the appropriate trajectory traced by the charged particle for different possible values of angle θ.

Angle	Trajectory
(i) θ = 0^o	(a) circle
(ii) θ = 45^o	(b) straight line
(iii) θ = 90^o	(c) helix

(A) (i) – (a) , (ii) – (b), (iii) – (c) (B) (i) – (b) , (ii) – (c), (iii) – (a)

(C) (i) – (b) , (ii) – (a), (iii) – (c) (D) (i) – (c) , (ii) – (b), (iii) – (a)

6. Below are the two statements related to magnetic flux and magnetic field lines.

Statement-I : The net magnetic flux through any closed surface is zero.

Statement-II: The number of magnetic field lines leaving the surface is balanced by the number of lines entering it.

(A) Both the statements I and II are correct and II is the correct explanation for I.

(B) Both the statements I and II are correct and II is not the correct explanation for I.

(C) Statement I is wrong but the statement II is correct.

(D) Statement I is correct but the statement II is wrong.

7. The polarity of induced emf in a coil is given by _____

(A) Lenz's law (B) Faraday's law (C) Gauss's law in magnetism (D) Ampere's circuital law

8. In a transformer, the windings of the primary and secondary coils are wound one over the other to reduce the energy loss due to _____

(A) flux leakage (B) resistance of the windings (C) eddy currents (D) hysteresis

9. The electromagnetic waves suitable for RADAR systems used in aircraft navigation are

(A) Gamma rays (B) Ultraviolet rays (C) Microwaves (D) Infrared waves

10. A ray of light is incident on glass-air interface at an angle greater than the critical angle for the pair of media. Then the ray undergoes

(A) refraction only (B) partial reflection and partial refraction

(C) total internal reflection (D) grazes the surface at the interface of the two media.

11. To observe sustained interference pattern on a screen placed at a suitable distance in Young's double slit experiment, which of the following condition/s is/are necessary?

(a) Sources of light should be coherent.

(b) Sources of light should be narrow.

(c) Sources of light should be very close.

(A) only (a) (B) both (a) and (b) (C) both (b) and (c) (D) all (a), (b) and (c)

12. The de Broglie wavelength of a moving particle is independent of _____ of the particle.

(A) charge (B) mass (C) speed (D) momentum

13. For an electron revolving around the nucleus,

(A) kinetic energy and potential energy are positive, total energy is negative.

(B) kinetic energy is positive, potential energy and total energy are negative.

(C) potential energy is negative, kinetic energy and total energy are positive.

(D) kinetic energy and potential energy are negative, total energy is positive.

14. The ratio of nuclear densities of $_{13}Al^{27}$ and $_{29}Cu^{64}$ is

(A) 1 : 1 (B) 3 : 4 (C) 13 : 29 (D) 27 : 64

15. The energy band gap in conductor, insulator and semiconductor are respectively E_1 , E_2 and E_3. The relation between them is

(A) $E_1 = E_2 = E_3$ (B) $E_1 < E_2 < E_3$ (C) $E_1 > E_2 > E_3$ (D) $E_1 < E_3 < E_2$

II. Fill in the blanks by choosing appropriate answer given in the bracket for ALL of the following questions: 5 × 1 = 5

(mutual induction, inductance, diffraction, magnification, quantisation, interference)

16. One of the basic properties of electric charge is _____.

17. The ratio of the magnetic flux-linkage to the current in a coil is called _____.

18. The principle of working of a transformer is _____.

19. A microscope is used to produce large _____ of small objects.

20. The phenomenon of bending of light around the edges of an obstacle is called _____.

PART – B

III. Answer any FIVE of the following questions: **5 × 2 = 10**

21. Name the two factors on which the resistance of a metallic wire depends.

22. When does a current carrying conductor placed in a uniform magnetic field experience
(i) maximum force and (ii) minimum force?

23. Define "magnetisation of a sample". How is it related to magnetic intensity?

24. A boy peddles a stationary bicycle. The pedals of the bicycle are attached to a coil of 100 turns, each turn of area 0.20 m^2. The coil rotates at 6 rotations per second and it is placed in a uniform magnetic field of 0.01 T perpendicular to the axis of rotation of the coil. Calculate the maximum value of emf generated in the coil.

25. What is displacement current? Give the expression for it.

26. Mention two uses of polaroids.

27. Write two limitations of Bohr's atom model.

28. How can a semiconductor diode be forward biased? What happens to the width of the depletion region when forward bias voltage is increased?

PART – C

IV. Answer any FIVE of the following questions: **5 × 3 = 15**

29. Derive the expression for the torque on an electric dipole placed in a uniform electric field.

30. Give three results of electrostatics of conductors.

31. State and explain Biot-Savart's law with a suitable diagram.

32. Write the three differences between diamagnetic and ferromagnetic materials.

33. Derive the expression for motional emf induced in a straight conductor moving perpendicular to uniform magnetic field.

34. A small candle is placed at a distance of 20 cm in front of a concave mirror of radius of curvature 30 cm.
At what distance from the mirror should a screen be placed in order to obtain a sharp image?
What is the nature of the image?

35. Using Huygen's principle, show that the angle of reflection is equal to the angle of incidence when a plane wavefront is reflected by a plane surface.

36. Write the three features of nuclear force.

PART – D

V. Answer any THREE of the following questions: **3 × 5 = 15**

37. State Gauss's law in electrostatics. Derive an expression for the electric field at a point due to an infinitely long thin uniformly charged straight wire using Gauss's law.

38. Arrive at the balance condition of Wheatstone bridge using Kirchhoff's rules.

39. What is the principle behind the working of a moving coil galvanometer? With the help of a neat labelled diagram, obtain the expression for the angular deflection produced in moving coil galvanometer.

40. Derive the expression for refractive index of the material of the prism in terms of angle of minimum deviation and angle of the prism.

41. (a) Write three differences between intrinsic semiconductor and extrinsic semiconductor. **(3)**
(b) Draw the energy band diagrams of (i) n-type and (ii) p-type semiconductors at temperature T > 0 K **(2)**

VI. Answer any TWO of the following questions: **2 × 5 = 10**

42. Three capacitors of capacitances 2μF, 3μF, 6μF are connected in series.

(a) Determine the effective capacitance of the combination.

(b) Find the potential difference across 6μF capacitor if the combination is connected to a 60 V supply.

43. For copper, the number density of free electrons is 8.5×10^{28} m^{-3} and resistivity is 1.7×10^{-8} **Ω** m. Calculate the conductivity of copper and relaxation time of free electrons in copper.
Take the mass of electron = 9.1×10^{-31} kg and e = 1.6×10^{-19} C.

44. A resistor of 50 Ω, a pure inductor of 250mH and a capacitor are in series in a circuit containing an AC source of 220 V, 50 Hz. In the circuit, current leads the voltage by 60^{o}. Find the capacitance of the capacitor.

45. When light of wavelength 400 nm is incident on a photosensitive surface, the stopping potential for the photoelectrons emitted is found to be 0.96 V. When light of wavelength 500 nm is incident on the same photosensitive surface, the stopping potential is found to be 0.34 V. Calculate the Planck's constant. Given: speed of light in vacuum is 3×10^{8} m s^{-1} and e = 1.6×10^{-19} C.

PART – E

(FOR VISUALLY CHALLENGED STUDENTS ONLY)

4. A wire has a non-uniform cross-sectional area in which end A of the wire has smaller area than that of end B. A steady current I flows through it. Which one of the following statements is correct?

(A) The drift speed of electron is constant.

(B) The drift speed of electron increases while moving from *A* to *B.*

(C) The drift speed of electron decreases while moving from *A* to *B.*

(D) The drift speed of electron varies randomly.

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