Series–A

Roll No.....

Total No. of Questions–27] [Total No. of Printed Pages–16

A–854–A–XII–2325

PHYSICS

(Theory)

Time Allowed—3 Hours Maximum Marks—60

Candidates are required to give their answers in their own words as far as practicable.

Marks allotted to each question are indicated against it.

Special Instructions :

(i) You must write Question Paper Series in the circle at top left side of title page of your Answer-book.

(ii) While answering your Questions, you must indicate on your Answer-book the same Question No. as appears in your Question Paper.

(iii) Do not leave blank page/pages in your Answer-book.

(iv) All questions are compulsory.

(v) The question paper has 27 questions. All the questions are compulsory. The Internal choice is given where applicable.

(vi) Answers should be brief and to the point.

(vii) Question Nos. 1 to 12 are MCQ (Multiple Choice Questions) carrying 1 mark each. Question Nos. 13 to 16 are very short answer type questions carrying 2 marks each. Question Nos. 17 to 23 are short answer type questions carrying 3 marks each and Question Nos. 24 carries 4 marks and Question Nos. 25 to 27 carry 5 marks each.

(viii) There is no negative marking.

(ix) All questions given in Section–A (Multiple Choice Questions) are to be attempt on OMR sheet provided with Answer book.

(x) You may use the following values of physical constants where ever necessary :

i) $c = 3 \times 10^8 \, ms^{-1}$.

ii) $m_e = 9.1 \times 10^{-31} \, kg$.

iii) $e = 1.6 \times 10^{-19} \, c$.

iv) $\mu_0 = 4\pi \times 10^{-7} \, Tm \, A^{-1}$.

v) $h = 6.63 \times 10^{-34} \, JS$.

vi) $\epsilon_0 = 8.854 \times 10^{-12} \; C^2N^{-1}m^{-2}$.

vii) Avogadro number = 6.023×10^{23} per gram mole.

SECTION–A

(Multiple Choice Questions)

1. The SI unit of electric flux is : 1

   (a) $Nm^2 C^{-2}$

   (b) $NC^{-1} m^2$

   (c) $CN^2 m^{-1}$

   (d) $C^2N^{-1} m^{-2}$.

2. Kirchhoff's junction rule is reflection of : 1

   (a) conservation of current density vector.

   (b) the fact that the momentum with which a charged particle approaches a junction is unchanged as the charge particle leaves the junction.

   (c) conservation of charge and the fact that there is no accumulation of charges at a junction.

   (d) None of the above.

3. Biot-Savart law indicates that the moving electrons (velocity $\vec{v}$) produce a magnetic field $\vec{B}$ such that : 1

(a) $\vec{B} \parallel \vec{v}$

(b) It obey inverse cube law

(c) It is along the line joining the electron and point of observation

(d) $\vec{B} \perp \vec{v}$.

4. A transformer has 400 secondary turns and 500 primary turns. If the secondary voltage is 400 V, the primary voltage is : 1

(a) 500V

(b) 400V

(c) 1000V

(d) 800V.

5. The magnetic flux linked with a Coil is given by $\phi = 5t^2 + 3t + 16$, where ϕ is in Weber and t is seconds. The induced e.m.f. in the Coil at $t = 5s$ will be : 1

(a) 6 volt

(b) 10 volt

(c) 53 volt

(d) 43 volt.

6. In Sunglasses and 3D movie cameras, polaroids are used to control : 1

(a) frequency of light

(b) intensity of light

(c) wavelength of light

(d) both (a) and (b).

7. The tangent of the angle by which it converges or diverges a beam of light parallel to the principle axis falling at unit distance from optical centre is called : 1

(a) Malus law

(b) Lens formula

(c) Power of a lens

(d) Snell's law.

8. The minimum energy needed by an electron to escape from the metal surface is called :

(a) potential difference

(b) work function

(c) gravitational potential energy

(d) momentum. 1

9. Heavy stable nuclei have more neutrons than protons. This because of the fact that : 1

(a) neutrons are heavier than protons

(b) electrostatic force between protons are repulsive

(c) neutrons decay into protons through beta decay

(d) nuclear forces between neutrons are weaker than that between protons.

10. When a junction diode is reverse biased, the flow of current across the junction is mainly due to : 1

(a) diffusion of charges

(b) depends on the nature of material

(c) drift of charges

(d) both drift and diffusion of charges.

11. Assertion : The turns of a spring come close to each other, when current is passed through it.

Reason : It is because, the turns of a spring carry current in same direction and hence attract each other.

(a) If both assertion and reason are true-and reason is the correct explanation of assertion.

(b) If both assertion and reason are true but reason is not a correct explanation of assertion.

(c) Assertion is true but reason is false.

(d) Both assertion and reason are false. 1

12. Assertion : Thickness of depletion layer is fixed in all semiconductor devices.

Reason : No immobile charged carrier ions are available in depletion layer.

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not a correct explanation of the assertion.

(c) Assertion is true but reason is false.

(d) Both assertion and reason are false. 1

SECTION–B

(Very Short Answer Type Questions)

13. Define the Conductivity of a Conductor and discuss variation of Conductivity with temperature of Metallic conductor. 2

14. Define relative permeability of Magnetic material. How is it related to magnetic susceptibility? 2

15. What are Matter waves? Write an expression for de-Broglie wavelength of a photon. 2

16. A solenoid of length 0.5 m has a radius of 1 cm and is made up of 500 turns. It carries a current of 5 A. What is the magnitude of the magnetic field inside the solenoid?

Or

What is Inductive reactance? Show that resistance offered by a ideal inductor to flow of direct current is zero. 2

SECTION–C

(Short Answer Type Questions)

17. What is Mutual induction? Define coefficient of Mutual induction and its SI unit. Give an expression for it. 3

18. What is a Wavefront? With the help of a suitable diagram, prove snell's law of refraction using Huygen's principle. 3

19. Define Mass defect and binding energy per nucleon. Discuss main features of the graph between mass number and binding energy per nucleon. 1,2

20. (a) An infinite line charge produces a field of 9×10^4 NC^{-1} at a distance of 2 cm. Calculate the linear charge density. 1½

(b) A point charge of 2.0 μC is at the centre of a cubic gaussian surface 9.0 cm on edge. What is the net electric flux through the surface? 1½

21. What is Electromagnetic spectrum? Name the main parts of the Electromagnetic spectrum and give two uses of Microwaves. 3

22. What is Cell ? Obtain the condition for maximum current through a resistor, when a number of cells are connected in series. 3

23. How de-Broglie hypothesis provides an explanation for Bohr's second postulate of Quantisation of angular momentum. 3

SECTION–D

(Case Study Based Question)

24. Study the following paragraph and answer question numbers (A) to (D) based on it.

A capacitor is a system of two conductors is separated by an insulator. Its capacitance is defined by $C = Q/V$, where Q and -Q are the charges on the two conductors and V is the potential difference between them. C is determined purely geometrically, by the shapes, sizes and relative positions of the two conductors. The unit of capacitance is Farad. For a parallel plate capacitor with vacuum between the plates.

$$C = \frac{\epsilon_0 A}{d}.$$

Where A is the area of each plate and d the separation between them. Consequently, the capacitance C increases from its value C_0 when

there is no vacuum, $C = KC_0$ where K is the dielectric constant of the insulating substance.

(A) When a number of capacitors are connected in series between two points, all the capacitors possess same : 1

(a) capacity

(b) potential

(c) charge

(d) None of the above.

(B) A potential difference of 250 volt is applied across the plates of a capacitor of 10 pF. The charge on the plates of the Capacitor is : 1

(a) 25×10^{-11} C

(b) 2.5×10^{-9} C

(c) 250×10^{-12} C

(d) None of the above.

(C) Charge on a capacitor is the : 1

(a) charge on the positive plate

(b) charge on the negative plate

(c) net charge on both the plates

(d) difference of charges on both the plates.

(D) The capacity of a Capacitor becomes 10 μF when air between the plates is replaced by dielectric slab of K = 2. The capacity of the capacitor with air in between the plates is :

(a) 5 μF

(b) 10 μF

(c) 15 μF

(d) 20 μF. 1

SECTION–E

25. What is lens maker's formula? Stating sign conventions and assumption, derive the expression for the lens maker's formula i.e.

$$\frac{1}{f} = (n - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

where the letters have their usual meaning.

1,1.3

(a) An object of size 3.0 cm is placed 14 cm in front of a concave lens of focal length 21 cm. Describe the image produced by the lens. What happens if the object is moved further away from the lens? 3

(b) The Radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. Its focal length is 12 cm. What is the refractive index of glass? 2

26. (a) Explain the terms 'depletion layer' in a junction diode. 1

(b) Using the circuit diagrams, show how the V-I characteristics of a p-n junction are obtained in forward biasing and reverse biasing? 4

27. An alternating e.m.f. is applied across an inductor obtain an expression for the current (I) in the circuit and hence obtain inductive reactance of the circuit and draw a phasor diagram to show phase difference between I and V. 5

Or

(a) A $100\,\Omega$ resistor is connected to a 220 V, 50 Hz a.c. supply. What is the r.m.s. value of current and net power consumed over a full cycle? 2½

(b) A light bulb is rated at 100 W for a 220 V supply. Find the resistance of the bulb and r.m.s. current through the bulb. 2½