Series–C

Roll No.....

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

A–854–C–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. Torque acting on an electric dipole moment $\vec{P}$ placed in uniform electric field $\vec{E}$ is : 1

(a) $\vec{P}.\vec{E}$

(b) PE

(c) $\vec{P} \times \vec{E}$

(d) None of the above.

2. Which of the following characteristics of electrons determine the current in a conductor?

(a) Drift velocity alone.

(b) Thermal velocity alone.

(c) Both drift velocity and Thermal velocity.

(d) Neither drift nor Thermal velocity. 1

3. The direction of force experienced by a current carrying conductor placed in a magnetic field is given by : 1

(a) Lenz's Rule.

(b) Fleming left hand rule.

(c) Fleming right hand rule.

(d) Screw rule.

4. Electrical energy is transmitted over large distances at high alternating voltages. Which of the following statements is not correct? 1

(a) For a given power level, there is a lower current.

(b) Transmission lines can be made thinner.

(c) Lower current implies less power loss.

(d) It is easy to reduce the voltage at receiving end using step-down transformers.

5. The mutual inductance M_{12} of coil 1 with respect to coil 2 : 1

(a) increases when they are brought nearer and is same as M_{21} of coil 2 with respect to coil 1.

(b) depends on current passing through the coils.

(c) increases when one of them is rotated about an axis.

(d) Both (b) and (c) are correct

6. When a Polaroid is rotated, the intensity of light varies but never reduces to zero? It shows that the incident light is : 1

(a) partially plane polarised

(b) completely polarised

(c) unpolarised

(d) None of the above.

7. An optician prescribes a corrective lens of power -4.0 D, then focal length of a concave lens is

(a) +40 cm

(b) 25 cm

(c) +20 cm

(d) −30 cm. 1

8. The de-Broglie wavelength of a ball of mass 0.12 kg moving with a speed of 20 ms^{-1} is : 1

(a) 2.76×10^{-34} m

(b) 1.53×10^{-34} m

(c) 6.63×10^{-34} m

(d) 1.47×10^{-34} m.

9. An atom bomb works on the principle of : 1

(a) α –decay

(b) β – decay

(c) nuclear fission

(d) nuclear fusion.

10. Thickness of depletion region is of the order of one-tenth of : 1

(a) an angstrom

(b) millimeter

(c) micrometer

(d) centimeter.

11. Assertion : Magnetic force is always perpendicular to the magnetic field.

Reason : Electric force is along the direction of electric field.

(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 : The energy gap between the valence band and conduction band is greater in silicon than in germanium.

Reason : In intrinsic semiconductor. The number of free electrons (n_e) is equal to the number of holes (n_h).

(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 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 resistivity of a material and give the factors on which it depends. State its SI unit? Which material has least value of resistivity? 2

14. What are Magnetic field lines? Why two Magnetic field lines do not cross each other? 2

15. What is the effect of intensity of light on Photocurrent? Draw the suitable graph.

16. A 3.0 cm wire carrying a current of 10 A is placed inside a solenoid perpendicular to its axis. The magnetic field inside the solenoid is given to be 0.27 T. What is the magnetic force on the wire?

Or

Mention two points of difference between step-up and step-down transformer. Does a step-up transformer contradict the principle of conservation of energy. 2

SECTION–C
(Short Answer Type Questions)

17. Define self inductance of a solenoid. Show that magnetic potential energy stored in an inductor (L) carrying current (I) is given by $\frac{1}{2}LI^2$. 3

18. State Huygen's principle and prove the laws of reflection on the basis of wave theory. Is huygen's principle valid for longitudinal sound waves? 3

19. What is Nuclear fusion? In what sense, it is different from nuclear fission? Give one example of each. ½,2,½

20. A system has two changes $q_A = 2.5 \times 10^{-7} C$ and $q_B = -2.5 \times 10^{-7} C$ located at points A(0, 0, –15cm) and B(0, 0, +15 cm) respectively. What are the total charge and Electric Dipole Moment of the system ? 3

21. What are electromagnetic waves? How are Electromagnetic waves produced? Write four properties of electromagnetic waves. 3

22. What is a Wheatstone bridge? Apply Kirchhoff's rules of Electric circuits to obtain the condition for balancing wheatstone bridge. 3

23. Write two important inferences drawn from Rutherford's alpha particle scattering experiment. Draw a graph between the number of particles scattered and scattering angle. 3

SECTION–D

(Case Study Based Question)

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

The capacity of a capacitor increases both, when a conducting slab or an insulating slab is introducted between the plates of the capacitor. In the former case, electric field $E = 0$ inside the conductor and in the latter case, $E < E_0$, inside the insulator. Thus, potential difference $V = E \times d$ decreases and hence capacity $C = {}^{Q}/_{V}$ increases.

It should be clearly understood that when a dielectric slab is introduced in between the plates of a charged capacitor with battery connected across the plates,

(i) Capacity (C) and charge (Q) increases.

(ii) Potential V remains constant.

(iii) Energy stored $U = \frac{1}{2}CV^2$ increases.

(iv) Electric field decreases.

The electric energy density in a region with electric field is $\frac{1}{2}\epsilon_0 E^2$.

(A) When a number of capacitors are connected in parallel between two points, the equivalent capacitance? 1

(a) increases

(b) decreases

(c) remain the same

(d) None of the above.

(B) A parallel plate capacitor is charged. If the plates are pulled apart? 1

(a) the capacitance increases

(b) the total charge increases

(c) the potential increases

(d) the charge and the potential difference remains the same.

(C) If there are n capacitors in parallel connected to V volt source, then the energy stored is equal to : 1

(a) CV

(b) $\frac{1}{2} n CV^2$

(c) CV^2

(d) $\frac{1}{2n} CV^2$.

(D) A 15 pF capacitor is connected to a 100V battery. The electrostatic energy stored in the capacitor is : 1

(a) $1.5 \times 10^{-8} J$

(b) $15 \times 10^{-8} J$

(c) $75 \times 10^{-8} J$

(d) $7.5 \times 10^{-8} J$.

SECTION–E

25. Discuss the refraction at a convex spherical surface when the object lies in rarer medium and the image formed is red. Hence derive the relation :

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$$

where the symbols have usual meanings.

Or

(a) A 4.5 cm needle is placed 12 cm away from a convex mirror of focal length 15 cm. Give the location of the image and magnification. Describe what happens as the needle is moved farther from the mirror. 3

(b) What is the focal length of a convex lens of focal length 30 cm in contact with a concave lens of focal length 20 cm ? Is the system a converging or a diverging lens? 2

26. (a) Define Doping. Distinguish between conductor, insulator and semiconductor on the basis of band theory. 2½

(b) Explain, how an intrinsic semiconductor can be converted into an n-type semiconductor. 2½

27. What is the principle of a transformer? With the help of a labelled diagram, describe briefly the construction and working of a transformer. Write four sources of energy loss in this device. Why the efficiency of a transformer is always less than unity?

Or

A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR-circuit in which $R = 3\,\Omega$, $L = 25.48$ mH and $C = 796\,\mu F$. Find the impedance and power dissipated in the circuit. 5