DAY — 06 SEAT NUMBER | | | | | | |

2024	II	27	1100	J-837	(E)

PHYSICS (54)

Time : 3 Hrs. **(8 Pages)** **Max. Marks : 70**

General Instructions :

*The question paper is divided into **four** sections :*

(1) ***Section A*** *: Q. No. 1 contains **Ten multiple choice type** of questions carrying **One mark** each.*

*Q. No. 2 contains **Eight very short answer type** of questions carrying **One mark** each.*

(2) ***Section B*** *: Q. No. **3** to Q. No. **14** contain **Twelve short answer type of questions carrying Two marks** each. (Attempt **any Eight**).*

(3) ***Section C*** *: Q. No. **15** to Q. No. **26** contain **Twelve short answer** type of questions carrying **Three marks** each. (Attempt **any Eight**).*

(4) ***Section D*** *: Q. No. **27** to Q. No. **31** contain **Five long answer type of questions carrying Four marks** each. (Attempt **any Three**).*

*(5) Use of the log table is allowed. Use of calculator is **not** allowed.*

(6) Figures to the right indicate full marks.

(7) For multiple choice type questions, only the first attempt will be considered for evaluation.

(8) Physical Constants :

(i) Mass of electron m = 9.1×10^{-31} kg

(ii) $\varepsilon_0 = 8.85 \times 10^{-12}\ C^2 / Nm^2$

(iii) $\pi = 3.142$

(iv) Charge on electron e $= 1.6 \times 10^{-19}$ C

(v) $\mu_0 = 4\pi \times 10^{-7}$ Wb / Am

(vi) Planck's constant $h = 6.63 \times 10^{-34}$ J.s.

(vii) Speed of light c = 3×10^8 m/s

(viii) $g = 9.8\ m/s^2$

(ix) Rydberg's constant $R_H = 1.097 \times 10^7\ m^{-1}$

(x) Stefan's constant $\sigma = 5.67 \times 10^{-8}\ J\ m^{-2}\ s^{-1} K^{-4}$

SECTION – A

Q. 1. Select and write the correct answer for the following multiple choice type of questions : **[10]**

(i) The moment of inertia (MI) of a disc of radius R and mass M about its central axis is _____.

(a) $\frac{MR^2}{4}$ (b) $\frac{MR^2}{2}$

(c) MR^2 (d) $\frac{3MR^2}{2}$

(ii) The dimensional formula of surface tension is _____.

(a) $[L^{-1}M^1T^{-2}]$ (b) $[L^2M^1T^{-2}]$

(c) $[L^1M^1T^{-1}]$ (d) $[L^0M^1T^{-2}]$

(iii) Phase difference between a node and an adjacent antinode in a stationary wave is _____.

(a) $\frac{\pi}{4}$ rad (b) $\frac{\pi}{2}$ rad

(c) $\frac{3\pi}{4}$ rad (d) π rad

(iv) The work done in bringing a unit positive charge from infinity to a given point against the direction of electric field is known as _____.

(a) electric flux (b) magnetic potential

(c) electric potential (d) gravitational potential

(v) To convert a moving coil galvanometer into an ammeter we need to connect a _____.

(a) small resistance in parallel with it

(b) large resistance in series with it

(c) small resistance in series with it

(d) large resistance in parallel with it

(vi) If the frequency of incident light falling on a photosensitive material is doubled, then kinetic energy of the emitted photoelectron will be _____.

(a) the same as its initial value

(b) two times its initial value

(c) more than two times its initial value

(d) less than two times its initial value

(vii) In a cyclic process, if $\Delta U =$ internal energy, W = work done, Q = Heat supplied then

(a) $\Delta U = Q$ (b) $Q = O$

(c) $W = O$ (d) $W = Q$

(viii) The current in a coil changes from 50A to 10A in 0.1 second. The self inductance of the coil is 20H. The induced e.m.f. in the coil is _____.

(a) 800V (b) 6000V

(c) 7000V (d) 8000V

(ix) The velocity of bob of a second's pendulum when it is 6 cm from its mean position and amplitude of 10 cm, is _____.

(a) 8π cm/s (b) 6π cm/s

(c) 4π cm/s (d) 2π cm/s

(x) In biprism experiment, the distance of 20^{th} bright band from the central bright band is 1.2 cm. Without changing the experimental set-up, the distance of 30^{th} bright band from the central bright band will be _____.

(a) 0.6 cm (b) 0.8 cm

(c) 1.2 cm (d) 1.8 cm

Q. 2. Answer the following questions : **[8]**

(i) Define centripetal force.

(ii) Why a detergent powder is mixed with water to wash clothes?

(iii) What is the resistance of an ideal voltmeter?

(iv) Write the formula for torque acting on rotating current carrying coil in terms of magnetic dipole moment, in vector form.

(v) What is binding energy of a hydrogen atom?

(vi) What is surroundings in thermodynamics?

(vii) In a photoelectric experiment, the stopping potential is 1.5V. What is the maximum kinetic energy of a photoelectron?

(viii) Two capacitors of capacities 5μF and 10μF respectively are connected in series. Calculate the resultant capacity of the combination.

SECTION – B

Attempt any EIGHT questions of the following : **[16]**

Q. 3. Explain the change in internal energy of a thermodynamic system (the gas) by heating it.

Q. 4. Explain the construction of a spherical wavefront by using Huygens' principle.

Q. 5. Define magnetization. State its SI unit and dimensions.

Q. 6. Obtain the differential equation of linear simple harmonic motion.

Q. 7. A galvanometer has a resistance of 30Ω and its full scale deflection current is 20 microampere (μA). What resistance should be added to it to have a range 0-10 volt?

Q. 8. Explain Biot-Savart law.

Q. 9. What is a Light Emitting Diode? Draw its circuit symbol.

Q. 10. An aircraft of wing span of 60 m flies horizontally in earth's magnetic field of 6×10^{-5}T at a speed of 500 m/s. Calculate the e.m.f. induced between the tips of wings of aircraft.

Q. 11. Derive an expression for maximum speed of a vehicle moving along a horizontal circular track.

Q. 12. A horizontal force of 0.5N is required to move a metal plate of area $10^{-2}m^2$ with a velocity of $3\times10^{-2}m/s$, when it rests on 0.5×10^{-3}m thick layer of glycerin. Find the coefficient of viscosity of glycerin.

Q. 13. Two tuning forks having frequencies 320 Hz and 340 Hz are sounded together to produce sound waves. The velocity of sound in air is 340 m/s. Find the difference in wavelength of these waves.

Q. 14. Calculate the change in angular momentum of electron when it jumps from third orbit to first orbit in hydrogen atom.

SECTION – C

Attempt any EIGHT questions of the following : **[24]**

Q. 15. A circular coil of wire is made up of 200 turns, each of radius 10 cm. If a current of 0.5A passes through it, what will be the magnetic field at the centre of the coil?

Q. 16. Define photoelectric effect and explain the experimental set-up of photoelectric effect.

Q. 17. Define the current gain α_{DC} and β_{DC} for a transistor. Obtain the relation between them.

Q. 18. Define surface energy of the liquid. Obtain the relation between the surface energy and surface tension.

Q. 19. What is an isothermal process? Obtain an expression for work done by a gas in an isothermal process.

Q. 20. Derive an expression for equation of stationary wave on a stretched string. Show that the distance between two successive nodes or antinodes is $\lambda/2$.

Q. 21. Derive an expression for the impedance of an LCR circuit connected to an AC power supply. Draw phasor diagram.

Q. 22. Calculate the wavelength of the first two lines in Balmer series of hydrogen atom.

Q. 23. A current carrying toroid winding is internally filled with lithium having susceptibility $\chi = 2.1 \times 10^{-5}$. What is the percentage increase in the magnetic field in the presence of lithium over that without it?

Q. 24. The radius of a circular track is 200 m. Find the angle of banking of the track, if the maximum speed at which a car can be driven safely along it is 25 m/sec.

Q. 25. Prove the Mayer's relation : $C_p - C_v = \frac{R}{J}$

Q. 26. An alternating voltage is given by $e = 8\sin 628.4t$. Find

(i) peak value of e.m.f.

(ii) frequency of e.m.f.

(iii) instantaneous value of e.m.f. at time t = 10 ms.

SECTION – D

Attempt any THREE questions of the following : **[12]**

Q. 27. What is a transformer? Explain construction and working of a transformer. Derive the equation for a transformer.

Q. 28. Using the geometry of the double slit experiment, derive the expression for fringe width of interference bands.

Q. 29. Distinguish between an ammeter and a voltmeter. (Two points each).

The displacement of a particle performing simple harmonic motion is $\frac{1}{3}$rd of its amplitude. What fraction of total energy will be its kinetic energy?

Q. 30. Draw a neat labelled diagram of Ferry's perfectly black body. Compare the rms speed of hydrogen molecules at 227°C with rms speed of oxygen molecule at 127°C. Given that molecular masses of hydrogen and oxygen are 2 and 32 respectively.

Q. 31. Derive an expression for energy stored in a charged capacitor.

A spherical metal ball of radius 15 cm carries a charge of 2μC. Calculate the electric field at a distance of 20 cm from the center of the sphere.

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