DAY —— 04 SEAT NUMBER | | | | | | |

2021	IX	22	1030	J-533	(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 each multiple choice type of question, it is mandatory to write the correct answer along with its alphabet. e.g., (a)...../*

(b)..... /(c)..... /(d)..... No marks(s) shall be given, if ONLY the correct answer or the alphabet of the correct answer is written. Only the first attempt will be considered for evaluation.

(8) Physical Constants :

(i) $h = 6.63 \times 10^{-34} Js$

(ii) $\pi = 3.142$

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

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

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

(vi) $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ SI unit

(vii) $R = 8.319$ SI unit

SECTION – A

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

(i) The SI unit of viscosity is :

(a) $\frac{Ns}{m^2}$ (b) $\frac{Nm^2}{s}$

(c) $\frac{N^2s^2}{m}$ (d) $\frac{m^2}{Ns}$

(ii) Colours of a shining bright star is an indication of its

(a) distance from the earth (b) size

(c) temperature (d) mass

(iii) In which thermodynamic process does the volume of system remain constant?

(a) isobaric (b) isothermal

(c) adiabatic (d) isochoric

(iv) If in a resonance tube a oil of density higher than that of water is used then resonance frequency would

(a) increase
(b) decrease
(c) slightly increase
(d) remain the same

(v) In an interference experiment a transparent glass plate with refractive index 'n' and thickness 't' is introduced between the slit and the screen, the optical path shifts by

(a) $(n + 1)\, t$
(b) $(n - 1)\, t$
(c) $(n - 1)^2 t$
(d) $(n - 1)\, t^2$

(vi) For a series LCR circuit at resonance the impedance of the circuit is equal to

(a) inductive reactance
(b) capacitive reactance
(c) resistance
(d) inductive and capacitive reactance both

(vii) In Bohr model of an atom which of the following is an integral multiple of $\frac{h}{2\pi}$?

(a) Kinetic energy
(b) Radius of the atom
(c) Potential energy
(d) Angular momentum

(viii) A mass 'm' attached to a spring oscillates every 2 seconds. If the mass is increased by 2 kg then the time period increases by 1 second. The initial mass is _____.

(a) 1.6 kg
(b) 2.4 kg
(c) 3.2 kg
(d) 1.4 kg

(ix) In biprism experiment, the distance of a point on the screen from the slits is 1.8×10^{-5}m and 1.23×10^{-5}m. If the wavelength of light used is 6000Å. The fringe formed at that point is

(a) 10^{th} bright (b) 10^{th} dark

(c) 9^{th} dark (d) 9^{th} bright

(x) In common emitter amplifier, current gain is 80 and emitter current is 9 mA. The base current is

(a) $\frac{1}{81}$ mA (b) 8 mA

(c) $\frac{1}{8}$ mA (d) $\frac{1}{9}$ mA

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

(i) State the formula for moment of inertia of a solid sphere about an axis passing through its centre.

(ii) Define angle of contact.

(iii) What is an isothermal process?

(iv) At which position, the restoring force acting on a particle executing linear SHM is maximum?

(v) When is an AC circuit non inductive?

(vi) What is the phase difference between input signal voltage and output signal voltage in CE amplifier?

(vii) Calculate the minimum energy required to take an electron from the ground state to the first excited state in hydrogen atom.

(viii) If a charge of 50μc is moving with speed of 50 m/s parallel to the direction of magnetic field, find the mechanical force acting on charged particle.

SECTION – B

Attempt any EIGHT questions of the following :

Q. 3. Draw a neat, labelled diagram of Ferry's black body.

Q. 4. Write a note on free expansion in thermodynamic process.

Q. 5. What is magnetization? Write its unit and dimensions.

Q. 6. State any two conditions for steady interference pattern.

Q. 7. With help of suitable diagram state the expression for Biot-Savart's law in vector form.

Q. 8. State Faraday's laws of electromagnetic induction.

Q. 9. Explain why the total impedance of a circuit decreases when a capacitor is added in series with inductor and resistor.

Q. 10. A motor cyclist (to be treated as a point mass) is to undertake horizontal circles inside the cylindrical wall of a well of inner radius 4 m. The co-efficient of static friction between tyres and the wall is 0.2. Calculate the minimum speed and period necessary to perform this stunt.

Q. 11. Compare the amount of work done in blowing two soap bubbles of radii in the ratio 4 : 5.

Q. 12. Find the distance between two successive antinodes in a stationary wave on a string vibrating with frequency 32 Hz.
[Speed of wave = 48 m/s.]

Q. 13. The e.m.f. of a cell is balanced by a length of 320 cm of the potentiometer wire. When a cell is shunted by a resistance of 50Ω the balancing length is reduced by 20 cm. Find internal resistance of the cell.

Q. 14. The photoelectric work function for a metal is 5 eV. Calculate the threshold frequency for the metal.

SECTION – C

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

Q. 15. With a neat, labelled schematic diagram, explain the experimental set-up for photoelectric effect.

Q. 16. What is light emitting diode? Explain working of a LED.

Q. 17. Obtain an expression for equivalent capacity for combination of three capacitors connected in series.

Q. 18. Explain surface tension on the basis of molecular theory.

Q. 19. Derive an expression for period of a simple pendulum.

Q. 20. State Huygens' principle. Explain geometrical construction of a plane wavefront.

Q. 21. Obtain the expression for Bohr magneton.

Q. 22. The wavelength of two sound waves in air are $\frac{82}{173}$ m and $\frac{82}{171}$ m. They produce 9 beats per second. Calculate velocity of sound in air.

Q. 23. A circular loop of radius 9.2 cm carries a current of 2.3 A. Obtain the magnitude of magnetic field at the centre of loop.

Q. 24. 0.5 mole of gas at temperature 450 K expands isothermally from an initial volume of 3L to final volume of 9L.

(a) What is the work done by the gas? ($R = 8.319\ J\ mol^{-1}K^{-1}$)

(b) How much heat is supplied to the gas?

Q. 25. An alternating e.m.f. $e = 200 \sin 314.2t$ volt is applied between the terminals of an electric bulb whose filament has a resistance of 100Ω. Calculate the following :

(a) RMS current

(b) Frequency of AC signal

(c) Period of AC signal

Q. 26. Two charges of magnitude 5nC and – 2 nC are placed at points (2 cm, 0, 0) and (20 cm, 0, 0) in a region of a space where there is a no external field. Find electrostatic potential energy of the system.

SECTION – D

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

Q. 27. Using the energy conservation, derive the expression for minimum speeds at different locations along a vertical circular motion controlled by gravity.

Q. 28. Explain the conversion of a Moving Coil Galvanometer (MCG) into an ammeter. Obtain necessary formula.

State any two advantages of potentiometer over voltmeter.

Q. 29. State :

(a) Stefan-Boltzmann law of radiation.

(b) Wien's displacement law.

The difference between two molar specific heats of a gas is 6000 J / kg K. If the ratio of specific heats is 1.4, calculate the molar specific heat at constant volume.

Q. 30. Define the following :

(a) Self inductance

(b) Mutual inductance

A straight conductor is moving with a velocity of 3 m/s, at right angles to a magnetic field 4.5×10^{-5} Wb /m^2. If an e.m.f. developed between its ends is 1.35×10^{-4} volt, calculate the length of straight conductor.

Q. 31. State any two limitations of Bohr's atomic model.

The half life of a radioactive species is 3.2 days. Calculate decay constant (per day).

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