

DAY — 04

SEAT NUMBER

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2024	VII	20	1100	J-129	(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) $g = 9.8 \text{ m/s}^2$
- (ii) $\pi = 3.142$
- (iii) $\mu_0 = 4\pi \times 10^{-7} \text{ Wb/Am}$
- (iv) $e = 1.6 \times 10^{-19} \text{ C}$

SECTION – A

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

- (i) Atoms having the same number of protons but different number of neutrons are called _____.
 - (a) isotopes
 - (b) isobars
 - (c) isotones
 - (d) isomers

- (ii) The molecules on the surface of liquid have _____.
 - (a) minimum kinetic energy.
 - (b) minimum potential energy.
 - (c) maximum kinetic energy.
 - (d) maximum potential energy.

- (iii) If coefficient of emission is 'e' for a perfectly black body and coefficient of transmission is 't' then _____.
 - (a) $e = 0, t = 1$
 - (b) $e = 1, t = 1$
 - (c) $e = 0, t = 0$
 - (d) $e = 1, t = 0$

- (iv) An LED emits light when its _____.
 - (a) junction is reverse biased.
 - (b) depletion region widens.
 - (c) holes and electrons recombine.
 - (d) junction becomes hot.

- (v) An electron, a proton, an α -particle and a hydrogen atom are moving with the same kinetic energy. The associated de Broglie wavelength will be the longest for ____.
- (a) electron
 - (b) proton
 - (c) α -particle
 - (d) hydrogen atom
- (vi) Cyclotron is used to accelerate ____.
- (a) neutral particles
 - (b) negatively charged particles
 - (c) positively charged particles
 - (d) all types of particles
- (vii) The unit henry is equal to ____.
- (a) watt
 - (b) ohm-second
 - (c) dyne
 - (d) Wb/m²
- (viii) The ratio of emissive power of a perfect black body at 927°C and 327°C is ____.
- (a) 2 : 1
 - (b) 4 : 1
 - (c) 8 : 1
 - (d) 16 : 1
- (ix) In a series LCR circuit the phase difference between the voltage and the current is 45°. Then the power factor will be ____.
- (a) 0.6071
 - (b) 0.7071
 - (c) 0.8081
 - (d) 1.0

- (x) When an air column in a pipe closed at one end vibrates such that two nodes are formed in it, the frequency of its vibrations is ____.
- (a) two times the fundamental frequency
 - (b) three times the fundamental frequency
 - (c) four times the fundamental frequency
 - (d) five times the fundamental frequency

Q. 2. Answer the following questions :

[8]

- (i) What is the radius of gyration of a solid sphere of radius R about its diameter?
- (ii) Write the differential equation for linear S.H.M.
- (iii) State any one method of polarization of light.
- (iv) What is the resistance of an ideal voltmeter?
- (v) What are eddy currents?
- (vi) What do you mean by logic gate?
- (vii) A body of mass 0.2 kg performs linear S.H.M. It experiences a restoring force of 0.4 N when its displacement from the mean position is 8 cm . Determine force constant.
- (viii) Determine the work done in bringing a charge of $5 \mu\text{C}$ from infinity to the point A. The potential at point A is 400 kV .

SECTION – B

Attempt any EIGHT questions of the following :

[16]

- Q. 3. Show that average energy per molecule is directly proportional to the absolute temperature 'T' of the gas.
- Q. 4. Explain cyclic process with the help of neat and labelled p-V diagram.
- Q. 5. Distinguish between progressive waves and stationary waves.
- Q. 6. Explain Biot and Savart's law with suitable diagram.
- Q. 7. Draw a neat and labelled diagram of van de Graaf generator.
- Q. 8. State the formula for the following :
(a) Average power in LCR circuit
(b) Q-factor
- Q. 9. Explain the working of a transformer with a neat, labelled diagram.
- Q. 10. A galvanometer has a resistance of 100Ω and its full scale deflection current is 0.2 mA, what resistance should be added to it to have a range of 0-10V?
- Q. 11. An electron in hydrogen atom stays in its second orbit for 10^{-8} s. How many revolutions will it make around the nucleus in that time?
[Velocity of electron in second orbit = 1.07×10^6 m/s, radius of electron in second orbit = 2.14×10^{-10} m]

- Q. 12. A torque of magnitude 400 Nm acting on a body of mass 40 kg produces an angular acceleration of 20 rad/s². Calculate the moment of inertia of the body.
- Q. 13. A bar magnet of moment of inertia of 500 gcm² oscillates with a time period of 3.142 seconds in a horizontal plane. What is its magnetic moment if the horizontal component of earth's magnetic field is 4×10^{-5} T ?
- Q. 14. A telescope has an objective of diameter 2.5m. What is its angular resolution when observed at 7500Å ?

SECTION – C

Attempt any EIGHT questions of the following :

[24]

- Q. 15. Define surface tension. Obtain the relation between surface tension and surface energy.
- Q. 16. Show that all harmonics are present in case of a stretched string.
- Q. 17. Derive an expression for the impedance of a series LCR circuit connected to an AC power supply.
- Q. 18. What is Curie temperature? Distinguish between diamagnetic and paramagnetic substances.
- Q. 19. Obtain the balancing conditions in case of Wheatstone's bridge.
- Q. 20. What is ionization energy? Assuming expression for energy of electron, derive an expression for wavelength of spectral lines in hydrogen atom.

- Q. 21.** What is voltage regulation? Explain the working of Zener diode as a voltage regulator.
- Q. 22.** A spherical drop of oil falls at a constant speed of 9.8 cm/s in steady air. Calculate the radius of the drop. The density of oil is 0.9013 g/cm^3 , density of air is 0.0013 g/cm^3 and the coefficient of viscosity of air is 1.8×10^{-4} poise.
- Q. 23.** A search coil having 2000 turns with area 1.5 cm^2 is placed in a magnetic field of 0.6T. The coil is moved rapidly out of the field in a time of 0.2 second. Calculate the induced emf across the search coil.
- Q. 24.** At what distance from the mean position is the kinetic energy of a particle performing S.H.M. of amplitude 10 cm, three times its potential energy?
- Q. 25.** When 2×10^{10} electrons are transferred from one conductor to another, a potential difference of 20V appears between the conductors. Find the capacitance of the two conductors.
- Q. 26.** The magnetic field at the centre of a circular current carrying loop of radius 12 cm is 6×10^{-6} T. What will be the magnetic moment of the loop?

SECTION – D

Attempt any THREE questions of the following :

[12]

- Q. 27.** Derive an expression for minimum speed to perform stunts in well of death.

Part of a racing track is to be designed for a radius of curvature of 288 m. We are not recommending the vehicles to drive faster than 216 km/hr. With what angle should the road be tilted?

- Q. 28.** Explain the concept of positive and negative work with varying pressure. Draw corresponding p-V diagrams.
- Q. 29.** Deduce an expression for molar specific heat of a monoatomic gas at constant volume.
Find kinetic energy of 4000 cc of a gas at S.T.P.
[Given : Standard pressure is $1.013 \times 10^5 \text{ N/m}^2$]
- Q. 30.** What is photoelectric effect?
Describe with neat circuit diagram an experimental setup of photoelectric effect.
- Q. 31.** Derive the formula for Brewster's angle.
Green light of wavelength 5100 \AA from a narrow slit is incident on a double slit. If the overall separation of 10 fringes on a screen 2 m away is 2 cm, find the slit separation.

