DAY —— 04 SEAT NUMBER | | | | | | |

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

(ii) $\pi = 3.142$

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

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

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/m^2

(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 0.4N when its displacement from the mean position is 8 cm. Determine force constant.

(viii) Determine the work done in bringing a charge of 5μC 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/s^2. Calculate the moment of inertia of the body.

Q. 13. A bar magnet of moment of inertia of 500 gcm^2 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 1.013×10^5 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 5100Å 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.

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