

MODEL QUESTION PAPER 2027

PHYSICS

Std. XII (H.S.C.) · Maharashtra State Board

Time: 3 Hours

Max. Marks: 70

General instructions:

- (1) All questions are compulsory.
- (2) The numbers to the right indicate full marks.
- (3) For each MCQ (Q. 1), only the first attempt will be evaluated.
- (4) Draw well-labelled diagrams wherever necessary.
- (5) Use of a calculator is not allowed.

SECTION A

Q. 1. Select and write the correct answer of the following (each 1 mark):

10

- (i) The Boolean equation for NOR gate is (a) $Y = A \cdot B$ (b) $Y = (A + B) \text{ bar}$ (c) $Y = A \text{ bar}$ (d) $Y = A + B$
- (ii) A conducting rod of length l , rotates about one of its ends in a uniform magnetic field B , with a constant angular velocity ω . If the plane of rotation is perpendicular to B , the e.m.f. induced between the ends of rod is _____. (a) $(1/2) B \omega l^2$ (b) $B \omega l^2$ (c) $2 B \omega l^2$ (d) $B \omega l$
- (iii) A ceiling fan has moment of inertia of 2 kg m^2 . It attains maximum frequency of 60 r.p.m. in 2 seconds. Calculate its power rating.
- (iv) Cyclotron can not accelerate _____. (a) protons (b) alpha-particles (c) neutrons (d) deuterons
- (v) In a purely inductive and capacitive circuit, power factor is, _____. (a) one (b) zero (c) infinity (d) 10
- (vi) The MI of ring of radius ' R ' and mass ' M ' about its central axis is _____. (a) $2 MR^2$ (b) $MR^2/2$ (c) MR^2 (d) $(3/2) MR^2$
- (vii) When n number of capacitors having each of capacity ' C ' are connected in series, their equivalent capacity is (a) $1/C$ (b) nC (c) C/n (d) $1/(nC)$
- (viii) What is the coefficient of transmission for athermanous materials?
- (ix) An electron, a proton, an alpha-particle and a hydrogen atom are moving with the same kinetic energy. The associated de-Broglie wavelength will be longest for - (a) proton (b) electron (c) hydrogen atom (d) alpha-particle
- (x) When a number of droplets coalesce to form a single drop, the total surface area of the drop _____. (a) decreases (b) becomes zero (c) remains same (d) increases

Q. 2. Answer the following (each 1 mark):

8

- (i) Define magnetization. State its S.I. unit and dimensions. What is the relation between permeability and magnetic susceptibility?
- (ii) Define : (i) Self inductance (ii) Mutual inductance. [Second part:] A conducting loop of area 1 m^2 is placed normal to a uniform magnetic field of 3 Wb/m^2 . If the magnetic field is uniformly reduced to 1 Wb/m^2 in 0.5 second, calculate the induced e.m.f. produced in the coil.
- (iii) State any two postulates of Bohr's theory of hydrogen atom.
- (iv) What is the resistance of an ideal voltmeter?
- (v) Write the differential equation for linear S.H.M.
- (vi) State the formula for electric field intensity due to uniformly charged spherical shell.
- (vii) What are Eddy currents? State its two applications.
- (viii) Obtain an expression for orbital magnetic moment of an electron revolving around the nucleus of an atom.

SECTION B

Q. 3 to Q. 14. Attempt any EIGHT of the following (each 2 marks):

16

- (i) For a thermodynamic system : Define : (a) Mechanical equilibrium (b) Chemical equilibrium

- (ii) A galvanometer has a resistance of 40 ohm and a current of 4 mA is needed for full scale deflection. What is the resistance and how is it to be connected to convert the galvanometer (a) into an ammeter of 0.4 A range and (b) into a voltmeter of 5 V range?
- (iii) An alternating voltage source given by $e = 140 \sin(314.2 t)$ is connected across a pure resistor of 50 ohm. Determine : (i) Frequency of the source. (ii) RMS value of emf.
- (iv) Obtain an expression for the maximum speed of a vehicle along horizontal circular curved road.
- (v) With the help of neat diagram explain construction of a transformer. [Second part:] Calculate energy required to build up current of 1A in an inductor of inductance 20 mH.
- (vi) Distinguish between harmonics and overtones. [Any Two points]
- (vii) Two tuning forks having frequencies 160 Hz and 170 Hz are sounded together to produce sound waves. The velocity of sound in air is 326.4 m/s. Calculate the difference between wavelengths of these waves.
- (viii) Derive an expression for the magnetic field produced by a current in a circular arc of a wire using Biot-Savart law.
- (ix) With a neat circuit diagram, explain the working of a full wave rectifier. Draw input-output waveforms.
- (x) 0.5 mole of an ideal gas at 300 K, expands isothermally from an initial volume of 2 L to a final volume of 6 L. Calculate : (a) work done by the gas (b) heat supplied to the gas [Given : $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$]
- (xi) Calculate the radius of water drop, so that the excess pressure inside it is 24 N/m^2 . [Surface tension of water = $7.2 \times 10^{-2} \text{ N/m}$]
- (xii) Explain the cyclic process with the help of a neat p-V diagram.

SECTION C

Q. 15 to Q. 26. Attempt any EIGHT of the following (each 3 marks):

24

- (i) Calculate the shortest wavelength of Paschen series and the longest wavelength of Balmer series for hydrogen atom.
- (ii) Using phasor diagram for a series LCR circuit, obtain an expression for impedance. Define admittance.
- (iii) Define isothermal process. Obtain an expression for work done during isothermal process. Draw P-V diagram.
- (iv) What is photoelectric effect? Describe with neat circuit diagram an experimental setup of photoelectric effect.
- (v) Define surface tension. Obtain the relation between surface tension and surface energy.
- (vi) What is interference of light? State any four conditions for obtaining well defined and steady interference pattern.
- (vii) Obtain an expression for period of a bar magnet vibrating in a uniform magnetic field and performing angular S.H.M.
- (viii) Derive the decay law of radioactivity and state SI unit of 'activity.'
- (ix) State differential equation of linear S.H.M. hence obtain an expression for acceleration, velocity and displacement of a particle performing S.H.M.
- (x) Calculate the current flowing through two long parallel wires carrying equal currents and separated by a distance of 1.35 cm experiencing a force per unit length of $4.76 \times 10^{-2} \text{ N/m}$.
- (xi) An electric dipole consists of two unlike charges of magnitude $2 \times 10^{-6} \text{ C}$ each and separated by 4 cm. The dipole is placed in an external electric field of 10^5 N/C . Calculate the work done by an external agent to turn the dipole through 180 deg.
- (xii) 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? [Given : $e = 1.6 \times 10^{-19} \text{ C}$, $m = 9.1 \times 10^{-31} \text{ kg}$]

SECTION D

Q. 27 to Q. 31. Attempt any THREE of the following (each 4 marks):

12

- (i) Derive an expression for pressure exerted by a gas on the basis of kinetic theory of gases.
- (ii) Using analytical method, obtain an expression for the fringe width of two interfering waves.
- (iii) Obtain an expression for magnetic induction of a toroid of N no. of turns about an axis passing through its centre and perpendicular to plane. [Second part:] A Carnot refrigerator operates between 150 K and 200 K, calculate its coefficient of performance.
- (iv) Define logic gate and explain why NOT gate is called an inverter. [Second part:] The transistor is in the common emitter configuration. Its DC current gain is 50. If collector current is 3mA, calculate the base current.
- (v) Obtain an expression for average power dissipated in a series LCR circuit.

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