Physics

HSC Board Exam February–March 2027 – Practice Paper No. 2

Practice Question Paper

Time: 3 hours **Max. Marks: 70**

(1) The question paper is divided into FOUR sections.
(2) Section A: Q.1 contains TEN multiple choice type of questions carrying ONE mark each. Q.2 contains EIGHT very short answer type of questions carrying ONE mark each.
(3) Section B: Q.3 to Q.14 contain TWELVE short answer type of questions carrying TWO marks each. (Attempt any EIGHT.)
(4) Section C: Q.15 to Q.26 contain TWELVE short answer type of questions carrying THREE marks each. (Attempt any EIGHT.)
(5) Section D: Q.27 to Q.31 contain FIVE long answer type of questions carrying FOUR marks each. (Attempt any THREE.)
(6) Use of log table is allowed. Use of calculator is not allowed.
(7) Figures to the right indicate full marks.
(8) For each MCQ, the correct answer must be written along with its alphabet, e.g. (a) ..... / (b) ..... Evaluation of MCQs will be done for the first attempt only.
(9) Physical constants are given in the questions wherever needed.

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

(i) A kathak dancer spinning on one heel draws her arms close to her body, so that her moment of inertia becomes 3/4 of its initial value. Her rotational kinetic energy becomes _____ times its initial value.

(A) 3/4 (B) 4/3
(C) 9/16 (D) 16/9

(ii) A soap bubble and a liquid drop have the same radius R and the same surface tension T. The ratio of the excess pressure inside the soap bubble to that inside the liquid drop is _____.

(A) 1 : 2 (B) 2 : 1
(C) 1 : 1 (D) 4 : 1

(iii) According to the law of equipartition of energy, the ratio $\gamma = C_p/C_v$ for a rigid diatomic ideal gas is _____.

(A) 5/3 (B) 7/5
(C) 4/3 (D) 9/7

(iv) In an isochoric process, the heat supplied to an ideal gas is used _____.

(A) only to do external work (B) only to increase the internal energy
(C) partly to do work and partly to increase the internal energy (D) neither to do work nor to change the internal energy

(v) For the air column in a pipe open at both ends, the frequencies of the first three harmonics are in the ratio _____.

(A) 1 : 3 : 5 (B) 1 : 2 : 3
(C) 1 : 2 : 4 (D) 1 : 4 : 9

(vi) A point charge q is placed at the centre of a cube. The electric flux through any one face of the cube is _____.

(A) q/ε_0 (B) $q/6\varepsilon_0$

(C) $6q/\varepsilon_0$ (D) zero

(vii) In a balanced Wheatstone's network, the positions of the cell and the galvanometer are interchanged. The balance _____.

(A) is disturbed (B) is not disturbed

(C) is disturbed only if the galvanometer resistance is large (D) is obtained only if all four resistances are equal

(viii) A straight conductor moves perpendicular to a uniform magnetic field. If its speed is doubled and the magnetic induction is halved, the induced emf across its ends _____.

(A) is doubled (B) is halved

(C) remains unchanged (D) becomes four times

(ix) The lines of the Balmer series of the hydrogen spectrum lie mainly in the _____ region.

(A) ultraviolet (B) visible

(C) infrared (D) microwave

(x) The output of a two-input NOR gate is 1 only when _____.

(A) both inputs are 1 (B) both inputs are 0

(C) only input A is 1 (D) the two inputs are different

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

(i) What is the coefficient of absorption (absorptive power) of a perfect blackbody?

(ii) Write the differential equation of linear S.H.M.

(iii) What is the phase difference between any two points on the same wavefront?

(iv) Write the SI unit of magnetic dipole moment.

(v) What is the magnetic susceptibility of a superconductor?

(vi) What is the power factor of a purely resistive a.c. circuit?

(vii) Define threshold frequency.

(viii) Which type of breakdown occurs in a heavily doped Zener diode?

SECTION B Attempt any EIGHT questions of the following: (2 marks each) **[16]**

Q.3 A flyover in Pune has a curved section of radius 90 m. The road is to be banked so that a car moving at 54 km/h can go round the curve without depending on friction. Find the required angle of banking. ($g = 10\ m/s^2$)

Q.4 State Bernoulli's principle. Using it, explain how an aeroplane wing gets an upward force (dynamic lift).

Q.5 Find (a) the average translational kinetic energy of a helium molecule at 27 °C and (b) the total translational kinetic energy of 2 mol of helium gas at that temperature. ($k_B = 1.38 \times 10^{-23}$ J/K, R = 8.31 J/mol K)

Q.6 One mole of an ideal monatomic gas is heated at constant pressure from 300 K to 350 K. Find (a) the work done by the gas, (b) the increase in its internal energy and (c) the heat supplied to it. (R = 8.31 J/mol K)

Q.7 A block of mass 0.5 kg is attached to a light horizontal spring of force constant 50 N/m and oscillates on a smooth table. Find its period. What will the period be if the block is replaced by one of mass 2 kg? ($\pi = 3.14$)

Q.8 Unpolarised light of intensity 32 W/m^2 falls on a polariser. The light coming out of it passes through an analyser whose transmission axis makes an angle of 30° with that of the polariser. (a) Find the intensity of light emerging from the analyser. (b) At what angle to the polariser's axis should the analyser be set so that the emerging intensity is 4 W/m^2?

Q.9 Capacitors of 6 µF and 3 µF are connected in series, and this pair is connected in parallel with a 4 µF capacitor. The combination is connected to a 12 V battery. Find (a) the equivalent capacitance and (b) the charge on the 6 µF capacitor.

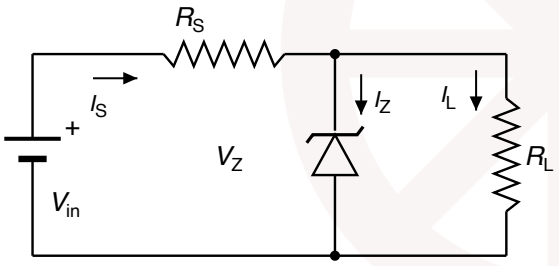
Q.10 In a metre bridge experiment, an unknown resistance X is in the left gap and a 12 Ω resistance in the right gap. The null point is at 40 cm from the left end. Find X. Where will the null point be if X and the 12 Ω resistance are interchanged?

Q.11 The two long, straight, parallel conductors of a battery cable are 2.5 cm apart and carry currents of 25 A each in opposite directions. Find the force per unit length on each conductor and state whether it is attractive or repulsive. ($\mu_0 = 4\pi \times 10^{-7}$ Wb/A m)

Q.12 A d.c. motor with armature resistance 2 Ω is connected to a 220 V d.c. supply. When running at normal speed it draws a current of 10 A. Find (a) the back emf at normal speed and (b) the current at the instant the motor is switched on.

Q.13 A capacitor of capacitance (125/π) µF is connected to a 240 V, 50 Hz a.c. supply. Find (a) its capacitive reactance and the r.m.s. current. (b) At what frequency of a 240 V supply would the current be doubled?

Q.14 In the Zener regulator circuit shown, V_{in} = 15 V, Zener voltage V_Z = 6 V, R_S = 300 Ω and load R_L = 1.2 kΩ. Find the currents I_S, I_L and I_Z.



Zener diode in reverse bias, R_L parallel to it

SECTION C Attempt any EIGHT questions of the following: (3 marks each) **[24]**

Q.15 State the theorem of parallel axes. A uniform wooden rod (lathi) of mass 0.5 kg and length 1.2 m is rotated about an axis perpendicular to its length and passing through a point 0.2 m from one end. Find its moment of inertia about this axis.

Q.16 State Stokes' law. Obtain an expression for the terminal velocity of a small sphere falling through a viscous fluid. When will the sphere move upward instead?

Q.17 A string of an ektara is 60 cm long between its fixed ends and has a linear density of 5 × 10^{-3} kg/m. It is stretched by a tension of 72 N. Find (a) the frequency of its fundamental mode, (b) the frequency of its second overtone and (c) the tension needed to make the fundamental frequency 150 Hz.

Q.18 Light from a red laser of wavelength 630 nm falls normally on a single slit of width 0.18 mm. The Fraunhofer diffraction pattern is observed on a screen 1.2 m away. Find (a) the width of the central bright fringe, (b) the distance of the first secondary bright fringe from the centre and (c) the angular width of the central bright fringe.

Q.19 State Gauss' theorem in electrostatics. Using it, obtain an expression for the electric field intensity at a point at distance r from an infinitely long, straight, uniformly charged wire of linear charge density λ placed in vacuum.

Q.20 A moving coil galvanometer has a resistance of 199 Ω and gives full-scale deflection for a current of 5 mA. How will you convert it into (a) an ammeter reading up to 1 A and (b) a voltmeter reading up to 10 V?

Q.21 State Ampère's circuital law. Using it, obtain an expression for the magnetic induction inside a toroid. A toroid of mean radius 12 cm has 600 turns and carries a current of 1.5 A. Find the magnetic induction inside its (air) core. ($\mu_0 = 4\pi \times 10^{-7}$ Wb/A m)

Q.22 Show that the orbital magnetic moment of an electron revolving in a circular orbit is M = (e/2m)L, where L is its orbital angular momentum. Using Bohr's quantisation condition, obtain the value of the Bohr magneton. (e = 1.6×10^{-19} C, m = 9.1×10^{-31} kg, h = 6.63×10^{-34} J s, π = 3.14)

Q.23 A red laser pointer emits light of wavelength 663 nm with a power of 3 mW. Find (a) the energy of each photon in joule and in eV, (b) the number of photons it emits per second and (c) the momentum of each photon. (h = 6.63×10^{-34} J s, c = 3×10^8 m/s, 1 eV = 1.6×10^{-19} J)

Q.24 Define mass defect and binding energy of a nucleus. Calculate the binding energy per nucleon of the neon nucleus $^{20}_{10}$Ne. (Mass of ^{20}Ne atom = 19.992440 u, mass of hydrogen atom m_H = 1.007825 u, mass of neutron m_n = 1.008665 u, 1 u = 931.5 MeV/c^2)

Q.25 A coil of N turns, each of area A, rotates with uniform angular velocity ω about an axis perpendicular to a uniform magnetic field B. Show that the emf induced in it is $e = e_0 \sin \omega t$, where e_0 = NABω. A coil of 50 turns, each of area 0.04 m^2, rotates at 1800 r.p.m. in a uniform magnetic field of 0.25 T. Find the peak emf. (π = 3.14)

Q.26 Define the coefficient of performance of a refrigerator. A cold storage for Nagpur oranges keeps its chamber at 7 °C while the outside temperature is 42 °C. Treating it as a Carnot refrigerator, find (a) its coefficient of performance, (b) the work needed to remove 4000 J of heat from the chamber and (c) the heat given out to the surroundings.

SECTION D Attempt any THREE questions of the following: (4 marks each) **[12]**

Q.27 (a) A small body tied to a string is whirled in a vertical circle of radius r under gravity. Using the principle of conservation of energy, obtain the minimum speeds of the body at the uppermost point, at the lowermost point and at a point where the string is horizontal. Show that the difference between the tensions at the lowermost and uppermost points is 6mg. [3]
(b) A farmer whirls a stone in a gofan (sling) in a vertical circle of radius 0.4 m. Find the minimum speed the stone must have at the top of the circle and the corresponding speed at the lowest point. (g = 10 m/s^2) [1]

Q.28 (a) Obtain an expression for the energy stored in a charged capacitor and express it in three forms. Show that only half of the energy supplied by the charging battery is stored in the capacitor. [3]
(b) The flash unit of a camera has a 500 μF capacitor charged to 200 V. Find the energy delivered in one flash. [1]

Q.29 (a) Draw the phasor diagram for a series LCR circuit connected to an a.c. source (take $X_L > X_C$). Obtain expressions for its impedance and the phase angle between the voltage and the current. State the condition for resonance and obtain the resonant frequency. [3]
(b) Find the resonant frequency of a series LCR circuit with L = (1/π) H and C = (1/π) μF. [1]

Q.30 (a) Obtain expressions for the kinetic energy and the potential energy of a particle performing linear S.H.M. Hence show that its total energy is conserved. Draw a graph showing how these energies vary with displacement. [3]

(b) A particle performs S.H.M. of amplitude 10 cm. At what displacement from the mean position are its kinetic and potential energies equal? [1]

Q.31 (a) Using Bohr's postulates, obtain an expression for the energy of the electron in the n^{th} orbit of the hydrogen atom. [3]

(b) The energy of the electron in the n^{th} orbit of hydrogen is $E_n = -13.6/n^2$ eV. Find the wavelength of the photon emitted when the electron jumps from the 5^{th} orbit to the 2^{nd} orbit. ($c = 3 \times 10^8$ m/s, $h = 6.63 \times 10^{-34}$ J s, 1 eV = 1.6×10^{-19} J) [1]

All the best for your exam!