Physics

HSC Board Exam February–March 2027 – Practice Paper

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 uniform disc rolls without slipping on a horizontal surface. The fraction of its total kinetic energy that is rotational is _____.

(A) 1/2 (B) 1/3
(C) 2/3 (D) 1/4

(ii) In a cyclotron, the frequency of revolution of a charged particle in the uniform magnetic field does NOT depend on its _____.

(A) charge (B) mass
(C) magnetic induction (D) speed

(iii) In linear S.H.M., the phase difference between the displacement and the velocity of the particle is _____.

(A) 0 (B) π/4 rad
(C) π/2 rad (D) π rad

(iv) A Young's double-slit set-up gives a fringe width W in air. If the entire set-up is immersed in water of refractive index 4/3, the fringe width becomes _____.

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

(v) The sensitivity of a potentiometer can be increased by _____.

(A) increasing the current through the wire (B) decreasing the length of the wire
(C) increasing the length of the potentiometer wire (D) increasing the potential gradient

(vi) The magnetic susceptibility of a diamagnetic substance is _____.

(A) small and positive (B) small and negative

(C) large and positive (D) zero

(vii) The average power consumed over one complete cycle in a purely inductive a.c. circuit is _____.

(A) $e_{rms}\, i_{rms}$ (B) $e_0\, i_0$

(C) $e_{rms}\, i_{rms}/\sqrt{2}$ (D) zero

(viii) The accelerating potential difference for an electron is made four times. Its de Broglie wavelength becomes _____.

(A) half (B) double

(C) one-fourth (D) four times

(ix) A full-wave rectifier is supplied with a.c. of frequency 50 Hz. The frequency of the ripple in its output is _____.

(A) 25 Hz (B) 50 Hz

(C) 100 Hz (D) 200 Hz

(x) According to Bohr's model, the ratio of the radius of the third orbit to that of the first orbit of the hydrogen atom is _____.

(A) 3 : 1 (B) 9 : 1

(C) 1 : 9 (D) 27 : 1

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

(i) Write the dimensions of the coefficient of viscosity.

(ii) What is the change in internal energy of an ideal gas in an isothermal process?

(iii) What is the distance between a node and the next antinode in a stationary wave of wavelength λ?

(iv) Write the SI unit of electric polarization.

(v) Write the expression for the magnetic induction inside a long solenoid having n turns per unit length and carrying current I.

(vi) Lenz's law is a consequence of the law of conservation of which physical quantity?

(vii) What is the output of a two-input NAND gate when both inputs are 1?

(viii) State the energy equivalent of 1 atomic mass unit (1 u) in MeV.

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

Q.3 The angular speed of a flywheel increases uniformly from 120 r.p.m. to 300 r.p.m. in 6 s. Find (a) its angular acceleration and (b) the number of revolutions it makes in this time.

Q.4 Define surface tension and surface energy. Show that the surface tension of a liquid is numerically equal to its surface energy per unit area.

Q.5 What is meant by the resolving power of a telescope? State two ways of increasing it.

Q.6 Using the first law of thermodynamics, explain why a gas cools when it expands adiabatically.

Q.7 A particle performs linear S.H.M. of amplitude 4 cm and period π/5 s. Find its maximum velocity and maximum acceleration.

Q.8 A pipe 17 cm long is closed at one end. Neglecting end correction, find the frequency of its fundamental mode and of its first overtone. (Speed of sound in air = 340 m/s)

Q.9 A parallel plate air capacitor has plates of area 0.02 m^2 separated by 1.77 mm. Find its capacitance and the charge on each plate when it is connected to a 50 V supply. ($\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/N\ m^2$)

Q.10 State Kirchhoff's current law and voltage law, mentioning the sign conventions used.

Q.11 A circular coil of 50 turns and radius 6.28 cm carries a current of 2 A. Find the magnetic induction at its centre. ($\mu_0 = 4\pi \times 10^{-7}$ Wb/A m, $\pi = 3.14$)

Q.12 An induction cooktop quickly heats a steel vessel kept on it, but a glass bowl kept on it stays cool. Explain, naming the currents responsible.

Q.13 Light of wavelength 4140 Å falls on a metal surface of work function 1.8 eV. Find the maximum kinetic energy of the photoelectrons (in eV) and the stopping potential. ($h = 6.63 \times 10^{-34}$ J s, $c = 3 \times 10^8$ m/s, 1 eV = 1.6×10^{-19} J)

Q.14 State Curie's law for a paramagnetic material. A paramagnetic salt kept in a fixed external magnetic field has magnetization 3.6×10^3 A/m at –73 °C. Find its magnetization in the same field at 27 °C.

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

Q.15 Obtain an expression for the total kinetic energy of a body rolling without slipping on a horizontal surface, in terms of its linear speed and radius of gyration.

Q.16 Water rises to a height of 3 cm in a clean glass capillary tube of radius 0.5 mm. (a) Find the surface tension of water. (b) To what height will it rise in a tube of radius 0.25 mm? (Angle of contact = 0°, density of water = 1000 kg/m^3, g = 9.8 m/s^2)

Q.17 State Wien's displacement law and draw the graphs of spectral emissive power against wavelength for a perfectly black body at three different temperatures. The radiation from a star has maximum intensity at 580 nm. Estimate the temperature of its surface. ($b = 2.9 \times 10^{-3}$ m K)

Q.18 A Carnot engine works between a source at 477 °C and a sink at 27 °C. If it absorbs 3500 J of heat from the source in each cycle, find (a) its efficiency, (b) the work done per cycle and (c) the heat rejected to the sink per cycle.

Q.19 Show that, for small amplitudes, the motion of a simple pendulum is linear S.H.M. Hence obtain the expression for its period.

Q.20 What are beats? Two tuning forks A and B produce 5 beats per second when sounded together. The frequency of A is 320 Hz. When A is filed slightly, the number of beats per second decreases. Find the frequency of B.

Q.21 In Young's double-slit experiment, the slits are 0.5 mm apart and the screen is 1 m from the slits. Light of wavelength 600 nm is used. Find (a) the fringe width, (b) the distance of the third bright fringe and (c) the distance of the second dark fringe from the central bright fringe.

Q.22 A parallel plate capacitor has plates of area A separated by a distance d in vacuum. A dielectric slab of dielectric constant k and thickness t (t < d) is placed between the plates as shown. Obtain an expression for its capacitance.

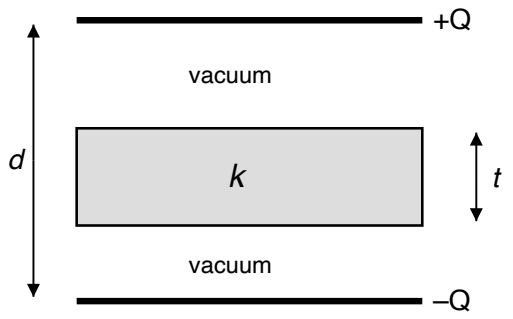


Plate area A; slab thickness t (t < d)

Q.23 Draw a labelled circuit diagram to determine the internal resistance of a cell using a potentiometer. With the key K_2 open, the balancing length is 300 cm; when the cell is shunted by a resistance of 10 Ω (K_2 closed), the balancing length becomes 250 cm. Find the internal resistance of the cell.

Q.24 An iron rod of relative permeability 600 is placed inside a solenoid that produces a magnetic intensity of 1000 A/m. Find (a) the magnetic susceptibility of iron, (b) the magnetization of the rod and (c) the magnetic induction in the rod. ($\mu_0 = 4\pi \times 10^{-7}$ Wb/A m, $\pi = 3.14$)

Q.25 A series LCR circuit has R = 40 Ω, L = (0.8/π) H and C = (200/π) μF. It is connected to a 220 V, 50 Hz a.c. supply. Find (a) the impedance, (b) the r.m.s. current, (c) the power factor and the average power consumed.

Q.26 Obtain an expression for the de Broglie wavelength of an electron accelerated from rest through a potential difference V. Calculate it for V = 400 V. ($h = 6.63 \times 10^{-34}$ J s, $m = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$ C)

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

Q.27 (a) On the basis of the kinetic theory of gases, derive an expression for the pressure exerted by an ideal gas in terms of its density and the r.m.s. speed of its molecules. [3]

(b) The r.m.s. speed of the molecules of a gas at 27 °C is 500 m/s. Find it at 927 °C. [1]

Q.28 (a) State Huygens' principle. Using it, prove the law of refraction of light at a plane surface separating two media. [3]

(b) The refractive index of a glass is $\sqrt{3}$. Find the polarising angle (Brewster's angle) for it and the angle of refraction at this angle of incidence. [1]

Q.29 (a) What is self-induction? Obtain an expression for the self-inductance of a long air-cored solenoid. [3]

(b) A solenoid 50 cm long has 500 turns and area of cross-section 10 cm^2. Find its self-inductance. ($\mu_0 = 4\pi \times 10^{-7}$ Wb/A m, $\pi = 3.14$) [1]

Q.30 (a) Draw a neat labelled circuit diagram of an n-p-n transistor in common-emitter configuration. Define the current gains α_{dc} and β_{dc} and show that $\beta_{dc} = \alpha_{dc}/(1 - \alpha_{dc})$. [3]

(b) For a transistor $\alpha_{dc} = 0.96$. If the emitter current is 7.5 mA, find β_{dc} and the base current. [1]

Q.31 (a) State the law of radioactive decay. Derive the relation $N = N_0 e^{-\lambda t}$ and hence obtain the relation between half-life and decay constant. [3]

(b) A radioactive sample has a half-life of 20 minutes and an initial activity of 6.4×10^4 Bq. Find its activity after 1 hour. [1]

All the best for your exam!