# BOARD QUESTION PAPER : OCTOBER 2015
# PHYSICS

**Time: 3 Hours** **Total Marks: 70**

**Note:**

i. All questions are compulsory.
ii. Neat diagrams must be drawn wherever necessary.
iii. Figures to the right indicate full marks.
iv. Use of only logarithmic table is allowed.
v. All symbols have their usual meaning unless otherwise stated.

## SECTION – I

**Q.1. A.** State an expression for the moment of inertia of a solid uniform disc, rotating about an axis passing through its centre, perpendicular to its plane. Hence derive an expression for the moment of inertia and radius of gyration:
i. about a tangent in the plane of the disc, and
ii. about a tangent perpendicular to the plane of the disc.

**B.** In a set, 21 turning forks are arranged in a series of decreasing frequencies. Each tuning fork produces 4 beats per second with the preceding fork. If the first fork is an octave of the last fork, find the frequencies of the first and tenth fork. **[7]**

**OR**

**A.** Discuss the composition of two S.H.M.s along the same path having same period. Find the resultant amplitude and intial phase.

**B.** A sonometer wire is in unison with a tuning fork of frequency 125 Hz when it is stretched by a weight. When the weight is completely immersed in water, 8 beats are heard per second. Find the specific gravity of the material of the weight. **[7]**

**Q.2. Select and write the most appropriate answer from the given alternatives for each sub-question :** **[7]**

i. Which of the following substances is ductile?
(A) Glass (B) High carbon steel
(C) Steel (D) Copper

ii. Angle of contact for the pair of pure water with clean glass is _____.
(A) acute (B) obtuse
(C) 90° (D) 0°

iii. A seconds pendulum is suspended in an elevator moving with constant speed in downward direction. The periodic time (T) of that pendulum is _____.
(A) less than two seconds (B) equal to two seconds
(C) greater than two seconds (D) very much greater than two seconds

iv. The equation of a progressive wave is $y = 7 \sin (4t - 0.02x)$, where $x$ and $y$ are in cms and time $t$ in seconds. The maximum velocity of a particle is _____.
(A) 28 cm/s (B) 32 cm/s
(C) 49 cm/s (D) 112 cm/s

v. The dimensions of emissive power are
(A) $[M^1L^{-2}T^{-3}]$ (B) $[M^1L^2T^{-3}]$
(C) $[M^1L^0T^{-3}]$ (D) $[M^1L^0T^{-2}]$

vi. The pressure (P) of an ideal gas having volume (V) is $\frac{2E}{3V}$, then the energy E is _____.

(A) translational kinetic (B) rotational kinetic
(C) vibrational kinetic (D) inversely proportional to pressure

vii. The fundamental frequency of transverse vibration of a stretched string of radius *r* is proportional to _____.

(A) $r^{-2}$ (B) $r^{-1}$
(C) $r^{-\frac{1}{2}}$ (D) $r^{2}$

**Q.3. Attempt any SIX:** **[12]**

i. Draw a neat labelled diagram of conical pendulum. State the expression for its periodic time in terms of length.

ii. A raindrop of diameter 4 mm is about to fall on the ground. Calculate the pressure inside the raindrop. [Surface tension of water T = 0·072 N/m, atmospheric pressure = $1{\cdot}013 \times 10^5$ N/m$^2$]

iii. Discuss the weightlessness experienced by an astronaut in an orbiting satellite.

iv. The periodic time of a linear harmonic oscillator is $2\pi$ second, with maximum displacement of 1 cm. If the particle starts from extreme position, find the displacement of the particle after $\frac{\pi}{3}$ seconds.

v. State and prove : Law of conservation of angular momentum.

vi. A pinhole is made in a hollow sphere of radius 5 cm whose inner wall is at temperature 727°C. Find the power radiated per unit area. [Stefan's constant $\sigma = 5{\cdot}7 \times 10^{-8}$ J/m$^2$s K$^4$, emissivity (e) = 0·2]

vii. Draw a neat labelled diagram showing forces acting on the meniscus of water in a capillary tube.

viii. Compute the temperature at which the r.m.s. speed of nitrogen molecules is 832 m/s. [Universal gas constant, R = 8320 J/k mole K, molecular weight of nitrogen = 28.]

**Q.4. Attempt any THREE:** **[9]**

i. Discuss the behaviour of wire under increasing load.

ii. Determine the binding energy of satellite of mass 1000 kg revolving in a circular orbit around the Earth when it is close to the surface of Earth. Hence find kinetic energy and potential energy of the satellite.
[Mass of Earth = $6 \times 10^{24}$ kg, radius of Earth = 6400 km; gravitational constant $G = 6{\cdot}67 \times 10^{-11}$ Nm$^2$/kg$^2$]

iii. Show that all harmonics are present on a stretched string between two rigid supports.

iv. A stone of mass 100 g attached to a string of length 50 cm is whirled in a vertical circle by giving velocity at lowest point as 7 m/s. Find the velocity at the highest point.
[Acceleration due to gravity = 9·8 m/s$^2$]

## SECTION – II

**Q.5. A.** Obtain an expression for average power dissipated in a purely resistive A.C. circuit. Define power factor of the circuit and state its value for purely resistive A.C. circuit.

**B.** A rectangular coil of a moving coil galvanometer contains 50 turns each having area 12 cm$^2$. It is suspended in radial magnetic field 0·025 Wb/m$^2$ by a fibre of twist constant $15 \times 10^{-10}$ N-m/degree. Calculate the sensitivity of the moving coil galvanometer. **[7]**

**OR**

**A.** State Bohr's third postulate for hydrogen ($H_2$) atom. Derive Bohr's formula for the wave number. Obtain expressions for longest and shortest wavelength of spectral lines in ultraviolet region for hydrogen atom.

**B.** The photoelectric current in a photoelectric cell can be reduced to zero by a stopping potential of 1·8 volt. Monochromatic light of wavelength 2200Å is incident on the cathode. Find the maximum kinetic energy of the photoelectrons in joules. [Charge on electron = $1{\cdot}6 \times 10^{-19}$ C] **[7]**

**Q.6. Select and write the most appropriate answer from the given alternatives for each sub-question :** **[7]**

i. Which one of the following particles cannot be accelerated by a cyclotron?
(A) Electrons (B) Protons
(C) Deuterons (D) $\alpha$ – particles

ii. In biprism experiment two interfering waves are produced due to division of _____.
(A) amplitude (B) wavefront
(C) amplitude and wavefront (D) neither wavefront nor amplitude

iii. The output of NOR gate is high, when _____.
(A) all inputs are high (B) all inputs are low
(C) only one of its inputs is high (D) only one of its inputs is low

iv. Light of a certain wavelength has a wave number $\bar{\upsilon}$ in vacuum. Its wave number in a medium of refractive index n is _____.
(A) $\frac{n}{\bar{\upsilon}}$ (B) $\frac{1}{n\bar{\upsilon}}$
(C) $\frac{\bar{\upsilon}}{n}$ (D) $n\bar{\upsilon}$

v. If the radius of a sphere is doubled without changing the charge on it, then electric flux originating from the sphere is _____.
(A) double (B) half
(C) same (D) zero

vi. The momentum of a photon of de Broglie wavelength 5000Å is _____.
[Planck's constant = $6{\cdot}63 \times 10^{-34}$ J.s.]
(A) $1{\cdot}326 \times 10^{-28}$ kg-m/s (B) $7{\cdot}54 \times 10^{-28}$ kg-m/s
(C) $1{\cdot}326 \times 10^{-27}$ kg-m/s (D) $7{\cdot}54 \times 10^{-27}$ kg-m/s

vii. Ionosphere mainly consists of _____.
(A) positive ions and electrons (B) water vapour and smoke
(C) ozone layer (D) dust particles

**Q.7. Attempt any SIX:** **[12]**

i. State any 'two' possible sources of errors in meter-bridge experiment. How can they be minimised?

ii. A potentionmeter wire has resistance of per unit length of 0·1 Ω/m. A cell of e.m.f. 1·5V balances against 300 cm length of the wire. Find the current in the potentiometer wire.

iii. Give any 'two' points of differences between diamagnetic and ferromagnetic substances.

iv. An iron rod of area of cross-section $0{\cdot}1 m^2$ is subjected to a magnetising field of 1000 A/m. Calculate the magnetic permeability of the iron rod.
[Magnetic susceptibility of iron = 59·9, magnetic permeability of vacuum = $4\pi \times 10^{-7}$ S. I. unit]

v. Draw a neat labelled circuit diagram of experimental arrangement for study of photoelectric effect.

vi. A coil of 100 turns, each of area 0·02 $m^2$ is kept in a uniform field of induction $3{\cdot}5 \times 10^{-5}$ T. If the coil rotates with a speed of 6000 r.p.m. about an axis in the plane of the coil and perpendicular to the magnetic induction, calculate peak value of e.m.f. induced in the coil.

vii. Define modulation and transducer.

viii. In a biprism experiment, when a convex lens was placed between the biprism and eyepiece at a distance of 30 cm from the slit, the virtual images of the slits are found to be separated by 7 mm. If the distance between the slit and biprism is 10 cm and between the biprism and eyepiece is 80cm, find the linear magnification of the image.

**Q.8. Attempt any THREE:** **[9]**

i. With the help of a neat circuit diagram, explain the working of a photodiode. State its any 'two' uses.

ii. A parallel beam of monochromatic light is incident on a glass slab at an angle of incidence 60°. Find the ratio of width of the beam in the glass to that in the air if refractive index of glass is 3/2.

iii. With the help of neat diagram, explain how non-polar dielectric material is polarised in external electric field of increasing intensity. Define polarisation in dielectrics.

iv. In a single slit diffraction pattern, the distance between first minima on the right and first minima on the left of central maximum is 4 mm. The screen on which the pattern is displaced, is 2m from the slit and wavelength of light used is 6000Å. Calculate width of the slit and width of the central maximum.