BOARD QUESTION PAPER : MARCH 2018

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.
vi. Answers to both sections must be written in the same answerbook.
vii. Answer to every question must be written on a new page.

SECTION – I

Q.1. Select and write the most appropriate answer from the given alternatives for each sub-question: **[7]**

i. In stationary wave, the distance between a node and its adjacent antinode is _____.

(A) λ (B) $\frac{\lambda}{4}$

(C) $\frac{\lambda}{2}$ (D) 2λ

ii. If the source is moving away from the observer, then the apparent frequency _____.

(A) will increase (B) will remain the same
(C) will be zero (D) will decrease

iii. A particle of mass m performs vertical motion in a circle of radius r. Its potential energy at the highest point is _____.
(g is acceleration due to gravity)

(A) 2mgr (B) mgr
(C) 0 (D) 3 mgr

iv. The compressibility of a substance is the reciprocal of _____.

(A) Young's modulus (B) bulk modulus
(C) modulus of rigidity (D) Poisson's ratio

v. If the particle starts its motion from mean position, the phase difference between displacement and acceleration is _____.

(A) 2π rad (B) $\frac{\pi}{2}$ rad

(C) π rad (D) $\frac{\pi}{4}$ rad

vi. The kinetic energy per molecule of a gas at temperature T is _____.

(A) $\left(\frac{3}{2}\right)RT$ (B) $\left(\frac{3}{2}\right)K_BT$

(C) $\left(\frac{2}{3}\right)RT$ (D) $\left(\frac{3}{2}\right)\left(\frac{RT}{M}\right)$

vii. A thin ring has mass 0.25 kg and radius 0.5m. Its moment of inertia about an axis passing through its centre and perpendicular to its plane is _____.

(A) 0.0625 kg m^2 (B) 0.625 kg m^2
(C) 6.25 kg m^2 (D) 62.5 kg m^2

Q.2. Attempt any SIX: **[12]**

i. State Kepler's law of orbit and law of equal areas.

ii. State any 'four' assumptions of kinetic theory of gases.

iii. Define moment of inertia. State its SI unit and dimensions.

iv. Distinguish between centripetal and centrifugal force.

v. In Melde's experiment, when tension in the string is 10 g wt then three loops are obtained. Determine the tension in the string required to obtain four loops, if all other conditions are constant.

vi. Calculate the work done in increasing the radius of a soap bubble in air from 1 cm to 2 cm. The surface tension of soap solution is 30 dyne/cm. ($\pi = 3.142$)

vii. A flat curve on a highway has a radius of curvature 400 m. A car goes around a curve at a speed of 32 m/s. What is the minimum value of coefficient of friction that will prevent the car from sliding? ($g = 9.8\ m/s^2$)

viii. A particle performing linear S. H. M. has maximum velocity of 25 cm/s and maximum acceleration of 100 cm/s^2. Find the amplitude and period of oscillation. ($\pi = 3.142$)

Q.3. Attempt any THREE: **[9]**

i. Derive Laplace's law for a spherical membrane.

ii. State and prove principle of conservation of angular momentum.

iii. Calculate the strain energy per unit volume in a brass wire of length 3 m and area of cross-section 0.6 mm^2 when it is stretched by 3 mm and a force of 6 kgwt is applied to its free end.

iv. What is the decrease in weight of a body of mass 500 kg when it is taken into a mine of depth 1000 km?
(Radius of earth R = 6400 km, $g = 9.8\ m/s^2$)

Q.4. A. State the differential equation of linear simple harmonic motion. **[7]**

B. Hence obtain the expression for acceleration, velocity and displacement of a particle performing linear S. H. M.
A body cools from 80°C to 70°C in 5 minutes and to 62°C in the next 5 minutes. Calculate the temperature of the surroundings.

OR

A. What is meant by harmonics? Show that only odd harmonics are present as overtones in the case of an air column vibrating in a pipe closed at one end.

B. The wavelengths of two sound waves in air are $\frac{81}{173}$ m and $\frac{81}{170}$ m. They produce 10 beats per second. Calculate the velocity of sound in air.

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SECTION – II

Q.5. Select and write the most appropriate answer from the given alternatives for each sub-question: **[7]**

i. The reflected waves from an ionosphere are _____.
(A) ground waves (B) sky waves
(C) space waves (D) very high frequency waves

ii. In interference pattern, using two coherent sources of light; the fringe width is _____.
(A) directly proportional to wavelength.
(B) inversely proportional to square of the wavelength.
(C) inversely proportional to wavelength.
(D) directly proportional to square of the wavelength.

iii. Electric intensity outside a charged cylinder having the charge per unit length 'λ' at a distance r from its axis is _____.
(A) $E = \frac{2\pi \in_0 \lambda}{Kr^2}$ (B) $E = \frac{\in_0 \lambda}{2\pi Kr^2}$
(C) $E = \frac{\lambda}{2\pi \in_0 Kr}$ (D) $E = \frac{4\pi \in_0 \lambda}{Kr^2}$

iv. SI unit of potential gradient is _____.
(A) V cm (B) $\frac{V}{cm}$ (C) V m (D) $\frac{V}{m}$

v. The momentum associated with photon is given by _____.
(A) hν (B) $\frac{h\nu}{c}$ (C) hE (D) hλ

vi. A pure semiconductor is _____.
(A) an extrinsic semiconductor (B) an intrinsic semiconductor
(C) p-type semiconductor (D) n-type semiconductor

vii. Glass plate of refractive index 1.732 is to be used as a polariser, its polarizing angle is _____.
(A) 30° (B) 45° (C) 60° (D) 90°

Q.6. Attempt any SIX: **[12]**

i. State the conditions to get constructive and destructive interference of light.
ii. State and explain Ampere's circuital law.
iii. Draw a neat and labelled block diagram of a receiver.
iv. Define magnetization. Write its SI unit and dimensions.
v. The electron in the hydrogen atom is moving with a speed of 2.3×10^6 m/s in an orbit of radius 0.53 Å. Calculate the period of revolution of electron. ($\pi = 3.142$)

vi. A capacitor of capacitance 0.5 μF is connected to a source of alternating e.m.f. of frequency 100 Hz. What is the capacitive reactance? ($\pi = 3.142$)

vii. Calculate the de-Broglie wavelength of an electron moving with one fifth of the speed of light. Neglect relativistic effects. ($h = 6.63 \times 10^{-34}$ J.s., $c = 3 \times 10^{8}$ m/s, mass of electron $= 9 \times 10^{-31}$ kg)

viii. In a cyclotron, magnetic field of 1.4 Wb/m^2 is used. To accelerate protons, how rapidly should the electric field between the Dees be reversed?
($\pi = 3.142$, $M_p = 1.67 \times 10^{-27}$ kg, $e = 1.6 \times 10^{-19}$ C)

Q.7. Attempt any THREE: **[9]**

i. Explain with a neat circuit diagram how will you determine unknown resistance 'X' by using meter bridge.

ii. What is Zener diode? How is it used as a voltage regulator?

iii. In a biprism experiment, light of wavelength 5200 Å is used to get an interference pattern on the screen. The fringe width changes by 1.3 mm when the screen is moved towards biprism by 50 cm. Find the distance between two virtual images of the slit.

iv. The refractive indices of water and diamond are $\frac{4}{3}$ and 2.42 respectively. Find the speed of light in water and diamond. ($c = 3 \times 10^{8}$ m/s)

Q.8. A. Prove theoretically the relation between e.m.f. induced in a coil and rate of change of magnetic flux in electromagnetic induction.

B. A parallel plate air condenser has a capacity of 20 μF. What will be the new capacity if:
i. the distance between the two plates is doubled?
ii. a marble slab of dielectric constant 8 is introduced between the two plates? **[7]**

OR

A. Draw a neat and labelled energy level diagram and explain Balmer series and Brackett series of spectral lines for hydrogen atom.

B. The work function for a metal surface is 2.2 eV. If light of wavelength 5000Å is incident on the surface of the metal, find the threshold frequency and incident frequency. Will there be an emission of photoelectrons or not?
($c = 3 \times 10^{8}$ m/s, 1 eV $= 1.6 \times 10^{-19}$ J, $h = 6.63 \times 10^{-34}$ J.s.) **[7]**