BOARD QUESTION PAPER : MARCH 2017

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. If the pressure of an ideal gas decreases by 10% isothermally, then its volume will _____.
(A) decrease by 9% (B) increase by 7%
(C) increase by 10% (D) increase by 11.4%

ii. Stretching of a rubber band results in _____.
(A) no change in potential energy. (B) zero value of potential energy.
(C) increase in potential energy. (D) decrease in potential energy.

iii. When the angular acceleration of a rotating body is zero, which physical quantity will be equal to zero?
(A) Angular momentum (B) Moment of inertia
(C) Torque (D) Radius of gyration

iv. In a damped harmonic oscillator, periodic oscillations have _____ amplitude.
(A) gradually increasing (B) suddenly increasing
(C) suddenly decreasing (D) gradually decreasing

v. A sine wave of wavelength ' λ' is travelling in a medium. What is the minimum distance between two particles of the medium which always have the same speed?
(A) λ (B) $\frac{\lambda}{2}$
(C) $\frac{\lambda}{3}$ (D) $\frac{\lambda}{4}$

vi. Velocity of transverse wave along a stretched string is proportional to _____. (T = tension in the string)
(A) $\sqrt{T}$ (B) T
(C) $\frac{1}{\sqrt{T}}$ (D) $\frac{1}{T}$

vii. Find the wavelength at which a black body radiates maximum energy, if its remperature is 427°C.
(Wein's constant b = 2.898×10^{-3} mK)
(A) 0.0414×10^{-6} m (B) 4.14×10^{-6} m
(C) 41.4×10^{-6} m (D) 414×10^{-6} m

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

i. Explain the concept of centripetal force.

ii. Prove that root mean square velocity of gas molecule is directly proportional to the square root of its absolute temperature.

iii. Obtain the differential equation of linear simple harmonic motion.

iv. Draw a neat, labelled diagram for a liquid surface in contact with a solid, when the angle of contact is acute.

v. A hole is drilled half way to the centre of the Earth. A body is dropped into the hole. How much will it weigh at the bottom of the hole if the weight of the body on the Earth's surface is 350 N?

vi. A solid sphere of mass 1 kg rolls on a table with linear speed 2 m/s, find its total kinetic energy.

vii. A transverse wave is produced on a stretched string 0.9 m long and fixed at its ends. Find the speed of the transverse wave, when the string vibrates while emitting second overtone of frequency 324 Hz.

viii. A body cools at the rate of 0.5°C / minute when it is 25° C above the surroundings. Calculate the rate of cooling when it is 15°C above the same surroundings.

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

i. Show that period of a satellite revolving around the Earth depends upon mass of the Earth.

ii. Obtain an expression for torque acting on a rotating body with constant angular acceleration. Hence state the dimensions and SI unit of torque.

iii. The total energy of free surface of a liquid drop is 2π times the surface tension of the liquid. What is the diameter of the drop?
(Assume all terms in SI unit).

iv. A vehicle is moving on a circular track whose surface is inclined towards the horizon at an angle of 10°. The maximum velocity with which it can move safely is 36 km / hr. Calculate the length of the circular track. [$\pi = 3.142$]

Q.4. A. Prove the law of conservation of energy for a particle performing simple harmonic motion. Hence graphically show the variation of kinetic energy and potential energy w. r. t. instantaneous displacement.

B. Two sound notes have wavelengths $\frac{83}{170}$ m and $\frac{83}{172}$ m in the air. These notes when sounded together produce 8 beats per second. Calculate the velocity of sound in the air and frequencies of the two notes. **[7]**

OR

A. Explain the formation of stationary waves by analytical method. Show the formation of stationary wave diagramatically.

B. A mass of 1 kg is hung from a steel wire if radius 0.5 mm and length 4 m. Calculate the extension produced. What should be the area of cross-section of the wire so that elastic limit is not exceeded? Change in radius is negligible.
(Given : $g = 9.8\ m/s^2$; Elastic limit of steel is $2.4 \times 10^8\ N/m^2$;
Y for steel (Y_{steel}) = $20 \times 10^{10}\ N/m^2$; $\pi = 3.142$) **[7]**

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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. If A.C. voltage is applied to a pure capacitor, then voltage across the capacitor _____.

(A) leads the current by phase angle $\left(\frac{\pi}{2}\right)$ rad.

(B) leads the current by phase angle (π) rad.

(C) lags behind the current by phase angle $\left(\frac{\pi}{2}\right)$ rad.

(D) lags behind the current by phase angle (π) rad.

ii. In Doppler effect of light, the term "red shift" is used for _____.

(A) frequency increase (B) frequency decrease
(C) wavelength decrease (D) frequency and wavelength increase

iii. If a watch-glass containing a small quantity of water is placed on two dissimilar magnetic poles, then water _____.

(A) shows a depression in the middle. (B) shows an elevation in the middle.
(C) surface remains horizontal. (D) evaporates immediately.

iv. Any device that converts one form of energy into another is termed as _____.

(A) amplifier (B) transducer
(C) receiver (D) demodulator

v. When a p-n-p transistor is operated in saturation region, then its _____.

(A) base-emitter junction is forward biased and base-collector junction is reverse biased.
(B) both base-emitter and base-collector junctions are reverse biased.
(C) both base-emitter and base-collector junctions are forward biased.
(D) base-emitter junction is reverse biased and base-collector junction is forward biased.

vi. In a photon-electron collision _____.

(A) only total energy is conserved.
(B) only total momentum is conserved.
(C) both total energy and total momentum are conserved.
(D) both total momentum and total energy are not conserved.

vii. If the charge on the condenser of 10 μF is doubled, then the energy stored in it becomes _____.

(A) zero (B) twice that of initial energy
(C) half the initial energy (D) four times the initial energy

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

i. Distinguish between the phenomenon of interference and diffraction of light.

ii. Explain how moving coil galvanometer is converted into a voltmeter. Derive the necessary formula.

iii. State the advantages of potentiometer over voltmeter.

iv. Draw a neat, labelled block diagram of a receiver for the detection of amplitude modulated wave.

v. A rectangular coil of a moving coil galvanometer contains 100 turns, each having area 15 cm^2. It is suspended in the radial magnetic field 0.03 T. The twist constant of suspension fibre is 15×10^{-10} N-m/degree. Calculate the sensitivity of the moving coil galvanometer.

vi. The magnetic flux through a loop is varying according to a relation $\phi = 6t^2 + 7t + 1$ where ϕ is in milliweber and t is in second. What is the e.m.f. induced in the loop at t = 2 second?

vii. An unknown resistance is placed in the left gap and resistance of 50 ohm is placed in the right gap of a meter bridge. The null point is obtained at 40 cm from the left end. Determine the unknown resistance.

viii. Find the frequency of revolution of an electron in Bohr's 2^{nd} orbit; if the radius and speed of electron in that orbit is 2.14×10^{-10} m and 1.09×10^6 m/s respectively. [$\pi = 3.142$]

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

i. Explain with a neat diagram, how a p-n junction diode is used as a half wave rectifier.

ii. Explain self induction and mutual induction.

iii. A cube of marble having each side 1 cm is kept in an electric field of intensity 300 V/m. Determine the energy contained in the cube of dielectric constant 8.
[Given : $\in_0 = 8.85 \times 10^{-12}$ C^2/Nm^2]

iv. An electron in an atom revolves around the nucleus in an orbit of radius 0.53 Å. If the frequency of revolution of an electron is 9×10^9 MHz, calculate the orbital angular momentum.
[Given : Charge on an electron = 1.6×10^{-19} C;
Gyromagnetic ratio = 8.8×10^{10} C/kg; $\pi = 3.142$]

Q.8. A. Describe the biprism experiment to find the wavelength of the monochromatic light. Draw the necessary ray diagram.

B. The width of plane incident wavefront is found to be doubled on refraction in denser medium. If it makes an angle of 65° with the normal, calculate the refractive index for the denser medium. **[7]**

OR

A. Draw a neat, labelled energy level diagram for H atom showing the transitions.
Explain the series of spectral lines for H atom, whose fixed inner orbit numbers are 3 and 4 respectively.

B. The work functions for potassium and caesium are 2.25 eV and 2.14 eV respectively. Is the photoelectric effect possible for either of them if the incident wavelength is 5180 Å?
[Given : Planck's constant = 6.63×10^{-34} J.s.;
Velocity of light = 3×10^8 m/s; 1 eV = 1.6×10^{-19} J] **[7]**