

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 temperature is 427°C.
 (Wein’s constant $b = 2.898 \times 10^{-3}$ 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 $0.5^{\circ}\text{C} / \text{minute}$ 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 diagrammatically.

B. A mass of 1 kg is hung from a steel wire of 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 : $g = 9.8 \text{ m/s}^2$; Elastic limit of steel is $2.4 \times 10^8 \text{ N/m}^2$;

Y for steel ($Y_{\text{steel}} = 20 \times 10^{10} \text{ N/m}^2$; $\pi = 3.142$)

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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 $10 \mu\text{F}$ 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 $15 \times 10^{-10} \text{ N-m/degree}$. 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 $2.14 \times 10^{-10} \text{ m}$ and $1.09 \times 10^6 \text{ m/s}$ 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 : $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{Nm}^2$]
- iv. An electron in an atom revolves around the nucleus in an orbit of radius 0.53 \AA . If the frequency of revolution of an electron is $9 \times 10^9 \text{ MHz}$, calculate the orbital angular momentum.
[Given : Charge on an electron = $1.6 \times 10^{-19} \text{ C}$;
Gyromagnetic ratio = $8.8 \times 10^{10} \text{ C/kg}$; $\pi = 3.142$]

- 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 \AA ?

[Given : Planck's constant = $6.63 \times 10^{-34} \text{ J.s.}$;Velocity of light = $3 \times 10^8 \text{ m/s}$; $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$]**[7]**