

# BOARD QUESTION PAPER : MARCH 2017

## PHYSICS

### 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 ' $\lambda$ ' is travelling in a medium. What is the minimum distance between two particles of the medium which always have the same speed?  
(A)  $\lambda$  (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)  $0.0414 \times 10^{-6}$  m (B)  $4.14 \times 10^{-6}$  m  
(C)  $41.4 \times 10^{-6}$  m (D)  $414 \times 10^{-6}$  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  $25^{\circ}\text{C}$  above the surroundings. Calculate the rate of cooling when it is  $15^{\circ}\text{C}$  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  $2\pi$  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  $10^{\circ}$ . 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  $2.4 \times 10^8 \text{ N/m}^2$ ;

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

[7]

**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  $(\pi)$  rad.
  - (C) lags behind the current by phase angle  $\left(\frac{\pi}{2}\right)$  rad.
  - (D) lags behind the current by phase angle  $(\pi)$  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  $15 \text{ cm}^2$ . It is suspended in the radial magnetic field  $0.03 \text{ T}$ . 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  $\phi$  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  $50 \text{ ohm}$  is placed in the right gap of a meter bridge. The null point is obtained at  $40 \text{ cm}$  from the left end. Determine the unknown resistance.
- viii. Find the frequency of revolution of an electron in Bohr's  $2^{\text{nd}}$  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  $1 \text{ cm}$  is kept in an electric field of intensity  $300 \text{ V/m}$ . 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  $0.53 \text{ \AA}$ . 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  $65^\circ$  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  $2.25 \text{ eV}$  and  $2.14 \text{ eV}$  respectively. Is the photoelectric effect possible for either of them if the incident wavelength is  $5180 \text{ \AA}$ ?

[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]