BOARD QUESTION PAPER : JULY 2017
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.
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. Attempt any SIX: **[12]**

i. If the angular speed of the earth is 7.26×10^{-5} rad/s and radius of the earth is 6,400 km, calculate the change in weight of 1 kg of mass taken from equator to pole.
ii. A small body of mass 0.3 kg oscillates in vertical plane with the help of a string 0.5 m long with a constant speed of 2 m/s. It makes an angle of 60° with the vertical. Calculate tension in the string ($g = 9.8$ m/s^2).
iii. Two soap bubbles have radii in the ratio 4:3. What is the ratio of work done to blow these bubbles?
iv. At what temperature will average kinetic energy of gas be exactly half of its value at N.T.P.?
v. Define surface tension and surface energy.
vi. Prove that $g_h = g\left(1 - \frac{2h}{R}\right)$ where g_h is the acceleration due to gravity at altitude h and h << R (R is the radius of the earth).
vii. Explain the physical significance of radius of gyration.
viii. Draw neat, labelled diagram showing different forces acting on a vehicle moving along a banked road.

Q.2. Attempt any THREE: **[9]**

i. Prove Kirchhoff's law of radiation theoretically.
ii. Within the elastic limit, find the work done by a stretching force on a wire.
iii. A set of 12 tuning forks is arranged in order of increasing frequencies. Each fork produces 'Y' beats per second with the previous one. The last is an octave of the first. The fifth fork has a frequency of 90 Hz. Find 'Y' and frequency of the first and the last tuning forks.
iv. A uniform solid sphere has radius 0.2 m and density 8×10^3 kg/m^3. Find the moment of inertia about the tangent to its surface. ($\pi = 3.142$)

Q.3. A. Define linear simple harmonic motion. Assuming the expression for displacement of a particle starting from extreme position, explain graphically the variation of velocity and acceleration w.r.t. time.

B. A clock regulated by seconds pendulum, keeps correct time. During summer, length of pendulum increases to 1.005 m. How much will the clock gain or loose in one day?
($g = 9.8$ m/s^2 and $\pi = 3.142$) **[7]**

OR

A. Discuss different modes of vibrations in an air column of a pipe open at both the ends. State the cause of end correction. Find the end correction for the pipe open at both the ends in fundamental mode.

B. What should be tension applied to a wire of length 1 m and mass 10 gram, if it has to vibrate with fundamental frequency of 50 Hz? **[7]**

Q.4. Select and write the most appropriate answer from the given alternatives for each sub-question: **[7]**

i. A body of mass 'm' performs uniform circular motion along a circular path of radius 'r' with velocity 'v'. If its angular momentum is L, then the centripetal force acting on it is _____.

(A) $\frac{mL^2}{r^3}$ (B) $\frac{L^2}{mr}$

(C) $\frac{L^2}{mr^2}$ (D) $\frac{L^2}{mr^3}$

ii. If the Earth completely loses its gravity, then for any body _____.

(A) both mass and weight become zero.
(B) neither mass nor weight become zero.
(C) weight becomes zero but not the mass.
(D) mass becomes zero but not the weight.

iii. If a rigid body of radius 'R' starts from rest and rolls down an inclined plane of inclination 'θ' then linear acceleration of body rolling down the plane is _____.

(A) $\frac{g\sin\theta}{1+\frac{K}{R}}$ (B) $g\sin\theta\left(1+\frac{K}{R}\right)$

(C) $\frac{g\sin\theta}{1+\frac{K^2}{R^2}}$ (D) $g\sin\theta\left(1+\frac{K^2}{R^2}\right)$

iv. 1000 tiny mercury droplets coalesce to form a bigger drop. In this process, temperature of the drop _____ .

(A) increases (B) may increase or decrease
(C) decreases (D) does not change

v. Doppler effect is not applicable when _____.

(A) source and observer are at rest.
(B) there is a relative motion between source and observer.
(C) both are moving in opposite directions.
(D) both are moving in same direction with different velocities.

vi. If the total kinetic energy per unit volume of gas enclosed in a container is E, the pressure exerted by the gas is _____.

(A) E (B) $\frac{3}{2}E$

(C) $\sqrt{3}\,E$ (D) $\frac{2}{3}E$

vii. Two wires of the same material have radii r_A and r_B respectively. The radius of wire A is twice the radius of wire B. If they are stretched by same load then stress on wire B is _____.

(A) equal to that of A (B) half that of A.
(C) two times that of A. (D) four times that of A.

SECTION – II

Q.5. Attempt any SIX: **[12]**

i. Thorium $_{90}Th^{232}$ is disintegrated into lead $_{82}Pb^{200}$. Find the number of α and β particles emitted in disintegration.

ii. If the work function of a metal is 3 eV, calculate the threshold wavelength of that metal. (Velocity of light = 3×10^8 m/s, Planck's constant = 6.63×10^{-34} J.s.; 1 eV = 1.6×10^{-19} J)

iii. Three capacitors of capacities 8 μF, 8 μF and 4 μF are connected in a series and potential difference of 120 volt is maintained across the combination. Calculate the charge on capacitor of capacity 4 μF.

iv. If the total energy of radiation of frequency 10^{14} Hz is 6.63 J, calculate the number of photons in the radiation. (Planck's constant = 6.63×10^{-34} J.s.)

v. Distinguish between diamagnetic and paramagnetic substances.

vi. Draw a neat, labeled diagram showing different layers of the Earth's atmosphere.

vii. Explain the construction of plane wavefront using Huygens' principle.

viii. Obtain an expression for electric field intensity at a point outside uniformly charged thin plane sheet.

Q.6. Attempt any THREE: **[9]**

i. Draw a neat circuit diagram to study the characteristics of common emitter n-p-n transistor. With the help of a graph, explain the output characteristics of this transistor.

ii. Obtain an expression for magnetic induction along the axis of toroid on the basis of Ampere's circuital law.

iii. When a resistance of 12 ohm is connected across a cell, its terminal potential difference is balanced by 120 cm length of potentiometer wire. When the resistance of 18 ohm is connected across the same cell, the balancing length is 150 cm. Find the balancing length when the cell is in open circuit. Also calculate the internal resistance of the cell.

iv. Find the ratio of longest wavelength in Paschen series to shortest wavelength in Balmer series.

Q.7. A. State the principle of working of transformer. Explain the construction and working of a transformer. Derive an expression for e.m.f. and current in terms of turns ratio.

B. Find the magnetization of a bar magnet of length 10 cm and cross-sectional area 4 cm^2, if the magnetic moment is 2 Am^2. **[7]**

OR

A. Obtain an expression for path difference and fringe width of interference pattern in Young's double slit experiment. Show that the fringe width is same for consecutive bright and dark bands.

B. The refractive indices of glass and water w.r.t. air are $\frac{3}{2}$ and $\frac{4}{3}$ respectively. Determine the refractive index of glass w.r.t. water. **[7]**

Q.8. Select and write the most appropriate answer from the given alternatives for each sub-question: **[7]**

i. The logic gate which produces LOW output when one of the input is HIGH and produces HIGH output only when all of its inputs are LOW is called _____.

(A) AND gate (B) OR gate

(C) NOR gate (D) NAND gate

ii. For efficient radiation and reception of signal with wavelength λ, the transmitting antennas would have length comparable to _____.

(A) λ of frequency used (B) $\frac{\lambda}{2}$ of frequency used

(C) $\frac{\lambda}{3}$ of frequency used (D) $\frac{\lambda}{4}$ of frequency used

iii. Cyclotron can not accelerate _____.

(A) protons (B) neutrons

(C) α-particles (D) deuterons

iv. In series LCR circuit at resonance, phase difference between current and e.m.f. of source is _____.

(A) π rad (B) $\frac{\pi}{2}$ rad

(C) $\frac{\pi}{4}$ rad (D) zero rad

v. When unknown resistance is determined by meter bridge, the error due to contact resistance is minimized _____.

(A) by connecting both the resistances only in one gap.
(B) by interchanging the positions of known and unknown resistance.
(C) by using uniform wire.
(D) by obtaining the null point near the ends of the wire.

vi. The ratio of kinetic energy of an electron in Bohr's orbit to its total energy in the same orbit is _____.

(A) -1 (B) 2

(C) $\frac{1}{2}$ (D) -0.5

vii. Using monochromatic light of wavelength λ in Young's double slit experiment, the eleventh dark fringe is obtained on the screen for a phase difference of _____.

(A) $\frac{11}{2}\pi$ rad (B) $\frac{21}{2}\pi$ rad

(C) $13\,\pi$ rad (D) $21\,\pi$ rad