

3132(aa)

Std. : 12th

Time : 3 Hours

1 - 59 Physics

Total Marks : 70

General Instructions :

- The question paper is divided into four sections.
- Section 'A' contains Q. No. 1 [(i) to (x)] of multiple choice type of questions carrying one mark each.
Q. No. 2 [(i) to (viii)] are very short answer type of questions carrying one mark each.
- Section 'B' contains Q. No. 3 to 14 of short answer type of questions carrying two marks each. (Attempt any eight.)
- Section 'C' contains Q. No. 15 to 26 of short answer type questions carrying three marks each. (Attempt any eight.)
- Section 'D' contains Q. No. 27 to 31 of long answer type questions carrying four marks each. (Attempt any three.)
- Use of log table is allowed. Use of calculator is not allowed.
- Figures to the right indicate full marks.
- For each MCQ, correct answer must be written along with its alphabet.
- Physical constants
 - Charge of electron (e) = 1.6×10^{-19} C
 - Permittivity of free space (ϵ_0) = 8.85×10^{-12} C²/N-m²
 - Mass of electron (m) = 9.11×10^{-31} kg
 - Planck's constant (h) = 6.63×10^{-34} J-s
 - One atmosphere = 1.01×10^5 N/m²
 - Latent heat of vaporization (L_{vap}) = 2256 kJ/kg
 - Acceleration due to gravity = 9.8 m/s²

Q.1 Select and write correct answers. (10)

- The nucleus contains all the positive charge of the atom and also _____ of its mass.
A) 90.9% B) 99.9% C) 80.9% D) 79.9%
- According to right hand rule, the direction of magnetic induction if current is directed in anticlockwise direction is
A) perpendicular and inwards
B) perpendicular and outwards
C) same as current
D) opposite to that of current
- The conical projection in Ferry's blackbody is
A) used to support the sphere.
B) used to transmit incident radiation to outer sphere.
C) used to prevent reflected radiation to escape outside.
D) used for all of the above purposes.
- In a series LCR circuit, the phase difference between the voltage and the current is 45° , then the power factor will be
A) 0.607 B) 0.707 C) 0.808 D) 1
- The maximum radiant power of the Sun is at wavelength 500 nm. The Wien displacement law constant is 2.898×10^{-3} mK. Estimate the temperature of the surface of the Sun. Assume the Sun to be a blackbody radiator.
A) 5796 K B) 6796 K C) 7796 K D) 4796 K
- Four resistances $10\ \Omega$, $10\ \Omega$, $10\ \Omega$ & $15\ \Omega$ form a Wheatstone's network. What shunt is required across $15\ \Omega$ resistor to balance the bridge?
A) $10\ \Omega$ B) $15\ \Omega$ C) $20\ \Omega$ D) $30\ \Omega$
- In which of the following devices, the eddy current is not used?
A) Electromagnet B) Induction furnace
C) Electric heater
D) Magnetic breaking in train

viii) For constructive interference, the phase difference between two waves should be

- $0, \frac{\pi}{2}, \pi, \dots$
- $0, 2\pi, 4\pi, \dots$
- $\pi, 2\pi, 4\pi, \dots$
- $\frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{2}, \dots$

ix) In which of the following processes, heat is neither absorbed nor released by a system?

- Isobaric
- Isochoric
- Isothermal
- Adiabatic

x) A sonometer wire is vibrating in second overtone. The number of nodes and antinodes formed respectively are

- 2, 3
- 3, 4
- 4, 3
- 3, 2

Q.2 Answer the following. (8)

- Name the logic gate which generates high output when at least one input is high.
- A body of mass m tied to a spring performs SHM with period 2 seconds. If the mass is increased by 3 m, what will be the period of SHM?
- Which material are used in making magnetic compass needle?
- The expression $p = \frac{E}{c}$ defines the momentum of a photon. Can this expression be used for momentum of an electron or proton?
- State Faraday's first law of electromagnetic induction.
- State the principle of capacitor.
- Draw P-V diagram for positive work at constant pressure.
- Define : Wave front

Section - B (2 marks each)

Attempt any Eight. (16)

- At the instant, the current through a coil 0.2A, the energy stored in its magnetic field is 6 mJ. What is the self-inductance of the coil?
- Calculate the value of the capacity in picofarad. Which will make 101.4 microhenry inductance to oscillate the frequency of one megahertz?

Q.5 State any two postulates of Bohr's atomic model.

Q.6 Obtain expression for magnetic field at a distance r from straight current conducting wire using Ampere's law.

Q.7 A motor cyclist (to be treated as a point mass) is to undertake horizontal circles inside the cylindrical wall of a well of inner radius 4 m. Coefficient of static friction between the tyres and the wall is 0.4. Calculate the minimum speed and frequency necessary to perform this stunt. ($g = 10 \text{ m/s}^2$)

Q.8 When 20 kcal heat is supplied to a system, the external work done is 20,000 J. Find the increase in integral energy of the system (in joule). ($J = 4200 \text{ J/kcal}$)

Q.9 A tuning fork with frequency 800 Hz produces resonance column tube with upper end open & lower end closed by water surface. Successive resonance are observed at lengths 9.75 cm, 31.25 cm & 52.75 cm. Calculate the speed of sound in air.

Q.10 Derive an expression for effective capacitance of three capacitors connected in parallel.

Q.11 What are the disadvantages of a potentiometer over a voltmeter?

Q.12 Draw a neat labelled diagram of Fraunhofer diffraction.

Q.13 State : i) Stefan's Boltzmann law of radiation
ii) Kirchhoff's law of heat radiation

Q.14 Define radius of gyration. Explain its physical significance.

Section - C (3 marks each)

Attempt any Eight. (24)

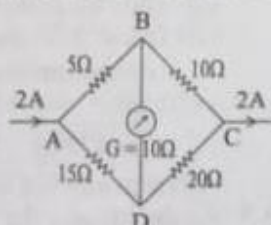
Q.15 Derive an expression that relates the angular momentum with the angular velocity of a rotating body.

Q.16 Explain classification of thermodynamic system.

Q.17 What is end correction? State the cause of end correction. How is it estimated?

Q.18 Determine the linear momentum of the electron in the second Bohr orbit of a hydrogen atom. Hence determine the linear momentum in the third Bohr orbit.

Q.19 Determine the current flowing through the galvanometer shown in the figure.



Q.20 In Young's double slit experiment using monochromatic light of wavelength λ , the intensity of light at a point on the screen where the path difference λ is I. What is the intensity of light at a point where the path difference is $\lambda/3$?

Q.21 Define admittance. The total impedance of a circuit decreases when a capacitor is added in series with L and R. Explain why?

Q.22 A 100 watt filament lamp loses all its power by radiation when it is heated to a temperature of 2500K. If the diameter of the filament is 0.2 mm and the surface emissivity of the filament is 0.5. Find the length of the filament. ($\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$)

Q.23 A capillary tube of radius $5 \times 10^{-4} \text{ m}$ is immersed in a beaker filled with mercury. The mercury level inside the tube is found to be $8 \times 10^{-3} \text{ m}$ below the level of reservoir. Determine the angle of contact between mercury and glass. Surface tension of mercury is 0.465 N/m and its density is $13.6 \times 10^3 \text{ kg/m}^3$. ($g = 9.8 \text{ m/s}^2$)

Q.24 Explain the phenomenon of mutual induction.

Q.25 Draw a neat, labelled diagram of a suspended coil type of moving coil galvanometer. What is the advantage of a radial magnetic field in a moving coil galvanometer and how is it produced?

Q.26 Derive an expression for electric potential due to a point charge. Show graphical variation of electric field (or electric field) and electric potential due to a single charge at a distance r .

Section - D (4 marks each)

Attempt any Three. (12)

Q.27 Explain construction and working of full wave rectifier.

Q.28 a) Can we get photoemission with an intense beam of radio waves? Is photoemission possible at all frequencies?

b) The wavelength and intensity of the incident light is 4000 \AA and 0.1 W respectively. What is the minimum change in the light energy? What is the number of incident photons?

Q.29 State the law of radioactive decay. Define half-life of radioactive material. Also obtain an expression for it.

Q.30 a) Why do molecules of a liquid in the surface film possess extra energy?

b) A beaker of radius 10 cm is filled with water. Calculate the force of surface tension on any diametrical line on its surface. Surface tension of water is 0.075 N/m .

Q.31 Draw the graph in which variation of KE, PE and TE with displacement. Deduce the expressions for KE and PE of a particle executing SHM. Hence obtain an expression for total energy of a particle performing SHM and show that the total energy is conserved.