(7) *For multiple choice type of questions, only the first attempt will be considered for evaluation.*

(8) *Physical constants :* –

(i) $h = 6.63 \times 10^{-34}\ Js$

(ii) $c = 3 \times 10^{8}\ m/s$

(iii) $\pi = 3.142$

(iv) $g = 9.8\ m/s^2$

(v) $\epsilon_0 = 8.85 \times 10^{-12} C^2/Nm^2$

(vi) $\mu_0 = 4\pi \times 10^{-7} Wb/A - m$

SECTION – A

Q. 1. Select and write the correct answers for the following multiple choice type of questions : **[10]**

(i) When a number of droplets coalesce to form a single drop, the total surface area of the drop _____.

(a) decreases. (b) becomes zero

(c) remains same (d) increases

(ii) In an ideal gas, molecules possess _____.

(a) only kinetic energy.

(b) both kinetic energy and potential energy

(c) only potential energy

(d) neither kinetic energy nor potential energy

(iii) If the frequency of incident radiation is increased above threshold frequency, keeping intensity and potential constant then the photoelectric current _____.

(a) decreases (b) becomes zero

(c) remains same. (d) increases

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(iv) The process in which heat is neither absorbed nor released by a system is called _____.

(a) isobaric (b) isochoric

(c) isothermal (d) adiabatic

(v) The period of conical pendulum in terms of its length (l), semi-vertical angle (θ) and acceleration due to gravity (g) is _____.

(a) $\frac{1}{2\pi}\sqrt{\frac{l\cos\theta}{g}}$ (b) $\frac{1}{2\pi}\sqrt{\frac{l\sin\theta}{g}}$

(c) $4\pi\sqrt{\frac{l\cos\theta}{4g}}$ (d) $4\pi\sqrt{\frac{l\tan\theta}{g}}$

(vi) A conducting rod of length l, rotates about one of its ends in a uniform magnetic field B, with a constant angular velocity ω. If the plane of rotation is perpendicular to B, the e.m.f. induced between the ends of rod is _____.

(a) $\frac{1}{2}B\omega l^2$ (b) $B\omega l^2$

(c) $2B\omega l^2$ (d) $B\omega l$

(vii) A metal surface is illuminated by photons of energy 5 eV and 2.5 eV respectively. The ratio of their wavelengths of emitted radiation is _____.

(a) 1 : 4 (b) 1 : 2

(c) 2 : 1 (d) 4 : 1

(viii) A particle is subjected to two parallel S.H.M.s such that $x = 2\sin\omega t$ and $y = 2\sin\left(\omega t + \frac{\pi}{3}\right)$. The amplitude of the resultant S.H.M. will be _____.

(a) 0 (b) $2\sqrt{3}$

(c) 4 (d) 12

P.T.O

(ix) A bar magnet of magnetic moment 10 Am^2 has a cross-sectional area of 2.5×10^{-4} m^2. If the intensity of magnetisation of magnet is 10^6 A/m, the length of the bar magnet is _____.

(a) 2 cm (b) 4 cm

(c) 6 cm (d) 8 cm

(x) In series LCR circuit for $X_L > X_C$, $\tan\phi$ will be _____.

(a) negative (b) zero

(c) positive (d) infinity

Q. 2. Answer the following questions : [8]

(i) State the formula for electric field intensity due to uniformly charged spherical shell.

(ii) Name an instrument for measurement of e.m.f. of a cell.

(iii) Calculate the magnitude of force experienced by a stationary charge exposed to uniform magnetic field.

(iv) Which property of bar magnet is used in navigation?

(v) In Young's double slit experiment, width of the two slits are in the ratio 25 : 1. Calculate the ratio of amplitudes.

(vi) What is beta plus decay?

(vii) If the tension in sonometer wire is increased by 21%, compare the initial frequency with the later.

(viii) Define second's pendulum.

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SECTION – B

Attempt any EIGHT questions of the following : [16]

Q. 3. What are Eddy currents? State its two applications.

Q. 4. State any two sources of error in meter bridge experiment. Explain how they can be minimised.

Q. 5. Draw a ray diagram showing position of virtual sources and region of interference in biprism experiment.

Q. 6. Derive an expression for radius of n^{th} Bohr orbit.

Q. 7. A ceiling fan has moment of inertia of 2 kg m^2. It attains maximum frequency of 60 r.p.m. in 2π seconds. Calculate its power rating.

Q. 8. An electric dipole consists of two unlike charges of magnitude 2×10^{-6} C each and separated by 4 cm. The dipole is placed in an external electric field of 10^5 N/C. Calculate the work done by an external agent to turn the dipole through 180°.

Q. 9. Derive an expression for the magnetic field produced by a current in a circular arc of a wire using Biot-Savart law.

Q. 10. State advantages and disadvantages of photodiode.

Q. 11. Distinguish between harmonics and overtones. [Any Two points]

Q. 12. A steel ball with radius 0.3 mm is falling with velocity of 2 m/s through a tube filled with glycerine. Calculate viscous force acting on the steel ball.

[Given : $\eta_{glycerine} = 0.833\ Ns/m^2$]

P.T.O

Q. 13. Calculate the temperature at which the average kinetic energy of a molecule of a gas will be same as that of an electron accelerated through 1 volt.

[Given: $k_B = 1.4 \times 10^{-23}$ J/k, $e = 1.6 \times 10^{-19}$C]

Q. 14. An inductor of inductance 200 mH is connected to an A.C. source of peak e.m.f. 220 V and frequency 50 Hz. Calculate the peak current in the circuit.

SECTION – C

Attempt any EIGHT questions of the following : [24]

Q. 15. In thermodynamics, define :

(a) Mechanical equilibrium

(b) Chemical equilibrium

(c) Thermal equilibrium

Q. 16. Derive an expression for resonant frequency of series resonant circuit.

Q. 17. Obtain an expression for period of a bar magnet vibrating in a uniform magnetic field and performing angular S.H.M.

Q. 18. Define magnetization. State its S.I. unit and dimensions. What is the relation between permeability and magnetic susceptibility?

Q. 19. Derive an expression for electric potential due to a point charge.

Q. 20. Obtain an expression for the de-Broglie wavelength associated with an electron accelerated from rest through a potential difference of 'V' volts.

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Q. 21. With a neat circuit diagram, explain the working of a full wave rectifier. Draw input–output waveforms.

Q. 22. The string of a guitar is 80 cm long and has a fundamental frequency of 112 Hz. If a guitarist wishes to produce a frequency of 160 Hz, where should he press the string?

Q. 23. 0.5 mole of an ideal gas at 300 K, expands isothermally from an initial volume of 2 L to a final volume of 6 L.

Calculate :

(a) work done by the gas

(b) heat supplied to the gas

[Given : $R = 8.31\ J\ mol^{-1}\ K^{-1}$]

Q. 24. A galvanometer has a resistance of 40Ω and a current of 4 mA is needed for full scale deflection. What is the resistance and how is it to be connected to convert the galvanometer

(a) into an ammeter of 0.4 A range and

(b) into a voltmeter of 5 V range?

Q. 25. A coaxial cable consists of a central conducting core wire of radius 'a' and a coaxial cylindrical outer conductor of radius 'b'. The two conductors carry equal current in opposite directions, in and out of the plane of the paper. What will be the magnitude of magnetic induction B for (i) $a < r < b$ and (ii) $b < r$? What will be its direction?
where 'r' is the radius of the Ampere's circular loop.

Q. 26. Energy of an electron in second Bohr orbit is –3.4 eV. Calculate its kinetic energy and potential energy in third Bohr orbit.

P.T.O

SECTION – D

Attempt any THREE questions of the following : [12]

Q. 27. Derive Laplace's law for spherical membrane of bubble due to surface tension.

Q. 28. Obtain an expression for maximum safety speed with which a vehicle should move along a curved horizontal road.

Moment of intertia of a solid sphere about its diameter is 25 kg m^2. Calculate its moment of inertia about a tangent.

Q. 29. Derive the relation between coefficient of absorption, coefficient of reflection and coefficient of transmission.

Compare the r.m.s. speed of hydrogen molecule at 127°C with r.m.s. speed of oxygen molecule at 27°C, given that molecular masses of hydrogen and oxygen are 2 and 32 respectively.

Q. 30. Define :

(i) Self inductance

(ii) Mutual inductance

A conducting loop of area 1m^2 is placed normal to a uniform magnetic field of 3 Wb/m^2. If the magnetic field is uniformly reduced to 1 Wb/m^2 in 0.5 second, calculate the induced e.m.f. produced in the coil.

Q. 31. Using analytical method, obtain an expression for the fringe width of two interfering waves.

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