Redefining Education

Association of Coaching Institutes

**Paper Contributor : SNEHA Tuition Classes**

**Time : 3:00 Hrs.** **Max. Marks : 70**

**General Instructions:**

1. The question paper is divided into four sections:

(1) **Section A: Q.** No. 1 contains **10** multiple choice type of questions carrying **one mark** each.
Q. No. 2 contains **8** very short answer type of questions carrying **one mark** each.

(2) **Section B:** Q.No. 3 to Q. No. 14 are **12** short answer-I type questions carrying **two marks** each.
Attempt any **eight** questions.

(3) **Section C:** Q. No. 15 to Q. No. 26 are **12** short answer-II type questions carrying **three marks** each.
Attempt any **eight** questions.

(4) **Section D:** Q. No. 27 to Q. No. 31 are **5** long answer type questions carrying **four marks** each.
Attempt any **three** questions.

2. Use of Logarithm Tables is allowed. Use of a calculator is **not** allowed.
3. Figures to the right indicate full marks.
4. For each MCQ, the correct answer must be written along with its alphabet:
e.g., (a)...../ (b)...../ (c)...../ (d)….

**Physical constants:**

(1) $\pi = 3.142$ (2) $g = 9.8\,m/s^2$ (3) $R = 8320\,J/\,k\,mol\cdot K$

(4) $h = 6.63\times10^{-34}\,J\cdot s$ (3) $\varepsilon_0 = 8.85\times10^{-12}\ C^2/Nm^2$ (6) $\mu_0 = 4\pi\times10^{-7}\ Wb/Am$

(7) $\sigma = 5.67\times10^{-8}\,W/m^2k^4$

## SECTION-A

**Q. 1. Select and write the correct answer:** **[10]**

(i) In a conical pendulum, the axial height of the right circular cone described by the string is equal to the radius of the circular path of its bob. The tension in the string is _____

(a) $\frac{mg}{2}$ (b) $\frac{mg}{\sqrt{2}}$ (c) mg (d) $\sqrt{2}$ mg

(ii) The acceleration of an Earth Satellite in a circular orbit is independent of _____

(a) The mass of the Earth (b) the radius of the Earth
(c) the mass of the satellite (d) the orbital radius of the satellite

(iii) The dimensions of angular momentum are_____

(a) $\left[M^1L^{-2}T^{-1}\right]$ (b) $\left[M^1L^2T^{-1}\right]$ (c) $\left[M^2L^1T^1\right]$ (d) $\left[M^2L^2T^{-2}\right]$

(iv) If equation of motion of a particle performing SHM is $x = 0.028\,Cos\,(2.8\pi t + \pi)$ m the frequency of the motion is _____

(a) 0.7 Hz (b) 1.4Hz (c) 2.8 Hz (d) 14 Hz

(v) Young's modules of the material of a wire is Y and the strain energy per unit volume is E. Then the strain is _____

(a) $\sqrt{\frac{Y}{2E}}$ (b) $\sqrt{\frac{E}{Y}}$ (c) $\sqrt{\frac{2E}{Y}}$ (d) $\sqrt{2EY}$

(vi) The fundamental frequency of an open organ pipe is 300Hz it one end is closed, the fundamental frequency will be _____

(a) 100Hz (b) 150Hz (c) 300Hz (d) 600Hz

(vii) The number of degrees of freedom for a rigid diatomic molecule is _____

(a) 3 (b) 5 (c) 6 (d) 7

(viii) The fringes produced in a diffraction pattern are of _____

(a) equal width with the same intensity (b) Unequal width with varrying intensity

(c) equal intensity (d) equal width with varrying intensity.

(ix) If a spherical conductor in air has a surface charge density 6, the electric field intensity on its surface is _____

(a) $\sigma$ (b) $\frac{\sigma}{\varepsilon_0}$ (c) $\frac{\sigma^2}{2\varepsilon_0}$ (d) $\frac{\sigma^2}{\varepsilon_\circ}$

(x) In a series LCR circuit, the power factor at resonance is _____

(a) Zero (b) $\frac{1}{2}$ (c) $\frac{1}{\sqrt{2}}$ (d) 1

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

(i) Define threshold frequency.

(ii) State Len'z Law.

(iii) Which physical quantity of an atomic electron has the dimensions same as that of h?

(iv) A gate generates a HIGH output when at least one of its inputs is LOW. Which is this gate?

(v) State the principle of potentiometer.

(vi) A 10 $\mu$f capacitor is connected to a 100v battery what is the electrostatic energy stored in the capacitor ?

(vii) State the formula of Young's modules.

(viii) Obtain the dimension of Surface Tension.

## SECTION – B

**Attempt any Eight:** **[16]**

Q. 3. In UCM, prove the relation $\vec{v} = \vec{w} \times \vec{r}$, where the symbols have their usual meaning.

Q. 4. Define Escape Velocity and Derive an expression for the escape velocity of a body from the surface of earth.

Q. 5. The radius of gyration of a disc about its transverse Symmetry axis is 2 cm. Determine its radius of gyration about a diameter.

Q. 6. Establish the relation between surface tension and surface energy.

Q. 7. The equation of a transverse wave on a stretched string is y = 0.2 sin $2\pi\left(\frac{t}{0.02} - \frac{x}{20}\right)$ where

distances are in metre and time in second.

Find (i) frequency (ii) speed of the wave.

Q. 8. Define Harmonics and overtones.

Q. 9. Two coherent Sources, whose intensity ratio is 81:1, produce interference fringes. Calculate the ratio of the intensities of maxima and minima in fringe system.

Q.10. Obtain an expression for the electric field intensity at a point outside a charged conducting sphere.

Q.11. A potentiometer wire has length 2m and resistance $10\Omega$. It is connected in series with a resistance $990\Omega$ and a cell of emf 2V. Calculate the potential gradient along the wire.

Q.12. Show that the orbital magnetic dipole moment of a revolving electron is $\frac{evr}{2}$

Q.13. Define peak value and rms value of an alternating emf.

Q.14. Draw the block diagram of a transmitter.

## SECTION – C

**Attempt *any Eight:*** **[24]**

Q.15. What is half-wave rectifier? With a heat circuit diagram, explain the use of a junction diode as a half-wave rectifier.

Q.16. A monochromatic light of wavelength $\lambda$ is incident on an hydrogen atom that takes it to the n = 3 state from the ground state. Find the frequency of the incident photon.

($E_1$ = -13.6ev, $E_3$ = -1.51ev) e = 1.602 x $10^{-19}$ C.

Q. 17. The work function of tungsten is 4.50eV. Calculate the speed of the fastest electron ejected from tungsten surface when light whose photon energy is 5.80eV shines on the surface.

Q. 18. Show that only odd harmonics are present in the vibrations of air column in a pipe closed at one end.

Q. 19. With the help of a heat diagram, explain reflection of light from a plane reflecting surface on the basis of wave theory of light.

Q. 20. State and prove principle of perpendicular axes.

Q. 21. Show that energy of S.H.M. is directly proportional to square of amplitude.

Q. 22. Define emissive power, coefficient of emission, and obsorptive power.

Q. 23. Explain how a moving coil galvanometer is converted into an ammeter. Derive the necessary formula.

Q. 24. Define magnetization and magnetic intensity and state units

Q. 25. Explain the expression for power in A.C. circuit with resistor.

Q. 26. If maximum kinetic energy of emitted electrons in photoelectric effect is 2eV. Find the stopping potential and threshold wavelength, if the work function for metal is 4.2eV.

## SECTION-D

Attempt any Three: [12]

Q.27. (i) Draw the schematic symbol for AND and OR gate.

(ii) Energy of electron in 2nd Bohr orbit is -3.4eV find the energy of electron in 3rd orbit.

Q. 28. Derive theoretical proof of $e=\frac{-d\phi}{dt}$

Q. 29. Using analytical method, obtain an expression for the path difference between two light waves.

Green light of wavelength $5100\,\mathring{A}$ from a narrow slit incident on a double slit. If the overall separation of 10 fringes on a screen 2m away is 2 cm, find the slit separation.

Q. 30. Obtain, differential equation linear S.H.M.

A particle is executing S.H.M. according to the equation, $x=5\sin\pi t$ where x is in cm. How long will the particle take to move from the position of equilibrium to the position of maximum displacement ?

Q. 31. Derive an expression for pressure exerted by the gas on the basis of kinetic theory of gasses.

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