

SAMPLE PAPER 4th

Time allowed: 3 hours

Max. Marks: 70

General Instructions:

1. All questions are compulsory. There are 37 questions in all.
2. This question paper has four sections: Section A, Section B, Section C and Section D.
3. Section A contains twenty questions of one mark each, Section B contains seven questions of two marks each, Section C contains seven questions of three marks each, and Section D contains three questions of five marks each.
4. There is no overall choice. However, internal choices have been provided in two questions of one mark each, two questions of two marks, one question of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.
5. You may use the following values of physical constants where ever necessary.

$$c = 3 \times 10^8 \text{ m/s}$$

$$h = 6.63 \times 10^{-34} \text{ Js}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$$

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

$$\text{mass of neutron} = 1.675 \times 10^{-27} \text{ kg}$$

$$\text{mass of proton} = 1.673 \times 10^{-27} \text{ kg}$$

$$\text{Avogadro's number} = 6.023 \times 10^{23} \text{ per gram mole}$$

$$\text{Boltzmann constant} = 1.38 \times 10^{-23} \text{ JK}^{-1}$$

1. A charge Q is supplied to a metallic conductor. Which is true?
 - a) Electric field inside it is same as on the surface.
 - b) Electric potential inside is zero.
 - c) Electric potential on the surface is zero
 - d) Electric potential inside it is constant
2. Work done to bring a unit positive charge un-accelerated from infinity to a point inside electric field is called:
 - (a) Electric field (b) Electric potential (c) Capacitance (d) Electric flux
3. To convert a moving coil galvanometer into an ammeter of given range, we must connect:
 - a) A suitable low resistance in series
 - b) A suitable low resistance in parallel
 - c) A suitable high resistance in parallel
 - d) A suitable high resistance in series
4. A stationary magnet does not interact with:-
 - (a) Iron rod (b) Moving charge (c) Magnet (d) Stationary charge
5. In EM spectrum minimum wavelength is of:
 - (a) Gamma rays (b) Radio waves (c) Visible rays (d) Micro wave
6. A glass lens is immersed in water. What will be the effect on the power of lens?
 - a) Increase (b) Decrease (c) Constant (d) Not depends

7. How does the magnifying power of a telescope change on increasing the linear diameter of its objective?
 - a) Power increases on increases diameter
 - b) Power decreases on decreases diameter
 - c) Power remain constant on increases diameter
 - d) Power doesn't depends on diameter
8. An object approaches a convergent lens from the left of the lens with a uniform speed 5m/s and stops at the focus. The image
 - a) Moves away from the lens with an uniform speed 5m/s.
 - b) Moves away from the lens with an uniform acceleration.
 - c) Moves away from the lens with a non-uniform acceleration.
 - d) Moves towards the lens with non-uniform acceleration.
9. In an experiment of scattering of alpha particle showed for the first time that the atom has, (a) Electron (b) Proton (c) Neutron (d) Nucleus
10. Silicon is doped with which of the following to obtain P type semiconductor (a) Phosphorus (b) Gallium (c) Germanium (d) Bismuth
11. It is safer to be inside the car rather than standing outside under a tree during lightning is based on _____ concept.
12. An electron passes undeflected when passes through a region with electric and magnetic fields. When electric field is switches off its path will change to _____
13. Two concentric circular coils one of small radius a_1 and the other of large radius a_2 such that $a_1 \ll a_2$ are placed co-axially with centres coinciding. The mutual inductance of the arrangements is _____
14. The scattering angle will decreases with the _____ in impact parameter.
15. The alloys which are used for making resistance have very low temperature coefficient of resistance and high _____
16. Which of the following waves can be polarised (i) heat waves (ii) sounds waves? Given reason to support your answer.
17. For a single slit of width of the first minimum of the interference pattern of a monochromatic light of wavelength λ occurs at angle of λ/a . at the same angle of λ/a , we get a maximum for two narrow slits separated by distance a . explain
18. What is the most common use of photodiode?
19. State the faraday's law of electromagnetic induction.
20. What is the maximum number of spectral lines limited by a hydrogen atom when it is in the third excited state?

Sec-B (2marks)

21. A slab of material of dielectric constant K has the same area as that of the plates of parallel plate capacitor, but has the thickness $d/2$, where d is separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of capacitor.
22. Two cells of emfs 1.5 V and 2.0 V having internal resistance 0.2Ω and 0.3Ω respectively are connected in parallel. Calculate the emf and internal resistance of the equivalent cell.
23. Find the condition under which the charged particles moving with different speeds in the presence of electric and magnetic field vectors can be used to select charged particles of a particular speed.
24. Show diagrammatically the behaviour of magnetic field lines in the presence of
 - (i) Paramagnetic and
 - (ii) Diamagnetic substance

How does one explain this distinguishing feature?

25. How is the speed of electromagnetic waves in vacuum determined by the electric and magnetic fields?

Or

- (i) How does oscillating charge produce electromagnetic waves?
(ii) Sketch a schematic diagram depicting oscillating electric and magnetic fields of EM wave propagating along positive Z-direction.

26. Explain, how a depletion region is formed in a junction diode?

27. Using Rutherford model of the derive the atom, a expression for the total energy of the electron hydrogen atom. What is the significance of total negative energy possessed by the electron?

Or

Using Bohr's postulates of the atomic model, derive the expression for the radius of nth electron orbit. Hence, obtain the expression for Bohr's radius.

Sec -c (3 marks)

28. A 12pF capacitor is connected to a 50 V battery. How much electrostatic energy is stored in the capacitor? If another capacitor of 6pF is connected in series with it with the same battery connected across the combination, find the charge stored and potential difference across each capacitor.

29. Draw a circuit diagram of a potentiometer which can be used to determine the internal resistance r of a given cell of emf E . explain briefly how the internal resistance of the cell is determined?

30. A convex lens made up of a glass of refractive index 1.5 is dipped in turn in

- (i) A medium of refractive index 1.65
(ii) A medium of refractive index 1.33
(a) Will it behave as converging lens or a diverging lens in the two cases?
(b) How will its focal length change in the two media?

31. A parallel beam of monochromatic light falls normally on a narrow slit of width 'a' to produce a diffraction pattern on the screen placed parallel to the plane of the slit. Use Huygens' principle to explain that

- (i) The central bright maxima is twice as wide as the other maxima.
(ii) The intensity falls as we move to successive maxima away from the centre on either side.

- 32.

- (i) The mass of a particle moving with velocity 5×10^6 m/s had de-Broglie wavelength associated with it to be 0.135nm. calculate its mass.
(ii) In which region of the electromagnetic spectrum does this wavelength lie?

33. Write two any distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams.

Or

Draw a labelled diagram of a full-wave rectifier circuit. State its working principle. Show the input -output waveforms.

34. Draw a plot potential energy per nucleons as a function of their separation. Mark the regions where potential energy is

- (i) Positive and
(ii) Negative.

Sec-d (5 marks)

35. (i) Define the term electric dipole moment. Is it a scalar or vector? Deduce the expression for the electric field at a point on the surface of the plate. (ii) Prove that no translational force acts on the dipole placed in uniform electric field. Deduce the expression for the torque acting on a dipole of dipole moment \mathbf{p} in the presence of uniform electric field \mathbf{E} . Also explain what will happen when dipole is placed in non-uniform electric field.

Or

Define electric flux. Write its SI unit. Using Gauss's law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of distance from it. How is the field directed if (a) The sheet is positively charged? (b) Negatively charged? Explain with the help of drawing electric field lines.

36. (i) Draw a labelled diagram of AC generator and state its working principle. (ii) How is magnetic flux linked with the armature coil changed in a generator? (iii) Derive the expression for the maximum value of the induced emf and state the rule that gives the direction of the induced emf. (iv) Show the variation of the emf generated versus time as the armature is rotated with respect to the direction of the magnetic fields.

Or

State the principle and working of transformer with the help of a labelled diagram.

Also write its forms of power loss and explain how can we minimise them.

37. How is the working of telescope different from that of a microscope? Using suitable diagram find magnifying power of telescope when final image is formed at least distance of distinct vision. The focal length of objective and eyepiece of a microscope are 1.25 cm and 5 cm, respectively. Find the position of the object relative to the objective in order to obtain an angular magnification of 30 in normal adjustment.

Or

- (i) Distinguishing between linearly polarised and unpolarised light.
(ii) Show that the light waves are transverse in nature.
(iii) Why does light from a clear blue portion of the sky show a rise and fall of intensity when viewed through a polaroid which is rotated?
Explain by drawing the necessary diagram.

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