



**INSTRUCTION: ANSWER ANY FOUR QUESTIONS**

**DURATION: 2HRS**

Electron charge  $e = 1.6 \times 10^{-19} \text{C}$ , Electron mass  $m = 9.1 \times 10^{-31} \text{kg}$ , Planck's constant  $h = 6.63 \times 10^{-34} \text{Js}$ , speed of light  $c = 3 \times 10^8 \text{m/s}$ , permittivity of free space  $\epsilon_0 = 8.86 \times 10^{-12} \text{C}^2/\text{N.m}^2$ .

**Question one**

- What is Galilean Transformation?
- States the fundamental postulates of Special Theory of relativity.
- Show that the quantity  $x^2 + y^2 + z^2 - c^2 t^2$  is invariant under Lorentz transformation.
- Two particles came towards each other with speed of  $0.8c$  with respect to laboratory. What is their relative speed?

**Question two**

- Explain Bohr's theory of atomic structure and state the shortcomings of Bohr's Theory.
- Making use of the physical constants given above, calculate for hydrogen atom.
  - Velocity of an electron in ground state
  - Radius of Bohr's orbit in ground state
  - Time taken by electron to traverse the first Bohr orbit's
  - Rydberg's constant.
- An atom can be found at two energy states of energies  $5.36 \text{eV}$  and  $3.45 \text{eV}$ . Find the wavelength of light emitted when the atom makes transition from one state to another.

**Question three**

- Explain the failure of Classical Mechanics
- Write short note on Planck's quantum theory explaining the basic postulates of the theory.
- Calculate the energy in electron volt of a photon of wavelength  $14 \text{\AA}$ . What is the momentum of this photon?
- In an experiment, Tungsten cathode which has a threshold of  $2300 \text{\AA}$  is irradiated by ultraviolet light of wavelength  $1800 \text{\AA}$ . Calculate
  - The maximum energy of emitted photoelectrons in eV.
  - Work function for tungsten in eV.

**Question four**

- Explain Photoelectric effect and state the fundamental laws of photoelectric emission.
- The work function of Aluminium is  $4.2 \text{eV}$ . Calculate the kinetic energy of the fastest and the slowest photoelectrons, the stopping potential and the cut off wavelength when light of wavelength  $2000 \text{\AA}$  falls on a clean Aluminium surface.
- Calculate the velocity of photoelectrons, if the work function of the target material is  $1.24 \text{eV}$  and the wavelength of incident light is  $4.36 \times 10^{-7} \text{m}$ . What retarding potential is necessary to stop the emission of these electrons?

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