

Physics (Hons.) Paper-VI

Answer five questions, selecting two from each group, in which Q.No. 1 compulsory.

1. Choose the correct answer of the given options :
- (a) The radius of a nucleus varies with mass number A as :
 (i) $\sqrt{3}$ (ii) $3\sqrt{A}$ (iii) \sqrt{A} (iv) A^2
- (b) In one average-life :
 (i) Half the active nuclei decay (ii) Less than half the active nuclei decay
 (iii) More than half the active nuclei decay (iv) All the nuclei decay
- (c) A cyclotron cannot be used to accelerate electron on account of :
 (i) Relativistic effect (ii) Its spin
 (iii) Its negative charge
 (iv) Its collision with residual gas in the dees
- (d) Two protons are kept at a separation of 10nm. If F_n and F_e be the nuclear force and the electromagnetic force respectively between them, then :
 (i) $F_e = F_n$ (ii) $F_e \gg F_n$ (iii) $F_e \ll F_n$
 (iv) F_e and F_n only differ slightly
- (e) An α -particle is bombarded on ^{14}N . As a result, a ^{17}O nucleus is formed and particle is emitted. This particle is a :
 (i) Positron (ii) Neutron (iii) Electron (iv) Proton
- (f) The main constituent of cosmic ray is :
 (i) Proton (ii) Meson (iii) Alpha particle (iv) Neutrino
- (g) The wavelength associated with an electron of mass m and kinetic energy T is :
 (i) $\lambda = \frac{h}{\sqrt{2mT}}$ (ii) $\lambda = \frac{h}{\sqrt{mT}}$ (iii) $\lambda = \frac{h}{2\sqrt{mT}}$ (iv) $\lambda = \frac{h}{\sqrt{2mT}}$
- (h) The group velocity of a wave-packet is :
 (i) $\frac{w}{k}$ (ii) $\frac{k}{w}$ (iii) $\frac{dw}{dk}$ (iv) $\frac{dk}{dw}$
 where w is cyclic frequency and k is the wave vector.
- (i) The time-energy uncertainty relation is given as :
 (i) $\Delta E \Delta t = \sqrt{h}$ (ii) $\Delta E \Delta t = h^2$ (iii) $\Delta E \Delta t = \frac{h}{c}$ (iv) $\Delta E \Delta t = h$
- (j) The energy operator is :
 (i) $ih \frac{\partial}{\partial t}$ (ii) $-ih \frac{\partial}{\partial t}$ (iii) $ih \vec{\nabla}$ (iv) $-ih \vec{\nabla}$

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2. Explain Geiger-Nuttal Law. Give Gamow's explanation of this law.
3. Describe the construction and working of a cyclotron. Discuss its limitations.
4. What are the different types of nuclear reactions ? Explain them with examples. What conservation laws are followed in a nuclear reaction ?
5. Write short notes on any two of the following :
 (a) Wilson's cloud chamber
 (b) Artificial radioactivity and its importance (c) Nuclear reactors
 (d) Cascade theory of cosmic ray showers

Group-B

6. Deduce Schrodinger's time-dependent equation for a particle under the action of conservative force. Explain the physical significance of ψ .
7. A particle of mass m and energy E approaches a potential step of height $V_0 < E$. Calculate quantum mechanically transmission and reflection co-efficients of the step.
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8. Establish Schrodinger's equation for a linear harmonic oscillator and solve it for its eigen values. Discuss, in short the significance of zero-point energy.
9. Write short notes on any two of the following :
 - (a) Bohr-Planck theory
 - (b) Eigen values and eigen functions
 - (c) Commuting and non-commuting operators
 - (d) Expectation values of dynamical qualities.

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