S^C

(A-46) Seat No: _____

SARDAR PATEL UNIVERSITY
B.Sc. EXAMINATION (IVth-Semester)
Thursday, 5th May 2016
2:30 p.m. to 5:30 p.m.
Subject: PHYSICS
Course: US04CPHY02
Classical, Quantum and Nuclear Physics

Total Marks:70

N.B: (i) All the symbol have their usual meanings
(ii) Figures at the right side of questions indicate full marks

Q-1 Multiple Choice Questions (Attempt All) (10)

(1) The electrostatic forces are very much _____ than the gravitational forces in the interaction of atomic and subatomic particles
  (a) poor   (b) equal
  (c) Stronger   (d) lower

(2) The quadrupole potential is varies as _____
  (a) r^3 (b) r^2
  (c) $1/r$ (d) $1/r^3$

(3) For elliptical orbit the values of energy E and eccentricity ϵ are _____
  (a) E<0 and ϵ<1   (b) E>0 and ϵ>1
  (c) E=0 and ϵ>1   (d) E>0 and ϵ=0

(4) All the planet moves around the Sun in _____ orbit
  (a) Elliptical   (b) circular
  (c) hyperbolic   (d) Parabolic

(5) The intensity of the diffraction pattern is proportional to _____ of the wave function
  (a) sixth power   (b) forth power
  (c) cube   (d) square

(6) The limit of a region-I for a square well potential is _____
  (a) $-\alpha < x < 0$ (b) $a < x < \alpha$
  (c) $-a < x < a$ (d) $-\alpha < x < -a$

(7) For $E > 0$, the particle has a _____ kinetic energy
  (a) zero   (b) positive
  (c) negative   (d) infinity

(8) The concept of first disintegration of nitrogen nuclei by α- particle was given by_____
  (a) Thompson   (b) Bohr
  (c) Rutherford   (d) Compton

(9) The nuclei of nitrogen atoms emit _____ when bombarded α- particles from radium C
  (a) electron   (b) positron
  (c) neutron   (d) proton

(10) The element with Z=93 is called _____
  (a) plutonium   (b) neptunium
  (c) uranium   (d) curium

(1)

(P.T.O.)

Q-2   Short Questions (Attempt any Six)   (12)
        (1)   Define equipotential surface
        (2)   Define electric dipole
        (3)   Define elliptical orbit
        (4)   Define group velocity of the wave packet
        (5)   Write the admissibility conditions on the wave function
        (6)   State the physical significance of time independent Schrodinger equation
        (7)   Define exothermic reaction
        (8)   Define relative stopping power

Q-3   (a)   Derive the expressions for gravitational fields and potentials   (3)
        (b)   Derive the expressions of fields and potentials for dipole and quadrupole   (5)
                                            OR
Q-3   (a)   State the laws of gravitational and electromagnetic forces   (3)
        (b)   State and prove the Gauss' law for electrostatic fields   (5)

Q-4   Discuss the motion of a particle in a central force field and prove the conservation laws of   (8)
                linear momentum and total energy
                                            OR
Q-4   Discuss the motion of a particle in an arbitrary potential field   (8)

Q-5   (a)   Discuss the concept of matter wave   (3)
        (b)   Derive the expression of group velocity of wave packet   (5)
                                            OR
Q-5   (a)   Discuss the Heisenberg's uncertainty principle   (3)
        (b)   Discuss the normalization and probability interpretation of a wave function (5)

Q-6   (a)   Describe the stationary states and energy spectra of the quantum mechanical system   (3)
        (b)   Derive the time independent Schrodinger equation and explain their physical significance   (5)
                                            OR
Q-6   (a)   Discuss the conservation of probability of the wave function and derive the condition   (4)
        (b)   Discuss the expectation values of the variable and prove the Ehrenfest's theorem   (4)

Q-7   (a)   Describe the transmutation of nuclei by proton with proper nuclear reactions   (4)
        (b)   Discuss transmutation by deuterons   (4)
                                            OR
Q-7   (a)   Describe the experiment for the disintegration of nuclei by α-particle with schematic   (4)
                diagram and illustrate various alpha-proton reactions
        (b)   Discuss the alpha-neutron reaction with necessary expressions   (4)

Q-8   (a)   Discuss about the discovery of artificial radioactivity in brief   (4)
        (b)   Write note on transuranium elements   (4)
                                            OR
Q-8   (a)   Discuss the production of electron and positron with necessary conditions of mass and   (4)
                energy
        (b)   Discuss the method of measurement of range, ionization and stopping power   (4)

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