

[A-13]

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SARDAR PATEL UNIVERSITY  
SEAT No. \_\_\_\_\_ Fourth Semester B.Sc. EXAMINATION No. of Printed Pages : 02  
(Under CBCS) 2010 Batch  
Thursday, 11<sup>th</sup> April-2019  
Time: 10:00 am to 01:00 pm  
PHYSICS - US04CPHY02  
Classical Quantum & Nuclear Physics

N.B: Figures on the right indicate maximum marks.

Total Marks: 70

Q.1 Answer the following MCQ by choosing correct option. (10)

- 1 The value of universal gravitational constant G is \_\_\_\_ .  
(a)  $4 \times 10^{42} \text{ Nm}^2/\text{Kg}^2$  (b)  $6.67 \times 10^{11} \text{ Nm}^2/\text{Kg}^2$   
(c)  $6.67 \times 10^{-11} \text{ Nm}^2/\text{Kg}^2$  (d)  $9.81 \text{ cm/cm}^2$
- 2 The potential due to dipole is proportional to \_\_\_\_ .  
(a)  $1/r^2$  (b)  $r^2$   
(c)  $r$  (d)  $1/r$
- 3 For circular orbit, the value of eccentricity is \_\_\_\_ .  
(a)  $\epsilon > 1$  (b)  $\epsilon = 0$   
(c)  $\epsilon < 1$  (d)  $\epsilon = 1$
- 4 The angular momentum is \_\_\_\_ in a central force field.  
(a) Conserved (b) Zero  
(c) Not conserved (d) Infinity
- 5 The Non-normalized wave function must have \_\_\_\_ norm.  
(a) Finite (b) Infinite  
(c) Zero (d) Complex
- 6 The concept of matter wave was suggested by \_\_\_\_ .  
(a) Schrodinger (b) Laplace  
(c) Heisenberg (d) de Broglie
- 7 Any function with property of symmetry is said to have \_\_\_\_ parity.  
(a) infinite (b) zero  
(c) even (d) odd
- 8 In alpha-proton reaction \_\_\_\_ particle is bombarded to radioactive nuclei.  
(a) alpha (b) Gamma  
(c) Beta (d) proton
- 9 \_\_\_\_ is a neutral particle.  
(a) Electron (b) Proton  
(c) Positron (d) Neutron
- 10 Artificial radioactivity was discovered by \_\_\_\_ and \_\_\_\_ .  
(a) Rutherford, Chadwick (b) Curie, Joliot  
(c) Bohr, Pauli (d) Aston, Dempster

(1)

(P.T.O.)

Q.2 Give short answers to the following questions. (Attempt any Six) (12)

- 1 Write down properties of electric lines of force.
- 2 What is equipotential surface?
- 3 State Kepler's law of planetary motion.
- 4 What is probability density?
- 5 Define: Square well potential.
- 6 What are exothermic and endothermic processes?
- 7 Define: Stopping power.
- 8 What is central force field?

- Q.3 (a) Derive Gauss' law for electrostatic field. [05]  
(b) Using the equation of Gauss' law, derive the equation for Laplace law. [03]

OR

- Q.3 (a) Explain Newton's law of gravitational force and Coulomb's electrostatic force. [05]  
(b) Deduce the expressions for gravitational fields and potentials. [03]

- Q.4 (a) Derive the equation of motion of equivalent one body problem and explain it with suitable example. [08]

OR

- Q.4 (b) Discuss the motion of a particle in a central force field and prove that the linear momentum and total energy remain conserved. [08]

- Q.5 (a) Discuss the stationary states and energy spectra of the quantum mechanical system. [05]  
(b) Write a note on box normalization. [03]

OR

- Q.5 (a) Explain the concept of matter waves and discuss the experimental agreement of electron. [05]  
(b) What is Heisenberg's uncertainty principle? Explain it. [03]

- Q.6 (a) Derive time independent Schrodinger equation and explain its physical significance. [04]  
(b) Describe stationary states and energy spectra of the quantum mechanical system. [04]

OR

- Q.6 (a) Explain the expectation values of the variable and prove the Ehrenfest's theorem. [04]  
(b) For a particle in a square well potential, draw the energy eigen function diagram. [04]

- Q.7 (a) Discuss the alpha-neutron reaction with necessary equations. [05]  
(b) Explain the transmutation by deuterons. [03]

OR

- Q.7 (a) Derive the Q-value for nuclear reaction and deduce the expression for threshold energy. [05]  
(b) Explain the transmutation by neutrons. [03]

- Q.8 (a) Discuss the method of measurement of range, ionization and stopping power with proper diagram of the apparatus. [05]  
(b) Write a note on trans-uranium elements. [03]

OR

- Q.8 (a) Discuss the method of measurement of velocity and energy of alpha particle with schematic diagram of deflection chamber. [05]  
(b) Discuss about the discovery of artificial radioactivity. [03]

\*\*X\*\*

(2)