

SEAT No. _____

[A-21(B)]

SARDAR PATEL UNIVERSITY

B. Sc., 4th SemesterMonday, 26th September 2022Session: ~~NDA~~ Time: 12:30 pm to 02:30 pm

Subject Code: (PHYSICS) US04CPHY02 (2010 Batch)

Subject Title: Classical, Quantum and Nuclear Physics



Max Marks: 70

Que: 1 Write correct answer for each of the following MCQs. **[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) $9.81 \text{ cm}/\text{cm}^2$
 - d) $6.67 \times 10^{+11} \text{ Nm}^2/\text{Kg}^2$
- 2 The potential due to dipole is proportional to ____ .
 - a) $1/r$
 - b) r
 - c) r^2
 - d) $1/r^2$
- 3 The angular momentum is ____ in a central force field.
 - a) Conserved
 - b) Not conserved
 - c) Zero
 - d) Infinity
- 4 According to de-Broglie hypothesis, the wavelength of matter waves $\lambda =$ ____ .
 - a) h/P
 - b) P/h
 - c) $h * P$
 - d) h/C
- 5 The normalized wave function must have ____ norm.
 - a) zero
 - b) finite
 - c) infinite
 - d) complex
- 6 For a square-well potential, energy of bound state particles is ____ .
 - a) $E = 0$
 - b) $E < 0$
 - c) $E > 0$
 - d) infinite
- 7 For $E > 0$, the particle has ____ kinetic energy .
 - a) positive
 - b) negative
 - c) infinite
 - d) zero
- 8 In alpha-proton reaction ____ particle is bombarded to radioactive nuclei.
 - a) alpha
 - b) beta
 - c) gamma
 - d) proton
- 9 ____ is a neutral particle.
 - a) Electron
 - b) neutron
 - c) positron
 - d) proton
- 10 The positive electron is known as ____ .
 - a) proton
 - b) positron
 - c) deuteron
 - d) electron

Que-2 Fill in the blank. Also, answer whether the remaining statements are TRUE or FALSE. [08]

- 1 The gravitational force between two masses is ____ .
- 2 The electrostatic force between two unlike charges is ____ .
- 3 For circular orbit, the eccentricity $e = 1$. [TRUE / FALSE]
- 4 The concept of matter wave was suggested by Schrodinger. [TRUE / FALSE]
- 5 The quantum mechanical states of a particle which does not depend on time, are called ____ .
- 6 α -particles are negatively charged particles. [TRUE / FALSE]
- 7 The Q- value equation represents balance of mass and energy in nuclear reactions. [TRUE / FALSE]
- 8 Artificial radioactivity was discovered by ____ .

Que-3 Write answers of any ten questions in brief. [20]

- 1 Write down properties of electric lines of force.
- 2 What is equipotential surface?
- 3 Define : Elliptical orbit.
- 4 State Kepler's law of planetary motion.
- 5 State Heisenberg uncertainty principle.
- 6 Define: Square well potential.
- 7 Write the admissibility conditions on the wave function.
- 8 State the physical significance of time independent Schrodinger equation.
- 9 What is Q-value?
- 10 What are exothermic and endothermic processes?
- 11 Define: Stopping power.
- 12 What are transuranium elements?

Que -4 Answer following questions. (Attempt any 4 out of 8) [32]

- 1 Derive Gauss' law for electrostatic field. Using the equation of Gauss' law, derive the equation for Laplace law.
- 2 Derive the equation of motion of equivalent one body problem and explain it with suitable example.
- 3 Discuss the motion of a particle in an arbitrary potential field.
- 4 Derive one-dimensional Schrodinger equation for a free particle and generalized it to three dimensions.
- 5 Explain the expectation values of the variable and prove the Ehrenfest's theorem.
- 6 Derive the Q-value for nuclear reaction and deduce the expression for threshold energy.
- 7 Discuss the method of measurement of range, ionization and stopping power with proper diagram of the apparatus.
- 8 Discuss the method of measurement of velocity and energy of alpha particle with schematic diagram of deflection chamber.

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