

Rajiv Gandhi Institute of Petroleum Technology



Quiz-1

Course Inorganic & Physical Chemistry
Course Code CY111
Full Marks 40
Date & Time 10/Feb/2022, 9:15 AM- 10:00 AM

1A- to- 1J : MCQ, each question carries 1.5 marks each, one wrong answer carries -5 marks.

- 1A. The concept that all microscopic physical entities have both wave & particle properties is called wave-particle:
- (a) Singularity (b) Triality (c) Infinality (d) Duality (e) Intellectuality
- 1B. The number energy states possible in the range $E < \frac{15h^2}{8ma^2}$ of a cubic box of side 'a' is
- (a) 03 (b) 6 (c) 12 (d) 12 (e) 15
- 1C. The wave function for a quantum mechanical particle in a 1-D box of length "l" is given by $\Psi = A \cdot \sin(\pi x/L)$. The value of 'A' for a box of length 50 cm is
- (a) $0.1 \text{ (cm)}^{-1/2}$ (b) $0.2 \text{ (cm)}^{-1/2}$ (c) $5\sqrt{2} \text{ (cm)}^{-1/2}$ (d) $\sqrt{2}/10 \text{ (cm)}^{-1/2}$ (e) 0.00
- 1D. In the probabilistic interpretation of wave function ψ , the $|\psi|^2$ is:
- (a) probability amplitude (b) probability density (c) negative probability (d) 1.00 (e) 0.00
- 1E. According to wave mechanics, a material particle is associated with :
- a) a single wave, b) a wave packet, c) progressive wave, d) light wave
- 1F. When two particles are entangled and it is observed that one has its spin up, how long does it take for the other's spin to be down?
- a) Instantaneously (b) 1 microsecond (c) 1 nanosecond, (d) 1 femtosecond, (e) Speed of light
- 1G. The Dirac equation shows that every particle has
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|---------------|-----------------|----------|-----------|-------------|
| (a) | (b) | (c) | (d) | (e) |
| Wave function | An Antiparticle | A Matrix | A duality | Uncertainty |

1H. When one operates with d^2/dx^2 on the function $6 \sin(4x)$, one finds that

- a) the function is an eigenfunction with eigenvalue -96.
- b) the function is an eigenfunction with eigenvalue 16.
- c) the function is an eigenfunction with eigenvalue -16.
- d) the function is not an eigenfunction.
- e) None of the above is a true statement.

1I. Indicate which of the following functions are “acceptable.”

- a) $\psi = x$
- b) $\psi = x^2$
- c) $\psi = \sin x$
- d) $\psi = \exp(-x)$
- e) $\psi = \exp(-x^2)$

1J. The reason for normalizing a wavefunction ψ is

- a) to guarantee that ψ is square-integrable.
- b) to make $\psi^*\psi$ equal to the probability distribution function for the particle.
- c) to make ψ an eigenfunction for the Hamiltonian operator.
- d) to make ψ satisfy the boundary conditions for the problem.
- e) to make ψ display the proper symmetry characteristics.

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| 2 | How does Planck's Theory explain Black Body Radiation? | 5 |
| 3 | Calculate the de Broglie wavelength in nanometers for each of the following:
a) An electron that has been accelerated from rest through a potential change of 500V.
b) A bullet weighing 5 gm and traveling at 400 m s ⁻¹ | 5 |
| 4 | Consider an electron in a one-dimensional box of length 258 pm.
a) What is the zero-point energy (<i>ZPE</i>) for this system? For a mole of such systems?
b) What electronic speed classically corresponds to this <i>ZPE</i> ? Compare to the speed of light. | 10 |
| 5 | For a particle in the n=2 state in a one-dimensional box of length L,
a) By sketching <i>estimate</i> the probability, ρ , for finding the particle between $x=0$ and $x=0.20L$.
b) <i>calculate</i> the probability using wave functions.
c) what probability for finding the particle between $x=0$ and $x=0.20L$ is predicted by classical physics? | 10 |