Rajiv Gandhi Institute of Petroleum Technology

Quiz-1

Course	Inorganic & Physical Chemistry
Course Code	CY111
Full Marks	40
Date & Time	09/Feb/2022, 10:15 AM- 11:00 AM

1A- to- 1J : MCQ, each question carries 1.5 marks each, one wrong answer carries 3 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) Nullility (e) Intellectuality

1B. **The expectation value of operator Q for a wave function is often written as:**

(a) Q (b) $\langle Q \rangle$ (c) $\rangle Q \langle$ (d) $\langle f(Q) \rangle$ (e) f(Q)

1C. **The energy operator for 1 particle in one dimension in quantum mechanics,**

$$H = -\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2} + V(x)$$ is called the:

(a) Lagrangian (b) Delhinian (c) Hamiltonian (d) Laplacian (e) Uponium

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. **The probability of finding a particle in differential region dx is:**

(a)	(b)	(c)	(d)	(e)
$\psi(x,t)\,dx$	$\psi(x,t)^*\,dx$	$\psi(x,t)^* / \psi(x,t)\,dx$	$\psi(x,t)^2\,dx$	$\psi(x,t)^* \times \psi(x,t)\,dx$

1F. **A physical requirement on wave functions is that they should be:**

(a) reliable (b) friable (c) certifiable (d) normalizable (e) retriable

1G. **It describes a fundamental limitation on the accuracy with which we can know position and momentum simultaneously.”**

(a)	(b)	(c)	(d)	(e)
Tarkovsky’s doubtful thesis	Rublev’s ambiguous postulate	Kelvin’s nebulous zeroth law	Schrödinger’s wild hypothesis	Heisenberg’s uncertainty principle

1H. **The momentum operator in one-dimension is:**

(a)	(b)	(c)	(d)	(e)
$\hbar \dfrac{\partial}{\partial x}$	$\dfrac{\hbar}{i} \dfrac{\partial}{\partial x}$	$\dfrac{i}{\hbar} \dfrac{\partial}{\partial x}$	$\dfrac{i}{\hbar} \dfrac{\partial}{\partial t}$	$\hbar \dfrac{\partial}{\partial t}$

1I. **The time-independent Schrödinger equation from the full Schrödinger equation by:**

(a)	(b)	(c)	(d)	(e)
colloquialism	solution for eigen functions	separation of the x and y variables	separation of the space and time variables	expansion

1J. **The full Schrödinger equation in compact form is:**

(a)	(b)	(c)	(d)	(e)
$H\Psi = \hbar \dfrac{\partial \Psi}{\partial t}$	$H\Psi = i \dfrac{\partial \Psi}{\partial t}$	$H\Psi = i\hbar \dfrac{\partial \Psi}{\partial t}$	$H^{-1}\Psi = i\hbar \dfrac{\partial \Psi}{\partial t}$	$H\Psi = i\hbar \dfrac{\partial \Psi}{\partial x}$

2. **Explain “Ultraviolet Catastrophe” in Black Body Radiation?** *Marks: 2*
3. **If an electron in a hydrogen atom is confined to a region of size 53 picometer (pm) from the nucleus, what is the indeterminacy in its momentum and velocity?** *Marks: 4*
4. **Write down the QM operator for momentum (p) and energy (E)** *Marks: 3 (1+2)*
5. **What are the conditions for acceptability of wave functions? Explain the validity of the function using graph**

$$\frac{1}{x}\sin x$$

Marks: 4 (2+2)

6. **What is Born Interpretation on Probability density of Wave function ?** *Marks: 3*
7. **Calculate the wavelength of light absorbed to bring out the transition from n = 1 and n = 2 for an electron in a one dimensional box of length of 1.0 nm.** *Marks: 4*
8. **In one dimensional box, calculate the expectation value for momentum $<P_x>$ and explain its value.** *Marks: 5 (2+2)*