PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Basic Quantum Mechanics - CSIR NET Physics PYQs

Quantum Mechanics . All PYQs (2015-2025) with answer key

36 questions . Answer key included

www.physicsbyaaryan.com . www.csirnetphysics.com
Contact: 9501976811

Q1. [Dec 2015] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2015 Dec	3.5 M

A Hermitian operator $\bar{O}$ has two normalized eigenstates $|1\rangle$ and $|2\rangle$ with eigenvalues 1 and 2 , respectively. The two states

$|u\rangle = \cos\theta|1\rangle + \sin\theta|2\rangle$ and $|v\rangle = \cos\phi|1\rangle + \sin\phi|2\rangle$ are such that $\langle v|\hat{O}|v\rangle = 7/4$ and $\langle u \mid v\rangle = 0$. Which of the following are possible values of θ and ϕ ?

1. $\theta = -\frac{\pi}{6}$ and $\phi = \frac{\pi}{3}$
2. $\theta = \frac{\pi}{6}$ and $\phi = \frac{\pi}{3}$
3. $\theta = -\frac{\pi}{4}$ and $\phi = \frac{\pi}{4}$
4. $\theta = \frac{\pi}{3}$ and $\phi = -\frac{\pi}{6}$

Q2. [June 2015] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2015 June	3.5 M

The wavefunction of a particle in onedimension is denoted by $\psi(x)$ in the coordinate representation and by $\phi(p) = \int \psi(x)e^{-ipx/h}dx$ in the momentum representation. If the action of an operator $\hat{T}$ on $\psi(x)$ is given by $\hat{T}\psi(x) = \psi(x + a)$, where a is a constant, then $\hat{T}\phi(p)$ is given by

1. $-\frac{i}{h}ap\phi(p)$
2. $e^{-iap/\hbar}\phi(p)$
3. $e^{+iap/h}\phi(p)$
4. $\left(1 + \frac{i}{h}ap\right)\phi(p)$

Q3. [June 2015] . 3.5 marks
Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2015 June	3.5 M

A particle moves in one dimension in the potential $V = \frac{1}{2}k(t)x^2$, where $k(t)$ is a time dependent parameter. Then $\frac{d}{dt}\langle V\rangle$. the rate of change of the expectation value $\langle V\rangle$ of the potential energy, is

1. $\frac{1}{2}\frac{dk}{dt}\langle x^2\rangle + \frac{k}{2m}\langle xp + px\rangle$
2. $\frac{1}{2}\frac{dk}{dt}\langle x^2\rangle + \frac{1}{2m}\langle p^2\rangle$
3. $\frac{k}{2m}\langle xp + px\rangle$
4. $\frac{1}{2}\frac{dk}{dt}\langle x^2\rangle$

Q4. [June 2015] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2015 June	5 M

A particle of mass m is in a potential $V = \frac{1}{2}m\omega^2 x^2$, where ω is a constant. Let $\hat{a} = \sqrt{\frac{m\omega}{2h}}\left(\hat{x} + \frac{i\hat{p}}{m\omega}\right)$. In the Heisenberg picture $\frac{d\hat{a}}{dt}$ is given by

1. $\omega\hat{a}$
2. $-i\omega\hat{a}$
3. $\omega\hat{a}^\dagger$
4. $i\omega\hat{a}^\dagger$

Q5. [June 2015] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2015 June	5 M

Two different sets of orthogonal basis vectors $\left\{\begin{pmatrix}1\\0\end{pmatrix},\begin{pmatrix}0\\1\end{pmatrix}\right\}$ and $\left\{\frac{1}{\sqrt{2}}\begin{pmatrix}1\\1\end{pmatrix},\frac{1}{\sqrt{2}}\begin{pmatrix}1\\-1\end{pmatrix}\right\}$ are given for a two-dimensional real vector space. The matrix representation of a linear operator $\hat{A}$ in these bases are related by a unitary transformation. The unitary matrix may be chosen to be

1. $\begin{pmatrix}0 & -1\\1 & 0\end{pmatrix}$
2. $\begin{pmatrix}0 & 1\\1 & 0\end{pmatrix}$
3. $\frac{1}{\sqrt{2}}\begin{pmatrix}1 & 1\\1 & -1\end{pmatrix}$
4. $\frac{1}{\sqrt{2}}\begin{pmatrix}1 & 0\\1 & 1\end{pmatrix}$

Q6. [Dec 2016] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2016 Dec	3.5M

Consider the two lowest normalized energy eigenfunctions $\psi_0(x)$ and $\psi_1(x)$ of a one dimensional system. They satisfy $\psi_0(x) = \psi_0^*(x)$ and $\psi_1(x) = \alpha \frac{d\psi_0}{dx}$, where α is a real constant. The expectation value of the momentum operator in the state ψ_1 is

1. $-\frac{\hbar}{\alpha^2}$
2. 0
3. $\frac{\hbar}{\alpha^2}$
4. $\frac{2\hbar}{\alpha^2}$

Q7. [Dec 2016] . 3.5 marks
Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2016 Dec	3.5M

Consider the operator $a = x + \frac{d}{dx}$ acting on smooth functions of x. The commutator $[a, \cos x]$ is

1. $-\sin x$
2. $\cos x$
3. $-\cos x$
4. 0

Q8. [June 2016] . 3.5 marks
Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2016 June	3.5M

The eigenstates corresponding to eigenvalues E_1 and E_2 of a time-independent Hamiltonian are $|1\rangle$ and $|2\rangle$ respectively. If at $t = 0$, the system is in a state $|\psi(t=0)\rangle = \sin\theta|1\rangle + \cos\theta|2\rangle$ the value of $\langle\psi(t) \mid \psi(t)\rangle$ at time t will be

1. 1
2. $\left(E_1\sin^2\theta + E_2\cos^2\theta\right)/\sqrt{E_1^2 + E_2^2}$
3. $e^{iE_1t/\hbar}\sin\theta + e^{iE_2t/\hbar}\cos\theta$
4. $e^{-iE_1t/\hbar}\sin^2\theta + e^{-iE_2t/\hbar}\cos^2\theta$

Q9. [June 2016] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2016 June	5M

Consider a gas of Cs atoms at a number density of 10^{12} atoms/cc. When the typical inter-particle distance is equal to the thermal de Broglie wavelength of the particles, the temperature of the gas is nearest to (Take the mass of a Cs atom to be 22.7×10^{-26} kg.)

1. 1×10^{-9} K
2. 7×10^{-5} K
3. 1×10^{-3} K
4. 2×10^{-8} K

Q10. [Dec 2017] . 3.5 marks
Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2017 Dec	3.5M

The state vector of a one-dimensional simple harmonic oscillator of angular frequency ω, at time $t=0$, is given by $|\psi(0)\rangle = \frac{1}{\sqrt{2}}[|0\rangle + |2\rangle]$, where $|0\rangle$ and $|2\rangle$ are the normalized ground state and the second excited state, respectively. The minimum time t after which the state vector $|\psi(t)\rangle$ is orthogonal to $|\psi(0)\rangle$, is

1. $\frac{\pi}{2\omega}$
2. $\frac{2\pi}{\omega}$
3. $\frac{\pi}{\omega}$
4. $\frac{4\pi}{\omega}$

Q11. [Dec 2017] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2017 Dec	3.5M

The normalized wavefunction in the momentum space of a particle in one dimension is

$\phi(p) = \frac{\alpha}{p^2+\beta^2}$, where α and β are real constants.

The uncertainty Δx in measuring its position is

1. $\sqrt{\pi}\frac{\hbar\alpha}{\beta^2}$
2. $\sqrt{\pi}\frac{\hbar\alpha}{\beta^3}$
3. $\frac{\hbar}{\sqrt{2}\beta}$
4. $\sqrt{\frac{\pi}{\beta}}\frac{\hbar\alpha}{\beta}$

Q12. [Dec 2017] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2017 Dec	3.5M

Let x denote the position operator and p the canonically conjugate momentum operator of a particle. The commutator

$$\left[\frac{1}{2m}p^2 + \beta x^2, \frac{1}{m}p^2 + \gamma x^2\right]$$

where β and γ are constants, is zero if

1. $\gamma = \beta$
2. $\gamma = 2\beta$
3. $\gamma = \sqrt{2}\beta$
4. $2\gamma = \beta$

Q13. [Dec 2017] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2017 Dec	5M

The Hamiltonian of a two-level quantum system is $H = \frac{1}{2}\hbar\omega \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix}$ possible initial state in which the probability of the system being in that quantum state does not change with time, is

1. $\begin{pmatrix} \cos\frac{\pi}{4} \\ \sin\frac{\pi}{4} \end{pmatrix}$
2. $\begin{pmatrix} \cos\frac{\pi}{8} \\ \sin\frac{\pi}{8} \end{pmatrix}$
3. $\begin{pmatrix} \cos\frac{\pi}{2} \\ \sin\frac{\pi}{2} \end{pmatrix}$
4. $\begin{pmatrix} \cos\frac{\pi}{6} \\ \sin\frac{\pi}{6} \end{pmatrix}$

Q14. [June 2018] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2018 June	5M

At $t = 0$, the wavefunction of an otherwise free particle confined between two infinite walls at $x = 0$ and $x = L$ is $\psi(x, t = 0) = \sqrt{\frac{2}{L}}\left(\sin\frac{\pi x}{L} - \sin\frac{3\pi x}{L}\right)$. Its wave function at a later time $t = \frac{mL^2}{4\pi h}$ is

1. $\sqrt{\frac{2}{L}}\left(\sin\frac{\pi x}{L} - \sin\frac{3\pi x}{L}\right) e^{i\pi/6}$

2. $\sqrt{\frac{2}{L}}\left(\sin\frac{\pi x}{L} + \sin\frac{3\pi x}{L}\right) e^{-i\pi/6}$

3. $\sqrt{\frac{2}{L}}\left(\sin\frac{\pi x}{L} - \sin\frac{3\pi x}{L}\right) e^{-i\pi/8}$

4. $\sqrt{\frac{2}{L}}\left(\sin\frac{\pi x}{L} + \sin\frac{3\pi x}{L}\right) e^{-i\pi/6}$

Q15. [Dec 2019] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2019 Dec	3.5M

The energy eigenvalues of a particle of mass m, confined to a rigid one-dimensional box of width L, are $E_n (n = 1,2, \dots)$. If the walls of the box are moved very slowly toward each other, the rate of change of time-dependent energy $\frac{dE_2}{dt}$ of the first excited state is

1. $\frac{E_2}{L}\frac{dL}{dt}$
2. $\frac{2E_2}{L}\frac{dL}{dt}$
3. $-\frac{2E_2}{L}\frac{dL}{dt}$
4. $-\frac{E_1}{L}\frac{dL}{dt}$

Q16. [Dec 2019] . 3.5 marks
Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2019 Dec	3.5M

A particle of mass m is confined to a box of unit length in one dimension. It is described by the wavefunction $\psi(x) = \sqrt{\frac{8}{5}} \sin\pi x(1 + \cos\pi x)$ for $0 \leq x \leq 1$ and zero outside this interval. The expectation value of energy in this state is

1. $\frac{4\pi^2}{3m}\hbar^2$
2. $\frac{4\pi^2}{5m}\hbar^2$
3. $\frac{2\pi^2}{5m}\hbar^2$
4. $\frac{8\pi^2}{5m}\hbar^2$

Q17. [Dec 2019] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2019 Dec	5M

Let $\hat{x}$ and $\hat{p}$ denote position and momentum operators obeying the commutation relation $[\hat{x}, \hat{p}] = i\hbar$. If $|x\rangle$ denotes an eigenstate of $\hat{x}$ corresponding to the eigenvalue x, then $e^{ia\hat{p}/\hbar}|x\rangle$ is

1. an eigenstate of $\hat{x}$ corresponding to the eigenvalue x
2. an eigenstate of $\hat{x}$ corresponding to the eigenvalue $(x + a)$
3. an eigenstate of $\hat{x}$ corresponding to the eigenvalue $(x - a)$
4. not an eigenstate of $\hat{x}$

Q18. [Dec 2019] . 5.0 marks
Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2019 Dec	5M

Let the normalized eigenstates of the Hamiltonian

$H = \begin{pmatrix} 2 & 1 & 0 \\ 1 & 2 & 0 \\ 0 & 0 & 2 \end{pmatrix}$ be $|\psi_1\rangle, |\psi_2\rangle$ and $|\psi_3\rangle$. The expectation value $\langle H \rangle$ and the variance of H in the state $|\psi\rangle = \frac{1}{\sqrt{3}}(|\psi_1\rangle + |\psi_2\rangle - i|\psi_3\rangle)$ are

1. $\frac{4}{3}$ and $\frac{1}{3}$
2. $\frac{4}{3}$ and $\frac{2}{3}$
3. 2 and $\frac{2}{3}$
4. 2 and 1

Q19. [June 2019] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2019 June	5M

The wave number k and the angular frequency ω of a wave are related by the dispersion relation $\omega^2 = \alpha k + \beta k^3$ where α and β are positive constants. The wave number for which the phase velocity equals the group velocity, is

1. $3\sqrt{\frac{\alpha}{\beta}}$
2. $\sqrt{\frac{\alpha}{\beta}}$
3. $\frac{1}{2}\sqrt{\frac{\alpha}{\beta}}$
4. $\frac{1}{3}\sqrt{\frac{\alpha}{\beta}}$

Q20. [June 2019] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2019 June	5M

The operator A has a matrix representation $\begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$ in the basis spanned by $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$. In another basis spanned by $\frac{1}{\sqrt{2}}\begin{pmatrix} 1 \\ 1 \end{pmatrix}$ and $\frac{1}{\sqrt{2}}\begin{pmatrix} 1 \\ -1 \end{pmatrix}$, the matrix representation of A is

1. $\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$
2. $\begin{pmatrix} 3 & 0 \\ 0 & 1 \end{pmatrix}$
3. $\begin{pmatrix} 3 & 1 \\ 0 & 1 \end{pmatrix}$
4. $\begin{pmatrix} 3 & 0 \\ 1 & 1 \end{pmatrix}$

Q21. [June 2019] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2019 June	5M

The operator $x\frac{d}{dx}\delta(x)$, where $\delta(x)$ is the Dirac delta function, acts on the space of real valued square-integrable functions on the real line. This operator is equivalent to

1. $-\delta(x)$
2. $\delta(x)$
3. x
4. 0

Q22. [June 2020] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2020 June	3.5M

Let $|n\rangle$ denote the energy eigenstates of a particle in a one-dimensional simple harmonic potential $V(x) = \frac{1}{2}m\omega^2x^2$. If the particle is initially prepared in the state $|\psi(t=0)\rangle = \sqrt{\frac{1}{2}}(|0\rangle + |1\rangle)$, the minimum time after which the oscillator will be found in the same state is

1. $3\pi/(2\omega)$
2. π/ω
3. $\pi/(2\omega)$
4. $2\pi/\omega$

Q23. [June 2021] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2021 June	3.5M

A two-state system evolves under the action of the Hamiltonian $H = E_0|A\rangle\langle A| + (E_0 + \Delta)|B\rangle\langle B|$, where $|A\rangle$ and $|B\rangle$ are its two orthonormal states. These states transform to one another under parity, i.e. $P|A\rangle = |B\rangle$ and $P|B\rangle = |A\rangle$. If at time $t = 0$ the system is in a state of definite parity $P = 1$, the earliest time t at which the probability of finding the system in a state of parity $P = -1$ is one is

1. $\frac{\pi\hbar}{2\Delta}$
2. $\frac{\pi\hbar}{\Delta}$
3. $\frac{3\pi\hbar}{2\Delta}$
4. $\frac{2\pi\hbar}{\Delta}$

Q24. [June 2021] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2021 June	5M

The unnormalized wave function of a particle in one dimension in an infinite square well with walls at $x = 0$ and $x = a$, is $\psi(x) = x(a - x)$. If $\psi(x)$ is expanded as a linear combination of the energy eigenfunctions, $\int_0^a |\psi(x)|^2 dx$ is proportional to the infinite series

(You may use $\int_0^a t \sin t\, dt = -a\cos a + \sin a$ and $\int_0^a t^2 \sin t\, dt = -2 - (a^2 - 2)\cos a + 2a\sin a$)

1. $\sum_{n=1}^{\infty} (2n - 1)^{-6}$
2. $\sum_{n=1}^{\infty} (2n - 1)^{-4}$
3. $\sum_{n=1}^{\infty} (2n - 1)^{-2}$
4. $\sum_{n=1}^{\infty} (2n - 1)^{-8}$

Q25. [June 2022] . 3.5 marks
Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2022 June	3.5M

If the expectation value of the momentum of a particle in one dimension is zero, then its (box-normalizable) wave function may be of the form

1. $\sin kx$
2. $e^{ikx} \sin kx$
3. $e^{ikx} \cos kx$
4. $\sin kx + e^{ikx} \cos kx$

Q26. [June 2022] . 3.5 marks
Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2022 June	3.5M

In terms of a complete set of orthonormal basis kets $|n\rangle$, $n = 0, \pm 1, \pm 2, \ldots$, the Hamiltonian is

$$H = \sum_n (E|n\rangle\langle n| + \epsilon|n+1\rangle\langle n| + \epsilon|n\rangle\langle n+1|)$$

where E and $\in$ are constants. The state $|\varphi\rangle = \sum_n e^{in\varphi}|n\rangle$ is an eigenstate with energy

1. $E + \in \cos\varphi$
2. $E - \in \cos\varphi$
3. $E + 2 \in \cos\varphi$
4. $E - 2 \in \cos\varphi$

Q27. [June 2022] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2022 June	3.5M

The momentum space representation of the Schrodinger equation of a particle in a potential $V(\vec{r})$ is $\left(|\vec{p}|^2 + \beta\left(\nabla_p^2\right)^2\right)\psi(\vec{p},t) = i\hbar\frac{\partial}{\partial t}\psi(\vec{p},t)$, where $\left(\nabla_p\right)_i = \frac{\partial}{\partial p_i}$, and β is a constant. The potential is (in the following V_0 and a are constants)

1. $V_0 e^{-r^2/a^2}$
2. $V_0 e^{-r^4/a^4}$
3. $V_0\left(\frac{r}{a}\right)^2$
4. $V_0\left(\frac{r}{a}\right)^4$

Q28. [Dec 2023] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2023 Dec	5 M

In a quantum harmonic oscillator problem, $\hat{a}$ and $\hat{N}$ are the annihilation operator and the number operator, respectively. The operator $e^{\hat{N}}\hat{a}e^{-\hat{N}}$ is

1. $\hat{a}$
2. $e^{-1}\hat{a}$
3. $e^{-(\hat{I}+\hat{a})}$
4. $e^{\hat{a}}$

(where $\hat{I}$ is the identity operator)

Q29. [June 2023] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2023 June	5M

Two operators A and B satisfy the commutation relations $[H, A] = -\hbar\omega B$ and $[H, B] = \hbar\omega A$, where ω is a constant and H is the Hamiltonian of the system. The expectation value $\langle A\rangle_\psi(t) = \psi|A|\psi)$ in a state $|\psi\rangle$, such that at time $t = 0, \langle A\rangle_\psi(0) = 0$ and $B_\psi(0) = i$, is

1. $\sin(\omega t)$
2. $\sinh(\omega t)$
3. $\cos(\omega t)$
4. $\cosh(\omega t)$

Q30. [Dec 2024] . 5.0 marks
Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2024 Dec	5M

The constant B which makes e^{-ax^2} an eigenfunction of the operator $\left(\frac{d^2}{dx^2} - Bx^2\right)$ is

1. $4a^2$
2. 0
3. $2a$
4. 1

Q31. [June 2024] . 3.5 marks
Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2024 June	3.5M

If A and B are Hermitian operators and C is an antihermitian operator, then

1. $[[A,B],C]$ is hermitian and $[[A,C],B]$ is antihermitian
2. $[[A,B],C]$ and $[[A,C],B]$ are both antihermitian
3. $[[A,B],C]$ and $[[A,C],B]$ are both hermitian
4. $[[A,B],C]$ is antihermitian and $[[A,C],B]$ is Hermitian

Q32. [Dec 2025] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2025 Dec	3.5M	QM

A quantum mechanical particle in a harmonic potential has the wave function $\frac{1}{\sqrt{2}}[\psi_0(x) + \psi_1(x)]$ at $t = 0$, where $\psi_0(x)$ and $\psi_1(x)$ are the wave functions of the ground state and the first excited state respectively. If the frequency of the oscillator is ω, the probability density of finding the particle at x after time $t = \frac{\pi}{\omega}$ is

1. $\frac{1}{2}|\psi_1(x) - \psi_0(x)|^2$
2. $\frac{1}{2}|\psi_1(x) + \psi_0(x)|^2$
3. $\frac{1}{2}|\psi_1(x) - i\psi_0(x)|^2$
4. $\frac{1}{2}|\psi_1(x)|^2 + \frac{1}{2}|\psi_0(x)|^2$

Q33. [Dec 2025] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2025 Dec	5M	QM

A one-dimensional quantum harmonic oscillator with frequency ω is in its ground state. Its normalized wave function is given by

$$\psi(x) = \left(\frac{m\omega}{\pi\hbar}\right)^{\frac{1}{4}} \exp\left[-\frac{m\omega}{2\hbar}x^2\right].$$

The frequency is suddenly increased to 2ω. The probability of finding the particle in its new ground state is

1. $\frac{2\sqrt{2}}{3}$
2. $\left(\frac{2\sqrt{2}}{3}\right)^{\frac{1}{2}}$
3. $\frac{2}{3}$
4. $\left(\frac{3}{2\sqrt{2}}\right)^{\frac{1}{2}}$

Q34. [June 2025] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2025 June	3.5M	QM

A particle of mass m is in the third energy eigenstate of an infinite potential well of width a. The time interval in which the phase of this wave function changes by 2π is

1. $\frac{4ma^2}{3\pi\hbar}$
2. $\frac{4ma^2}{9\pi\hbar}$
3. $\frac{8ma^2}{3\pi\hbar}$
4. $\frac{8ma^2}{9\pi\hbar}$

Q35. [June 2025] . 3.5 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2025 June	3.5M	QM

The Hamiltonian of the 1-dimensional quantum harmonic oscillator is given by $H = \frac{p^2}{2m} + \frac{1}{2}m\omega^2 x^2$. The expectation value of $[D, H]$ in the ground state, where $D = \frac{1}{2\hbar}(xp + px)$, is (in units of $\hbar\omega$)

1. i
2. $\frac{1}{2}$
3. 3. $\frac{-3i}{2}$
4. 0

Q36. [June 2025] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2025 June	5M	QM

The probability density of a free particle of mass m at time $t = 0$, is given by $A\exp\left(-\frac{x^2}{2\sigma^2(0)}\right)$. At $t > 0$, its probability density is proportional to $\exp\left(-\frac{x^2}{2\sigma^2(t)}\right)$, where $\sigma^2(t)$ is

1. $\sigma^2(0) + \frac{\hbar^2 t^2}{\sigma^2(0) m^2}$
2. $\sigma^2(0) + \frac{\hbar^2 t^2}{4\sigma^2(0) m^2}$
3. $\sigma^2(0) + \frac{4\hbar^2 t^2}{\sigma^2(0) m^2}$
4. $\sigma^2(0) + \frac{2\hbar^2 t^2}{\sigma^2(0) m^2}$

Answer Key

36 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q2	Quantum Mechanics	Basic Quantum Mechanics	**3**
Q3	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q4	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q5	Quantum Mechanics	Basic Quantum Mechanics	**3**
Q6	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q7	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q8	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q9	Quantum Mechanics	Basic Quantum Mechanics	**4**
Q10	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q11	Quantum Mechanics	Basic Quantum Mechanics	**3**
Q12	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q13	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q14	Quantum Mechanics	Basic Quantum Mechanics	**4**
Q15	Quantum Mechanics	Basic Quantum Mechanics	**3**
Q16	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q17	Quantum Mechanics	Basic Quantum Mechanics	**3**
Q18	Quantum Mechanics	Basic Quantum Mechanics	**3**
Q19	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q20	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q21	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q22	Quantum Mechanics	Basic Quantum Mechanics	**4**
Q23	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q24	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q25	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q26	Quantum Mechanics	Basic Quantum Mechanics	**3**
Q27	Quantum Mechanics	Basic Quantum Mechanics	**4**
Q28	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q29	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q30	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q31	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q32	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q33	Quantum Mechanics	Basic Quantum Mechanics	**1**
Q34	Quantum Mechanics	Basic Quantum Mechanics	**2**
Q35	Quantum Mechanics	Basic Quantum Mechanics	**4**
Q36	Quantum Mechanics	Basic Quantum Mechanics	**2**

Study with PhysicsByAaryan