PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Dirac delta potential - CSIR NET Physics PYQs

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

6 questions . Answer key included

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Q1. [Dec 2016] . 5.0 marks

Quantum Mechanics > Dirac delta potential

CSIR NET	2016 Dec	5M

A particle in one dimension is in a potential $V(x) = A\delta(x-a)$. Its wavefunction $\psi(x)$ is continuous everywhere. The discontinuity in $\frac{d\psi}{dx}$ at $x = a$ is

1. $\frac{2m}{\hbar^2}A\psi(a)$
2. $A(\psi(a) - \psi(-a))$
3. $\frac{\hbar^2}{2m}A$
4. 0

Q2. [June 2016] . 5.0 marks

Quantum Mechanics > Dirac delta potential

CSIR NET	2016 June	5M

A particle of mass m moves in one dimension under the influence of the potential $V(x) = -\alpha\delta(x)$, where α is a positive constant. The uncertainty in the product $(\Delta x)(\Delta p)$ in its ground state is

1. $2\hbar$
2. $\hbar/2$
3. $\hbar/\sqrt{2}$
4. $\sqrt{2}\hbar$

Q3. [Dec 2023] . 5.0 marks

Quantum Mechanics > Dirac delta potential

CSIR NET	2023 Dec	5 M

A quantum particle of mass m is moving in a one dimensional potential

$$V(x) = V_0\theta(x) - \lambda\delta(x)$$

where V_0 and λ are positive constants, $\theta(x)$ is the Heaviside step function and $\delta(x)$ is the Dirac delta function. The leading contribution to the reflection coefficient for the particle incident from the left with energy $E \gg V_0 > \lambda$ and $\sqrt{2mE} \gg \frac{V_0\hbar}{\lambda}$ is

1. $\frac{V_0^2}{4E^2}$
2. $\frac{V_0^2}{8E^2}$
3. $\frac{m\lambda^2}{2E\hbar^2}$
4. $\frac{m\lambda^2}{4E\hbar^2}$

Q4. [Dec 2024] . 5.0 marks

Quantum Mechanics > Dirac delta potential

CSIR NET	2024 Dec	5M

A particle of mass m, moving in one-dimension is subjected to the potential

$$V(x) = \begin{cases} V_0\delta(x-a) & 0 < x < 2a \\ \infty & \text{otherwise} \end{cases}$$

The energy eigenvalues E satisfy

1. $\tan\frac{a\sqrt{2mE}}{\hbar} = \frac{\hbar}{V_0}\sqrt{\frac{2E}{m}}$
2. $\tanh\frac{a\sqrt{2mE}}{\hbar} = \frac{\hbar}{V_0}\sqrt{\frac{2E}{m}}$
3. $\tan\frac{a\sqrt{2mE}}{\hbar} = -\frac{\hbar}{V_0}\sqrt{\frac{2E}{m}}$
4. $\tanh\frac{a\sqrt{2mE}}{\hbar} = -\frac{\hbar}{V_0}\sqrt{\frac{2E}{m}}$

Q5. [Dec 2024] . 5.0 marks

Quantum Mechanics > Dirac delta potential

CSIR NET	2024 Dec	5M

A particle of mass m is bound in one dimension by the potential $V(x) = V_0\delta(x)$ with $V_0 < 0$. If the probability of finding it in the region $|x| < a$ is 0.25, then a is

1. $\frac{\hbar^2}{4mV_0}\ln\frac{3}{4}$
2. $\frac{\hbar^2}{2mV_0}\ln\frac{3}{4}$
3. $\frac{\hbar^2}{4mV_0}\ln\frac{1}{4}$
4. $\frac{\hbar^2}{2mV_0}\ln\frac{1}{4}$

Q6. [June 2024] . 5.0 marks

Quantum Mechanics > Dirac delta potential

CSIR NET	2024 June	5M

A particle of energy E is scattered off a one-dimensional potential $\lambda\delta(x)$, where λ is a real positive constant, with a transmission amplitude t_+. In a different experiment, the same particle is scattered off another one-dimensional potential $-\lambda\delta(x)$, with a transmission amplitude t_-. In the limit $E \to 0$, the phase difference between t_+ and t_- is

1. $\pi/2$
2. π
3. 0
4. $3\pi/2$

Answer Key

6 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Quantum Mechanics	Dirac delta potential	**1**
Q2	Quantum Mechanics	Dirac delta potential	**3**
Q3	Quantum Mechanics	Dirac delta potential	**3**
Q4	Quantum Mechanics	Dirac delta potential	**3**
Q5	Quantum Mechanics	Dirac delta potential	**2**
Q6	Quantum Mechanics	Dirac delta potential	**2**

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