PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

WKB Approximation - CSIR NET Physics PYQs

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

6 questions . Answer key included

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Q1. [June 2016] . 5.0 marks

Quantum Mechanics > WKB Approximation

CSIR NET	2016 June	5M

The energy levels for a particle of mass m in the potential $V(x) = \alpha|x|$, determined in the WKB approximation

$$\sqrt{2m}\int_a^b \sqrt{E - V(x)}dx = \left(n + \frac{1}{2}\right)\hbar\pi$$

(where a, b are the turning points and $n = 0,1,2\cdots$), are

1. $E_n = \left[\frac{\hbar\pi\alpha}{4\sqrt{m}}\left(n + \frac{1}{2}\right)\right]^{2/3}$
2. $E_n = \left[\frac{3\hbar\pi\alpha}{4\sqrt{2m}}\left(n + \frac{1}{2}\right)\right]^{2/3}$
3. $E_n = \left[\frac{3\hbar\pi\alpha}{4\sqrt{m}}\left(n + \frac{1}{2}\right)\right]^{2/3}$
4. $E_n = \left[\frac{\hbar\pi\alpha}{4\sqrt{2m}}\left(n + \frac{1}{2}\right)\right]^{2/3}$

Q2. [Dec 2017] . 5.0 marks

Quantum Mechanics > WKB Approximation

CSIR NET	2017 Dec	5M

The energy eigenvalues E_n of a quantum system in the potential $V = cx^6$ (where $c > 0$ is a constant), for large values of the quantum number n, varies as

1. $n^{4/3}$
2. $n^{3/2}$
3. $n^{5/4}$
4. $n^{6/5}$

Q3. [Dec 2018] . 5.0 marks

Quantum Mechanics > WKB Approximation

CSIR NET	2018 Dec	5M

A one-dimensional system is described by the Hamiltonian $H = \frac{p^2}{zm} + \lambda|x|$ (where $\lambda > 0$). The ground state energy varies as a function of λ as

1. $\lambda^{5/3}$
2. $\lambda^{2/3}$
3. $\lambda^{4/3}$
4. $\lambda^{1/3}$

Q4. [June 2018] . 5.0 marks

Quantum Mechanics > WKB Approximation

CSIR NET	2018 June	5M

The n^{th} energy eigenvalues E_n of a one-dimensional Hamiltonian $H = \frac{p^2}{2m} + \lambda x^4$ (where $\lambda > 0$ is a constant) in the WEB approximation, is proportional to

1. $\left(n + \frac{1}{2}\right)^{4/3} \lambda^{1/3}$
2. $\left(n + \frac{1}{2}\right)^{4/3} \lambda^{2/3}$
3. $\left(n + \frac{1}{2}\right)^{5/3} \lambda^{1/3}$
4. $\left(n + \frac{1}{2}\right)^{5/3} \lambda^{2/3}$

Q5. [June 2019] . 5.0 marks

Quantum Mechanics > WKB Approximation

CSIR NET	2019 June	5M

The Hamiltonian of A quantum particle of mass m is $H = \frac{p^2}{2m} + \alpha|x|^r$, where α and r are positive constants. The energy E_n of the n^{th} level for large n, depends on n as

1. n^{2r}
2. n^{r+2}
3. $n^{1/(r+2)}$
4. $n^{2r/(r+2)}$

Q6. [June 2024] . 5.0 marks

Quantum Mechanics > WKB Approximation

CSIR NET	2024 June	5M

The Hamiltonian of a particle of mass m is given by

$$H = \frac{p^2}{2m} + V(x), \text{ with } V(x) = \begin{cases} -\alpha x & \text{for } x \leq 0 \\ \beta x & \text{for } x > 0 \end{cases}$$

where α, β are positive constants. The n^{th} energy eigenvalue E_n obtained using WKB approximation is $E_n^{3/2} = \frac{3}{2}\left(\frac{\hbar^2}{2m}\right)^{1/2} \pi \left(n - \frac{1}{2}\right) f(\alpha, \beta)$ $(n = 1,2, \ldots)$

The function $f(\alpha, \beta)$ is

1. $\sqrt{\frac{\alpha^2\beta^2}{2(\alpha^2+\beta^2)}}$
2. $\frac{\alpha\beta}{\alpha+\beta}$
3. $\frac{\alpha+\beta}{4}$
4. $\frac{1}{2}\sqrt{\frac{\alpha^2+\beta^2}{2}}$

Answer Key

6 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Quantum Mechanics	WKB Approximation	**2**
Q2	Quantum Mechanics	WKB Approximation	**2**
Q3	Quantum Mechanics	WKB Approximation	**2**
Q4	Quantum Mechanics	WKB Approximation	**1**
Q5	Quantum Mechanics	WKB Approximation	**4**
Q6	Quantum Mechanics	WKB Approximation	**2**

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