

2018 年招收攻读硕士学位研究生入学统一考试试题

科目名称：量子力学 参考答案

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$$\text{一. (1) } \Phi_1(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{\pi x}{a}\right) \quad \Phi_2(x) = \sqrt{\frac{2}{a}} \sin\left(\frac{2\pi x}{a}\right)$$

$$A^2 + A^2 = 1 \quad A = \frac{1}{\sqrt{2}}$$

$$(2) \Psi(x, t) = \frac{1}{\sqrt{2}} \Phi_1(x) e^{-iE_1 t/\hbar} + \frac{1}{\sqrt{2}} \Phi_2(x) e^{-iE_2 t/\hbar}$$

$$\text{其中, } E_1 = \frac{\pi^2 \hbar^2}{2ma^2}, E_2 = \frac{4\pi^2 \hbar^2}{2ma^2}$$

$$\begin{aligned} (3) \quad \bar{x} &= \int_0^a \Psi^*(x, t) x \Psi(x, t) dx \\ &= \int_0^a x \left(\frac{1}{\sqrt{2}} \Phi_1^*(x) e^{iE_1 t/\hbar} + \frac{1}{\sqrt{2}} \Phi_2^*(x) e^{iE_2 t/\hbar} \right) \left(\frac{1}{\sqrt{2}} \Phi_1(x) e^{-iE_1 t/\hbar} + \frac{1}{\sqrt{2}} \Phi_2(x) e^{-iE_2 t/\hbar} \right) dx \\ &= \frac{1}{2} \left(\int_0^a x |\Phi_1(x)|^2 dx + \int_0^a x |\Phi_2(x)|^2 dx + \int_0^a \Phi_1^*(x) \Phi_2(x) e^{-i(E_2 - E_1)t/\hbar} dx + \int_0^a \Phi_2^*(x) \Phi_1(x) e^{-i(E_1 - E_2)t/\hbar} dx \right) \end{aligned}$$