# Quantum Mechanics - Griffiths, David J

## 1 The Wave Function

### 1.1

### 1.2

### 1.3 Gaussian distribution

"Consider the Gaussian distribution..."

a) $\sqrt{\frac{\lambda}{\pi}}$
b) $\langle x\rangle = a, \langle x^2\rangle = \frac{1}{2\lambda} + a^2, \sigma^2 = \frac{1}{2\lambda}$
c) a smooth gentle hump centered at $a$

### 1.4

a) $A = \frac{2}{b}$
b) a sharp concave up peak
c) ??

### 1.5 Delta potential

a) $A = \sqrt{\lambda}$
b) $\langle x\rangle = 0, \langle x^2\rangle = \frac{1}{2\lambda^2}$
c) $\sigma = \frac{\sqrt{2}}{2}\frac{1}{\lambda}, \Pr(|x| > \sigma) = e^{-\sqrt{2}}$

### 1.6

### 1.7

### 1.8

### 1.9

a) $A^2 = \sqrt{\frac{2am}{\pi\hbar}}$
b) $V = 2a^2mx^2$
c)$\langle x\rangle = 0, \langle x^2\rangle = \frac{\hbar}{4am}, \langle p\rangle = 0, \langle p^2\rangle = am\hbar$
d) $\sigma_x^2\sigma_p^2 = \frac{\hbar^2}{4}$

### 1.10

### 1.11

### 1.12

### 1.13

### 1.14

a) ?? b) 0

### 1.15 Unstable particle

"Suppose you wanted to describe an unstable particle..."

a) ?? b) $P = P_0 e^{-(2\Gamma/\hbar)t}$

### 1.16

Done

### 1.17

a) $A^2 = \frac{15}{16a^5}$ b) $\langle x \rangle = 0$ c) $\langle p \rangle = 0$ d) $\langle x^2 \rangle = \frac{A^2 a^7 16}{105}$ e) $\langle p^2 \rangle = \frac{8}{3}\hbar^2 A^2 a^4$ f,g,h) $\sigma_x^2 \sigma_p^2 = \hbar^2 \frac{5}{2}$

## 2 The time-independent Schrödinger equation

### 2.1

### 2.2

### 2.3

Done

### 2.4

"Calculate $\langle x \rangle, \langle x^2 \rangle, ...$ for the $n$th stationary state..."

$\langle x \rangle = a/2$
$\langle x^2 \rangle = a^2 \left(\frac{1}{3} + \frac{1}{2n\pi}\right)$
$\langle p \rangle = 0$
$\langle p^2 \rangle = \frac{\hbar^2 n^2 \pi^2}{a^2}$
$\sigma_x^2 = a^2 \left(\frac{1}{12} + \frac{1}{2n\pi}\right)$
$\sigma_x^2 \sigma_p^2 = \hbar^2 \pi^2 \left(\frac{n^2}{12} + \frac{n}{2\pi}\right)$

### 2.5

"A particle in the infinite square well has as its initial wave function an even mixture of the first two..."

a) $A = \frac{\sqrt{2}}{2}$
b) $\psi(x,t) = \frac{\sqrt{a}}{a}\left(\sin(\frac{\pi x}{a})e^{-i\pi^2\hbar/2ma^2} + \sin(\frac{2\pi x}{a})e^{-4i\pi^2\hbar t/2ma^2}\right)$, $|\psi|^2 = \frac{1}{a}\left(\sin^2\frac{\pi x}{a} + \sin^2\frac{2\pi x}{a} + 2\sin\frac{\pi x}{a}\sin\frac{2\pi x}{a}\cos\frac{3\pi^2\hbar}{2ma^2}t\right)$
c) $\langle x \rangle = \frac{a}{2} - \frac{16a}{9\pi^2}\cos 3\omega t$
d)? e)?

### 2.6

### 2.7

$\langle x \rangle = \frac{a}{2}$, $\langle x^2 \rangle = \frac{2}{7}a^2$, $\sigma_x^2 = \frac{5}{14}a^2$
$\langle p \rangle = 0$, $\langle p^2 \rangle = \frac{10\hbar^2}{a^2}$