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# Quantum Notes

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## CONTENTS

<b>1</b>	<b>Introduction</b>	<b>3</b>
<b>2</b>	<b>Table of Contents</b>	<b>5</b>
2.1	Collections . . . . .	5



Some notes for quantum



## INTRODUCTION

Some notes continued from the full theoretical physics notes are [here](#).





## TABLE OF CONTENTS

### 2.1 Collections

#### 0. Fine Structure Constant

$\alpha = \frac{k_{\text{e}} e^2}{\hbar c} = \frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar c} = \frac{e^2 c}{\mu_0 \hbar^2}$

In electrostatic cgs units,  $\alpha = \frac{e^2}{\hbar c}$ .

In natural units,  $\alpha = \frac{e^2}{4\pi}$ .

#### 1. Hydrogen Atom

Potential  $V(r) = -\frac{Ze^2}{4\pi\epsilon_0 r}$ .

Energy levels:  $E_n = -\left(\frac{Z^2 \mu e^4}{32\pi^2\epsilon_0 \hbar^2}\right) \frac{1}{n^2} = -\left(\frac{Z^2 \hbar^2}{2\mu a_{\mu}^2}\right) \frac{1}{n^2} = \frac{\mu c^2 Z^2 \alpha^2}{2n^2}$ .

Ground state of hydrogen atom  $\psi_{100}(r) = \frac{1}{\sqrt{\pi}} \frac{1}{a^{3/2}} e^{-Zr/a}$ .



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This open source project is hosted on GitHub: [quantum](#).