

Solved Problems on Quantum Mechanics in One Dimension

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Fall 1999; revised 2011 by Malcolm McMillan

Given here are solutions to 15 problems on Quantum Mechanics in one dimension.

The solutions were used as a learning-tool for students in the introductory undergraduate course *Physics 200 Relativity and Quanta* given by Malcolm McMillan at UBC during the 1998 and 1999 Winter Sessions. The solutions were prepared in collaboration with Charles Asman and Adam Monahan who were graduate students in the Department of Physics at the time.

The problems are from Chapter 5 *Quantum Mechanics in One Dimension* of the course text *Modern Physics* by Raymond A. Serway, Clement J. Moses and Curt A. Moyer, Saunders College Publishing, 2nd ed., (1997).

Planck's Constant and the Speed of Light.

When solving numerical problems in Quantum Mechanics it is useful to note that the product of Planck's constant

$$h = 6.6261 \times 10^{-34} \text{ J s} \quad (1)$$

and the speed of light

$$c = 2.9979 \times 10^8 \text{ m s}^{-1} \quad (2)$$

is

$$hc = 1239.8 \text{ eV nm} = 1239.8 \text{ keV pm} = 1239.8 \text{ MeV fm} \quad (3)$$

where

$$1 \text{ eV} = 1.6022 \times 10^{-19} \text{ J} \quad (4)$$

Also,

$$hc = 197.32 \text{ eV nm} = 197.32 \text{ keV pm} = 197.32 \text{ MeV fm} \quad (5)$$

where $\hbar = h/2\pi$.

Wave Function for a Free Particle

Problem 5.3, page 224

A free electron has wave function

$$\Psi(x, t) = \sin(kx - \omega t) \quad (6)$$

- Determine the electron's de Broglie wavelength, momentum, kinetic energy and speed when $k = 50 \text{ nm}^{-1}$.
- Determine the electron's de Broglie wavelength, momentum, total energy, kinetic energy and speed when $k = 50 \text{ pm}^{-1}$.

Solved Problems On Quantum Mechanics In One Dimension

Elliott H. Lieb, Daniel C. Mattis



Solved Problems On Quantum Mechanics In One Dimension:

Quantum Mechanics Fayyazuddin,1990 The book is a text on quantum mechanics It starts from an elementary level and gradually develops into advanced level The difficult concepts are progressively developed They are not glossed over but are explained thoroughly The uniformity of treatment enables the reader to go over difficult and advanced topics without strain The emphasis is on the basic concepts and the methodology rather than on specific applications

Problems in Quantum Mechanics Emilio d'Emilio,Luigi E. Picasso,2012-02-28 242 solved problems of several degrees of difficulty in nonrelativistic Quantum Mechanics ranging from the themes of the crisis of classical physics through the achievements in the framework of modern atomic physics down to the still alive more intriguing aspects connected e g with the EPR paradox the Aharonov Bohm effect quantum teleportation

Mathematical Physics in One Dimension Elliott H. Lieb,Daniel C. Mattis,2013-09-17 *Mathematical Physics in One Dimension Exactly Soluble Models of Interacting Particles* covers problems of mathematical physics with one dimensional analogs The book discusses classical statistical mechanics and phase transitions the disordered chain of harmonic oscillators and electron energy bands in ordered and disordered crystals The text also describes the many fermion problem the theory of the interacting boson gas the theory of the antiferromagnetic linear chains and the time dependent phenomena of many body systems i e classical or quantum mechanical dynamics Physicists and mathematicians will find the book invaluable

Engineering Physics - Part A Thakur Publication,2021-02-03 Buy *Solved Series of Engineering Physics Part A E Book for B Tech I II Semester Students Common to All of APJ Abdul Kalam Technological University KTU Kerala*

[Many-body Problem, The: An Encyclopedia Of Exactly Solved Models In One Dimension \(3rd Printing With Revisions And Corrections\)](#) Daniel C Mattis,1993-03-15 This book differs from its predecessor Lieb Mattis *Mathematical Physics in One Dimension* in a number of important ways Classic discoveries which once had to be omitted owing to lack of space such as the seminal paper by Fermi Pasta and Ulam on lack of ergodicity of the linear chain or Bethe s original paper on the Bethe ansatz can now be incorporated Many applications which did not even exist in 1966 some of which were originally spawned by the publication of Lieb Mattis are newly included Among these this new book contains critical surveys of a number of important developments the exact solution of the Hubbard model the concept of spinons the Haldane gap in magnetic spin one chains bosonization and fermionization solitons and the approach to thermodynamic equilibrium quantum statistical mechanics localization of normal modes and eigenstates in disordered chains and a number of other contemporary concerns

Advanced Partial Differential Equations Sameer Kulkarni,2025-02-28 Embark on an in depth exploration of partial differential equations PDEs with *Advanced Partial Differential Equations* Our comprehensive guide provides a thorough overview of the theory numerical methods and practical applications of PDEs across various scientific and engineering fields This resource is designed for both graduate level students and professionals seeking to deepen their understanding of PDEs We cover a wide range of topics from classical

PDEs and numerical methods to applications in physics engineering biology and finance Additionally we delve into advanced topics such as nonlinear equations and stochastic processes presenting each subject with rigorous mathematical treatment and clear explanations Our guide includes detailed discussions on numerical techniques for solving PDEs featuring finite difference finite element spectral and boundary integral methods Real world examples and case studies illustrate the practical relevance of PDEs in disciplines like fluid dynamics heat transfer electromagnetics structural mechanics and mathematical biology To enhance your learning experience we offer thought provoking exercises and problems at the end of each chapter along with MATLAB and Python code snippets for implementing numerical algorithms Whether you re a student researcher or practitioner *Advanced Partial Differential Equations* equips you with the knowledge and tools to tackle complex problems in science and engineering

Statistical Physics Leo P. Kadanoff,2000 The material presented in this invaluable textbook has been tested in two courses One of these is a graduate level survey of statistical physics the other a rather personal perspective on critical behavior Thus this book defines a progression starting at the book learning part of graduate education and ending in the midst of topics at the research level To supplement the research level side the book includes some research papers Several of these are classics in the field including a suite of six works on self organized criticality and complexity a pair on diffusion limited aggregation some papers on correlations near critical points a few of the basic sources on the development of the real space renormalization group and several papers on magnetic behavior in a plain geometry In addition the author has included a few of his own papers

American Journal of Physics ,2001 **Quasi-Exactly Solvable Models in Quantum Mechanics** A.G Ushveridze,2017-07-12 Exactly solvable models that is models with explicitly and completely diagonalizable Hamiltonians are too few in number and insufficiently diverse to meet the requirements of modern quantum physics Quasi exactly solvable QES models whose Hamiltonians admit an explicit diagonalization only for some limited segments of the spectrum provide a practical way forward Although QES models are a recent discovery the results are already numerous Collecting the results of QES models in a unified and accessible form *Quasi Exactly Solvable Models in Quantum Mechanics* provides an invaluable resource for physicists using quantum mechanics and applied mathematicians dealing with linear differential equations By generalizing from one dimensional QES models the expert author constructs the general theory of QES problems in quantum mechanics He describes the connections between QES models and completely integrable theories of magnetic chains determines the spectra of QES Schr dinger equations using the Bethe l ansatz solution of the Gaudin model discusses hidden symmetry properties of QES Hamiltonians and explains various Lie algebraic and analytic approaches to the problem of quasi exact solubility in quantum mechanics Because the applications of QES models are very wide such as for investigating non perturbative phenomena or as a good approximation to exactly non solvable problems researchers in quantum mechanics related fields cannot afford to be unaware of the possibilities of QES models

Understanding Quantum Physics Michael A. Morrison,1990 Written in an informal yet substantive style that is a joy to

read this book provides a uniquely engaging in depth introduction to the concepts of quantum physics and their practical implementation and is filled with clear thorough explanations that help readers develop insight into physical ideas and master techniques of problem solving using quantum mechanics Fully explores the concepts and strategies of quantum mechanics showing the connections among the physical concepts that govern the atomic and sub atomic domain of matter and examining how these concepts manifest themselves in the mathematical machinery of quantum mechanics Focuses on the explanations and motivations of the postulates that underlie the machinery of quantum mechanics and applies simple single particle systems in one dimension Illuminates discussions of ideas and techniques with a multitude of examples that show not just the answers but also the reasoning behind them and adds dimension to the subject with historical biographical and philosophical references throughout Designed for a wide range of readers interested in various branches of physics and engineering physics Science Abstracts ,1929 *Physics Briefs* ,1991 **Electro-technology** Stanley A. Dennis,Leon Irving Thomas,1961 Contemporary Physics: Trieste Symposium: Theory of condensed matter and related problems ,1969 The Graduate School, University of Kentucky Bulletin University of Kentucky,1970 *Proceedings of the National Academy of Sciences of the United States of America* National Academy of Sciences (U.S.),2002 Reviews in Partial Differential Equations, 1980-86, as Printed in Mathematical Reviews ,1988 *Physics in One Dimension* ,1981 *Quantum Mechanics* Nouredine Zettili,2001-09-11 Written for undergraduates and graduates this richly illustrated textbook offers a clear balanced and modern approach to quantum mechanics It combines the essentials of the theory with its practical applications Mathematical Reviews ,2007

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