

Atomic Physics, Nuclear Physics and Radioactivity: Example Problems with Solutions

ATOMIS PHYSICS

DISCOVERY OF THE PARTS OF THE ATOM: ELECTRONS AND NUCLEI

1. Rutherford found the size of the nucleus to be about 10^{-15} m . This implied a huge density. What would this density be for gold?

Nucleus diameter = 10^{-15} m Gold mass = 197 amu 1 amu = 1.66×10^{-27} kg

Solution

$$m = 197 \text{ amu} \times 1.66 \times 10^{-27} \text{ kg/amu} \quad m = 3.27 \times 10^{-25} \text{ kg}$$

$$r = 5 \times 10^{-16} \text{ m}$$

$$m = \rho V \Rightarrow \rho = \frac{m}{V}$$

$$\rho = \frac{m}{\frac{4}{3} \pi r^3} \quad \rho = \frac{(3.27 \times 10^{-25} \text{ kg})}{\frac{4}{3} \pi (5 \times 10^{-16} \text{ m})^3} \quad \rho = \frac{(3.27 \times 10^{-25} \text{ kg})}{5 \times 10^{-46} \text{ m}^3} \quad \rho = 6.5 \times 10^{20} \text{ kg/m}^3$$

2. In Millikan's oil-drop experiment, one looks at a small oil drop held motionless between two plates. Take the voltage between the plates to be 2033 V, and the plate separation to be 2.00 cm. The oil drop (of density 0.81 g/cm^3) has a diameter of 4.0×10^{-6} m . Find the charge on the drop, in terms of electron units.

Solution

$$F_e = q E; \quad E = \frac{V}{d}$$

$$W = m g$$

$$m = \rho V = \rho \left(\frac{4}{3} \pi r^3 \right) = \rho \left(\frac{4}{3} \pi \left(\frac{d_{\text{oil drop}}}{2} \right)^3 \right) = \rho \left(\frac{4}{3} \pi \frac{d_{\text{oil drop}}^3}{8} \right)$$

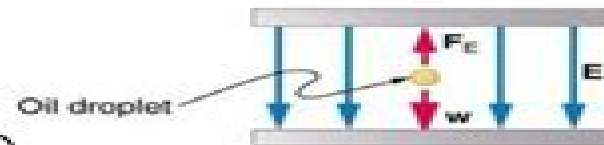
$$m = \rho \left(\frac{1}{6} \pi d^3 \right) \quad m = \frac{(810 \text{ kg/m}^3) \pi (4.0 \times 10^{-6} \text{ m})^3}{6} \quad m = 2.71 \times 10^{-14} \text{ kg}$$

$$F_e = W \Leftrightarrow q \frac{V}{d} = m g \Rightarrow q = \frac{m g d}{V}$$

$$q = \frac{(2.71 \times 10^{-14} \text{ kg})(9.8 \text{ m/s}^2)(2 \times 10^{-2} \text{ m})}{2033 \text{ V}} \quad q = 2.6 \times 10^{-18} \text{ C}$$

$$n_{\text{electrons}} = \frac{q}{e} = \frac{2.6 \times 10^{-18} \text{ C}}{1.6 \times 10^{-19} \text{ C}}$$

$$n_{\text{electrons}} \approx 16$$



Problems In Atomic And Nuclear Physics

Yung-kuo Lim



Problems In Atomic And Nuclear Physics:

Modern Atomic And Nuclear Physics (Revised Edition): Problems And Solutions Manual Fujia Yang, Joseph H Hamilton, 2010-06-01 This problems and solutions manual is intended as a companion to an earlier textbook Modern Atomic and Nuclear Physics Revised Edition World Scientific 2010 This manual presents solutions to many end of chapter problems in the textbook These solutions are valuable to the instructors and students working in the modern atomic field Students can master important information and concept in the process of looking at solutions to some problems and become better equipped to solve other problems that the instructors propose Problems in atomic and nuclear physics B.

Chop, 2000-01-01 Solutions to Problems in Atomic and Nuclear Physics Derek Leonard Livesey, 1966 **Modern Atomic And Nuclear Physics (Revised Edition)** Joseph H Hamilton, Fujia Yang, 2010-01-29 The book is the culmination of the authors many years of teaching and research in atomic physics nuclear and particle physics and modern physics It is also a crystallization of their intense passion and strong interest in the history of physics and the philosophy of science The book gives students a broad perspective of the current understandings of the basic structures of matter from atoms nucleus to leptons quarks and gluons along with the essential introductory quantum mechanics and special relativity Fundamentals aside the book retrospects the historical development and examines the challenging future directions of nuclear and particle physics Interwoven within the content are up to date examples of very recent developments and future plans that show in detail how the techniques and ideas of atomic nuclear and particle physics have been used and are being used to solve important problems in basic and applied areas of physics chemistry and biology that are closely linked to the prevailing major societal problems in medicine energy resources new custom made materials and environmental pollution as well as areas that encroach the broad cultural and historical interest The uncertain path of success and failure opportunities seized and missed and the axiom of probability and scientists intuition in the unfolding human drama of scientific discovery are vividly presented Throughout the highly perceptive book readers especially the students are encouraged to reflect on problems and ask questions **Problems in atomic and nuclear physics** Igor' Evgen'evič Irodov, 1983 *Atomic and Nuclear Physics*

Thomas Albert Littlefield, 2012-12-06 After the death of Dr Littlefield it was decided that I should undertake the revision of the whole of Atomic and Nuclear Physics an Introduction for the third edition and it was soon apparent that major changes were necessary I am confident that these changes would have had Dr Littlefield's approval The prime consideration for the present edition has been to modernize at a minimum cost As much as possible of the second edition has therefore been retained but where changes have been made they have been fairly drastic Thus the chapters on fine structure wave mechanics the vector model of the atom Pauli's principle and the Zeeman effect have been completely restructured The chapters on nuclear models cosmic rays fusion systems and fundamental particles have been brought up to date while a new chapter on charm and the latest ideas on quarks has been included It is hoped that the presentation of the last named will give readers a

feeling that physics research can be full of adventure and surprises Modern Atomic and Nuclear Physics Fujia Yang, Joseph H. Hamilton, 2010 The textbook itself is the culmination of the authors many years of teaching and research in atomic physics nuclear and particle physics and modern physics It is also a crystallization of their intense passion and strong interest in the history of physics and the philosophy of science Together with the solution manual which presents solutions to many end of chapter problems in the textbook they are a valuable resource to the instructors and students working in the modern atomic field Publisher s website **Problems And Solutions On Atomic, Nuclear And Particle Physics** Yung-kuo Lim, 2000-03-04 This book part of the seven volume series Major American Universities PhD Qualifying Questions and Solutions contains detailed solutions to 483 questions problems on atomic molecular nuclear and particle physics as well as experimental methodology The problems are of a standard appropriate to advanced undergraduate and graduate syllabi and blend together two objectives understanding of physical principles and practical application The volume is an invaluable supplement to textbooks Problems in Atomic and Nuclear Physics I. E. Irodov, 1983 **Molecular Physics, Thermodynamics, Atomic and Nuclear Physics** V. L. Ginzburg, L. M. Levin, M. S. Rabinovich, 2013-10-22 Problems in Undergraduate Physics Volume IV Molecular Physics Thermodynamics Atomic and Nuclear Physics presents a set of problems in physics as well as answers and solutions in the second part This book covers several subjects including thermometry atoms kinetic theory of matter surface tension thermodynamics and thermal conductivity Organized into two parts encompassing two chapters this volume begins with several problems involving molecular physics particularly calorimetry thermal expansion and thermometry This text proceeds with a set of problems concerning atomic and nuclear physics including the quantum nature of light the wave properties of particles X rays and structure of the atom and spectra Tables at the end of this book provide information on the range energy relationships for particles in emulsions as well as well as on the uranium radium radioactive series This book is intended to be suitable for students in physics Teachers and research workers will also find this book extremely useful **Atomic and Nuclear Physics** N. Subrahmanyam | Brij Lal | Jivan Seshan, 2007-12 The present edition of the book is revised as per the UGC syllabus Questions and problems at the end of each chapter have been up dated Many new solved examples are included in this edition Certain topic have been added so that students from some universities where the syllabus has been modified and upgraded may benefit Besides being a text book we hope that this benefit students appearing at the IAS AMIE and other Competitive Examinations *Some Problems in the Theory of Atomic and Nuclear Physics* C. A. Caine, 1957 **Problems And Solutions On Atomic, Nuclear And Particle Physics (Second Edition)** Swee Cheng Lim, Choy Heng Lai, Leong-chuan Kwek, 2025-03-07 This volume is a comprehensive compilation of carefully selected questions at the PhD qualifying exam level including many actual questions from Columbia University University of Chicago MIT State University of New York at Buffalo Princeton University University of Wisconsin and the University of California at Berkeley over a twenty year period The topics covered in this book include

basic nuclear properties fission and fusion symmetries in particle physics grand unification theories and experimental methods of high energy particles among many others This latest edition has been updated with more problems and solutions while the original problems are modernized excluding outdated questions and emphasizing those that rely on calculations The problems range from fundamental to advanced in a wide range of topics easily enhancing the student's knowledge through workable exercises Simple to solve problems play a useful role as a first check of the student's level of knowledge whereas difficult problems will challenge the student's capacity on finding solutions Few-Body Problems in Physics '99 S. Oryu, M. Kamimura, S. Ishikawa, 2012-12-06 The first Asia Pacific Conference on Few Body Problems in Physics took place from August 23 to August 28 1999 at the Noda campus of the Science University of Tokyo in Noda city and Sawayaka Chiba Kenmin Plaza in Kashiwa city a suburb of Tokyo close to the Narita Tokyo International Air port with the Frontier Research Center for Computation Sciences FRCCS of the Science University of Tokyo as the host institute The High Energy Accelerator Research Organization KEK the Institute of Physical and Chemical Research RIKEN the Research Center for Nuclear Physics RCNP Osaka University the Physical Society of Japan and the Association of Asia Pacific Physical Societies AAPPS supported this conference The conference was initiated in the Asia Pacific area as a counterpart to the successful European Conference on Few Body Problems in Physics APFB99 in addition to the International Few Body Conference Series and the Few Body Gordon Conference series in North America The Physics of Few Body Problems covers as is well known systems with finite numbers of particles in contrast to many body systems with very large numbers of particles Therefore it covers such wide fields as mesoscopic atom molecular exotic atom nucleon hyperon and quark gluon physics plus their applications

Molecular physics, thermodynamics, atomic and nuclear physics Vitalii Lazarevich Ginzburg, 1965 **Problems and Solutions in Nuclear Physics** Mouaiyad M. S Alabed, 2012-06 The book uses to help students that study nuclear physics The book contains 242 tasks and solutions in different fields involving nuclear physics such as accelerators which accelerate the particles and calculate the relative mass and velocity of the particle nuclear reactors nuclear fission inside the reactor core radioactivity decay of the particle such as alpha and beta and gamma decay Many tasks that include the radiation doses The book uses many of concepts such as binding energy kinetic energy and radius of nuclei wavelength of the particle such as electron proton and neutron There are tasks about the density of nuclear material heat equilibrium and collision which occur between these particles and nuclei of the target produce by these collision two types of scattering they are elastic and inelastic scattering of the particle The angle of the scattering plays an important role in the calculation of kinetic energy and momentum The book also includes appendix with tables of physical constants related to these tasks This includes a table of radioactive isotopes Student can be used this book to help him to develop his acknowledge of the many topics related to nuclear energy in general and especially nuclear physics **Modern Atomic and Nuclear Physics** Clarence Sharp Cook, 1961 **Dynamical Collision Theory and Its Applications** Sadhan Adhikari, 2012-12-02 Dynamical

Collision Theory and Its Applications reviews some of the powerful methods that have evolved for calculating the predictions of dynamical collision theory. Topics range from scattering theory to potential scattering, three and four particle scattering, multiparticle scattering, many particle Lippmann-Schwinger equations and the connected kernel approach. This book is comprised of nine chapters, the first of which introduces the reader to the quantum theory of scattering. This topic is followed by a discussion on two particle potential scattering and various methods for calculating off-shell two-body amplitudes as well as approximating them by finite rank forms. The next chapters focus on the interpretation and applicability of the multichannel multiparticle Lippmann-Schwinger equations along with the known N -particle connected kernel integral equations and their physical predictions. Descriptions of contemporary field theoretical and relativistic approaches such as the Dirac phenomenology for intermediate energy nucleon-nucleus scattering are included. The singularity structure of multiparticle amplitudes and the associated dispersion relation techniques are also considered. This book concludes by describing the relationship between the conventional optical potentials, multiple scattering theories and the coupled reaction channel and resonating group methods and the few-body approaches. This text is primarily intended for chemists, physicists and graduate students interested in general scattering theory, intermediate and low energy hadron and nuclear physics, atomic and molecular physics, statistical mechanics and physical and quantum chemistry. There are a number of topics in this book that will be interesting to both mathematicians and particle physicists as well as advanced graduate students in courses that involve collision theory. *Quantum Mechanics, Selected Topics* Askold M. Perelomov, Yakov B. Zeldovich, 1998-12-31. It can serve as a good supplement to any quantum mechanics textbook, filling the gap between standard textbooks and higher level books on the one hand and journal articles on the other. This book provides a detailed treatment of the scattering theory, multidimensional quasi-classical approximation, non-stationary problems for oscillators and the theory of unstable particles. It will be useful for postgraduate students and researchers who wish to find new interesting information hidden in the depths of non-relativistic quantum mechanics. **Nuclear Science Abstracts**, 1973.

Unveiling the Energy of Verbal Art: An Mental Sojourn through **Problems In Atomic And Nuclear Physics**

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sysout dd01 dd

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