

# Problem Set on Heat & Thermodynamics

## Thermometry

1. The precision & reliability of 'Modern Platinum Resistance Thermometers' are due to the work of Callender & Griffiths who, from a wide range of experiments, found that the resistance of 'Pure Platinum' is very accurately given by  $R_t = R_0(1 + \alpha t + \beta t^2)$  where  $R_t$  &  $R_0$  are resistances at  $t^\circ\text{C}$  &  $0^\circ\text{C}$  respectively and  $\alpha$  &  $\beta$  are constants of finite dimensions depending upon the material being tested. Also we know that the platinum temperature is calculated from the formula

$$t_p = (R_t - R_0/R_{100} - R_0) \times 100$$

Show that, using the these two relations, a true temperature  $t$  can be measured by the formula:

$$t - t_p = \delta \left\{ \left( \frac{t}{100} \right)^2 - \left( \frac{t_p}{100} \right)^2 \right\}$$

where  $\delta$  is a constant depending upon the purity of the specimen.

2. A platinum resistance thermometer reads  $2.57 \Omega$  at  $0^\circ\text{C}$ ,  $3.53 \Omega$  at  $100^\circ\text{C}$  and  $2.89 \Omega$  in a bath. Calculate the temperature of the bath on Platinum scale & Celsius scale. Assume  $\delta = 1.5$ .
3. The resistances of a Platinum wire at  $0^\circ\text{C}$ ,  $100^\circ\text{C}$  and at Sulphur point ( $444.6^\circ\text{C}$ ) are found to be  $2.56 \Omega$ ,  $3.56 \Omega$  &  $6.78 \Omega$  respectively. The resistance of the wire at a temperature  $t^\circ\text{C}$  is given by  $R_t = R_0(1 + \alpha t + \beta t^2)$ . Calculate the ratio  $\alpha/\beta$ .
4. The platinum temperature corresponding to  $50^\circ\text{C}$  on the gas scale is  $50.25^\circ\text{C}$ . find the temperature on the platinum scale that corresponds to  $150^\circ\text{C}$  on the gas scale.
5. The resistances of a Platinum wire at  $0^\circ\text{C}$ ,  $100^\circ\text{C}$  and at Sulphur point ( $444.6^\circ\text{C}$ ) are found to be  $2.56 \Omega$ ,  $3.56 \Omega$  &  $6.78 \Omega$  respectively. Find the true temperature when the resistance of the thermometer is  $5.56 \Omega$ .
6. The resistance of a carbon resistor obeys the following relation:  

$$a + b \log R = \sqrt{\log R/t}$$
 where  $t$  is the temperature. The resistance is found to be exactly  $1 \text{ K}\Omega$  in a liquid helium cryostat. If  $a = -1.16$  &  $b = 0.675$ , what is the temperature of the cryostat?

## Kinetic Theory of Gases

7. Calculate the pressure exerted by a gas having  $2.5 \times 10^{19}$  molecules per c.c. at a temperature of  $27^\circ\text{C}$ .
8. Calculate the r.m.s. velocity of hydrogen at NTP. Given that 1 litre hydrogen weighs  $0.0897 \text{ g}$  at NTP.
9. At what temperature will the r.m.s. velocity of a gas is half of its value at  $0^\circ\text{C}$ ?
10. The mean kinetic energy of a molecule at  $27^\circ\text{C}$  is  $8 \times 10^{-14} \text{ erg}$ . Calculate the number of molecules per cc. of an ideal gas at  $27^\circ\text{C}$  and at a pressure of  $40 \text{ mm}$  of Hg.
11. Estimate the size of a He atom, assuming its mean free path at NTP to be  $28.5 \times 10^{-6} \text{ cm}$ . Given the density of He at NTP is  $0.0178 \text{ g/Litre}$  and the mass of He atom is  $6 \times 10^{-24} \text{ g}$ . (Hint:  $\lambda = 1/\sqrt{2}n\sigma$ )

# Problems In Heat And Thermodynamics

**L. Pincherle**



## **Problems In Heat And Thermodynamics:**

**Worked Problems in Heat, Thermodynamics and Kinetic Theory for Physics Students** L. Pincherle, 2013-10-22

Worked Problems in Heat Thermodynamics and Kinetic Theory for Physics Students is a complementary to textbooks in physics This book is a collection of exercise problems that have been part of tutorial classes in heat and thermodynamics at the University of London This collection of exercise problems with answers that are fully worked out deals with various topics This book poses problems covering the definition of temperature such as calculating the assigned value of the temperature of boiling water under specific conditions This text also gives example of problems dealing with the first law of thermodynamics and with the definition of thermal capacities Some practical questions such as problems dealing with thermal engines are presented This book then discusses problems using the energy equation as well as asking the student to derive a general equation of state of a material satisfying a specific condition This text challenges the student to use a T S diagram to calculate the efficiency of a reversible cycle under certain conditions Several other problems concern the Joule and Joule Kelvin effects low temperature physics and heat conduction This review material can be helpful for students of physics thermodynamics and related subjects It can also be used by teachers of physics

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**Thermodynamics Problem Solver** The Editors of REA, Ralph Pike, 2013-01-01 REA's Thermodynamics Problem Solver Each Problem Solver is an insightful and essential study and solution guide chock full of clear concise problem solving gems Answers to all of your questions can be found in one convenient source from one of the most trusted names in reference solution guides More useful more practical and more informative these study aids are the best review books and textbook companions available They're perfect for undergraduate and graduate studies This highly useful reference provides thorough coverage of pressure work and heat energy entropy first and second laws ideal gas processes vapor refrigeration cycles mixtures and solutions For students in engineering physics and chemistry

*Worked Problems in Heat, Thermodynamics and Kinetic Theory* L. Pincherle, 1966-10 **Problems in Thermodynamics and Statistical Physics** Peter T. Landsberg, 2014-06-10 Well respected widely used volume presents problems and full solutions related to a wide range of topics in thermodynamics statistical physics statistical mechanics Suitable for undergraduates and graduate students self study reference 1989 edition

**Thermodynamics and Heat Power** Kurt C. Rolle, 2005 This book presents

learners with the fundamental concepts of thermodynamics and their practical application to heat power heat transfer and heating and air conditioning It addresses real world problems in engineering and design rather than focusing on abstract mathematics Chapter topics include the thermodynamic system work heat and reversibility conservation of mass and the first law of thermodynamics equations of state and calorimetry availability and useful work the internal combustion engine and the Otto and Diesel cycles gas turbines jet propulsion and the Brayton cycle steam power generation and the Rankine cycle refrigeration and heat pumps and much more For use in engineering technology programs     Problems in Chemical Thermodynamics with Solutions Maka Aleksishvili, Shota Sidamonidze, 2002 The methods of chemical thermodynamics are effectively used in many fields of science and technology Mastering these methods and their use in practice requires profound comprehension of the theoretical questions and acquisition of certain calculating skills This book is useful to undergraduate and graduate students in chemistry as well as chemical thermal and refrigerating technology it will also benefit specialists in all other fields who are interested in using these powerful methods in their practical activities

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of solved examples a number of review questions at the end of each chapter and a fairly large number of unsolved exercises with hints New to This Edition Includes a set of 107 additional problems in Appendix A set in different examinations An Introduction to General Thermodynamics Henry Augustus Perkins,1912 **Thermodynamics with Chemical Engineering Applications** Elias I. Franses,2014-08-25 Master the principles of thermodynamics and understand their practical real world applications with this deep and intuitive undergraduate textbook Engineering Applications of Higher Mathematics: Problems on thermodynamics Vladimir Karapetoff,1916 *The Collected Works of J. Willard Gibbs ...: Thermodynamics* Josiah Willard Gibbs,1928 Problems on Statistical Mechanics D.A.R Dalvit,J Frastai,Ian Lawrie,1999-01-01 A thorough understanding of statistical mechanics depends strongly on the insights and manipulative skills that are acquired through the solving of problems Problems on Statistical Mechanics provides over 120 problems with model solutions illustrating both basic principles and applications that range from solid state physics to cosmology An introductory chapter provides a summary of the basic concepts and results that are needed to tackle the problems and also serves to establish the notation that is used throughout the book The problems themselves occupy five chapters progressing from the simpler aspects of thermodynamics and equilibrium statistical ensembles to the more challenging ideas associated with strongly interacting systems and nonequilibrium processes Comprehensive solutions to all of the problems are designed to illustrate efficient and elegant problem solving techniques Where appropriate the authors incorporate extended discussions of the points of principle that arise in the course of the solutions The appendix provides useful mathematical formulae **Thermodynamics Problem Solver** The Editors of REA,Ralph Pike,2013-01-01 REA s Thermodynamics Problem Solver Each Problem Solver is an insightful and essential study and solution guide chock full of clear concise problem solving gems Answers to all of your questions can be found in one convenient source from one of the most trusted names in reference solution guides More useful more practical and more informative these study aids are the best review books and textbook companions available They re perfect for undergraduate and graduate studies This highly useful reference provides thorough coverage of pressure work and heat energy entropy first and second laws ideal gas processes vapor refrigeration cycles mixtures and solutions For students in engineering physics and chemistry Thermodynamics Josiah Willard Gibbs,1906 **Modern Engineering Thermodynamics - Textbook with Tables Booklet** Robert T. Balmer,2011-01-03 Modern Engineering Thermodynamics Textbook with Tables Booklet offers a problem solving approach to basic and applied engineering thermodynamics with historical vignettes critical thinking boxes and case studies throughout to help relate abstract concepts to actual engineering applications It also contains applications to modern engineering issues This textbook is designed for use in a standard two semester engineering thermodynamics course sequence with the goal of helping students develop engineering problem solving skills through the use of structured problem solving techniques The first half of the text contains material suitable for a basic Thermodynamics course taken by engineers from all majors The second half of the text is suitable for an Applied

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## **Table of Contents Problems In Heat And Thermodynamics**

1. Understanding the eBook Problems In Heat And Thermodynamics
  - The Rise of Digital Reading Problems In Heat And Thermodynamics
  - Advantages of eBooks Over Traditional Books
2. Identifying Problems In Heat And Thermodynamics
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Problems In Heat And Thermodynamics
  - User-Friendly Interface
4. Exploring eBook Recommendations from Problems In Heat And Thermodynamics
  - Personalized Recommendations
  - Problems In Heat And Thermodynamics User Reviews and Ratings
  - Problems In Heat And Thermodynamics and Bestseller Lists
5. Accessing Problems In Heat And Thermodynamics Free and Paid eBooks
  - Problems In Heat And Thermodynamics Public Domain eBooks
  - Problems In Heat And Thermodynamics eBook Subscription Services
  - Problems In Heat And Thermodynamics Budget-Friendly Options
6. Navigating Problems In Heat And Thermodynamics eBook Formats
  - ePub, PDF, MOBI, and More
  - Problems In Heat And Thermodynamics Compatibility with Devices
  - Problems In Heat And Thermodynamics Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Problems In Heat And Thermodynamics
  - Highlighting and Note-Taking Problems In Heat And Thermodynamics
  - Interactive Elements Problems In Heat And Thermodynamics



8. Staying Engaged with Problems In Heat And Thermodynamics
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Problems In Heat And Thermodynamics
9. Balancing eBooks and Physical Books Problems In Heat And Thermodynamics
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Problems In Heat And Thermodynamics
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Problems In Heat And Thermodynamics
  - Setting Reading Goals Problems In Heat And Thermodynamics
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Problems In Heat And Thermodynamics
  - Fact-Checking eBook Content of Problems In Heat And Thermodynamics
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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