

## 3

## SCIENTIFIC MEASUREMENT

## Practice Problems

In your notebook, solve the following problems.

## SECTION 3.1 MEASUREMENTS AND THEIR UNCERTAINTY

Using different rulers, Bruce and Pete each measure the length of the same object three times.

1. Bruce's three measurements are 19 cm, 20 cm, and 22 cm. Calculate the average value of his measurements and express the answer with the correct number of significant figures.

$$\frac{19 \text{ cm} + 20 \text{ cm} + 22 \text{ cm}}{3} = 20 \text{ cm}$$

2. Pete's three measurements are 20.9 cm, 21.0 cm, and 21.0 cm. Calculate the average value of his measurements and express the answer with the correct number of significant figures.

$$\frac{20.9 \text{ cm} + 21.0 \text{ cm} + 21.0 \text{ cm}}{3} = 20.9 \text{ cm}$$

3. Multiply the answer to problem 1 by the answer to problem 2. Express the answer in scientific notation with the correct number of significant figures.

$$20 \text{ cm} \times 20.9 \text{ cm} = 418 \text{ cm}^2$$

4. Whose measurements are more precise?

Pete's

5. The actual length of the object is 20 cm. Whose measurements are more accurate?

Bruce's

6. What is the error of Pete's average measurement?

$$(21.0 - 20) \text{ cm} = 1 \text{ cm}$$

7. What is the percent error of Pete's average measurement?

$$100 \times \frac{|21.0 - 20| \text{ cm}}{20 \text{ cm}} = 5\%$$

# Section 3 1 Measurements And Their Uncertainty

## Practice Problems

**Yicheng Fang**



### **Section 3 1 Measurements And Their Uncertainty Practice Problems:**

*Surveying Measurements and Their Analysis* R. B. Buckner, 1983      *An Introduction to Error Analysis* John R. Taylor, 2022-08-30 John R Taylor's best selling text will be released in a new third edition that features Bayesian statistics and updated new chapter ending problems throughout Previously translated into nine languages this brilliant little text introduces the study of uncertainties to lower division science students using familiar examples This remarkable text by John R Taylor has been a non stop best selling international hit since it was first published forty years ago However the two plus decades since the second edition was released have seen two dramatic developments the huge rise in popularity of Bayesian statistics and the continued increase in the power and availability of computers and calculators In response to the former Taylor has added a full chapter dedicated to Bayesian thinking introducing conditional probabilities and Bayes theorem The several examples presented in the new third edition are intentionally very simple designed to give readers a clear understanding of what Bayesian statistics is all about as their first step on a journey to become practicing Bayesians In response to the second development Taylor has added a number of chapter ending problems that will encourage readers to learn how to solve problems using computers While many of these can be solved using programs such as Matlab or Mathematica almost all of them are stated to apply to commonly available spreadsheet programs like Microsoft Excel These programs provide a convenient way to record and process data and to calculate quantities like standard deviations correlation coefficients and normal distributions they also have the wonderful ability if students construct their own spreadsheets and avoid the temptation to use built in functions to teach the meaning of these concepts      **Optical Engineering**, 2006 Publishes papers reporting on research and development in optical science and engineering and the practical applications of known optical science engineering and technology      **Method Performance Studies for Speciation Analysis** Philippe Quevauviller, 2007-10-31 Speciation is one of the growing features of analytical chemistry of this decade It is now widely recognized that the determination of total trace element contents is no longer sufficient understanding pathways of trace elements depends on specific chemical forms such as oxidation states organometallic compounds etc However lack of quality control of speciation often hampers the comparability of data within and between laboratories Considering the high number of analyses performed by a wide range of EC laboratories the SM T programme formerly BCR of the European Commission has launched collaborative projects to improve the state of the art of speciation analysis in Europe Method Performance Studies for Speciation Analysis presents an overview of these recent studies As well as discussion of the techniques used their performance as applied to real case analyses and possible sources of error the preparation of Certified Reference Materials for the validation of methods used is also described With its broad coverage and in depth discussions which encompass the work of eminent European experts this unique book will be essential reading for laboratory staff in industry academia and government      *Autonomous Robot Vehicles* Ingemar J. Cox, Gordon T.

Wilfong,2012-12-06 Autonomous robot vehicles are vehicles capable of intelligent motion and action without requiring either a guide or teleoperator control The recent surge of interest in this subject will grow even grow further as their potential applications increase Autonomous vehicles are currently being studied for use as reconnaissance exploratory vehicles for planetary exploration undersea land and air environments remote repair and maintenance material handling systems for offices and factories and even intelligent wheelchairs for the disabled This reference is the first to deal directly with the unique and fundamental problems and recent progress associated with autonomous vehicles The editors have assembled and combined significant material from a multitude of sources and in effect now conveniently provide a coherent organization to a previously scattered and ill defined field     *Analytical Chemistry, International Adaptation* Gary D. Christian,Purnendu K. Dasgupta, Kevin A. Schug,2020 With the 7th Edition of Analytical Chemistry renowned chemists Purnendu Sandy Dasgupta and Kevin Schug both of the University of Texas Arlington join the author team The new edition focuses on more in depth coverage of the principles and techniques of quantitative analysis and instrumental analysis aka Analytical Chemistry The goal of the text is to provide a foundation of the analytical process tools and computational methods and resources and to illustrate with problems that bring realism to the practice and importance of analytical chemistry It is designed for undergraduate college students majoring in chemistry and in fields related to chemistry     *Basic Concepts of Chemistry* Leo J. Malone, Theodore O. Dolter,2012-04-13 Basic Concepts of Chemistry was originally written over thirty years ago to address the needs of general chemistry students with little or no background in chemistry Over time the text has evolved beyond purposes solely aimed at a preparatory chemistry course For some preparatory chemistry students a main sequence in general chemistry may follow but for others a semester of organic and biochemistry may follow Other students enroll to simply satisfy a basic science or chemistry requirement The text was written with a level and functionality designed to accommodate the needs of each of these varied groups of students Basic Concepts of Chemistry was designed with a flexibility that allows instructors to emphasize or omit certain clearly delineated sections The mission of the text has evolved in response to the increased diversity of students and the emphasis on outcomes assessment     **An Introduction to Error Analysis** John Robert Taylor,1982     Railroad Gazette ,1876     The Engineer ,1870     Railroad Age Gazette ,1909     *An Outline Course of Study for the Elementary Public Schools of North Carolina* North Carolina. Department of Public Instruction,1915     Selected Papers on Holographic Interferometry R. S. Sirohi,2001 Applications of holographic interferometry are so vast that they are limited only by the imagination of the researchers This collection represents a variety of HI applications from micro crack detection in ancient paintings to holographic testing of nuclear technology     **Annals of Clinical Biochemistry** ,1998     **Educational Bulletin ...** North Carolina. Department of Public Instruction,1902     *Gas Age* ,1914 Includes summaries of proceedings and addresses of annual meetings of various gas associations L C set includes an index to these proceedings 1884 1902 issued as a supplement to Progressive age Feb 15 1910     **Engineering; an**

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