

INSTRUCTOR'S SOLUTIONS MANUAL

SEARS & ZEMANSKY'S

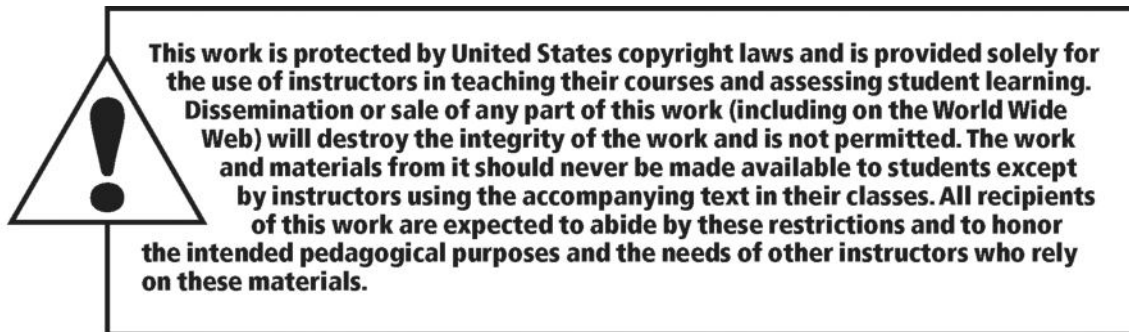
UNIVERSITY PHYSICS

14TH EDITION

**WAYNE ANDERSON
A. LEWIS FORD**

PEARSON

Editor in Chief, Physical Sciences: Jeanne Zalesky
Executive Editor: Nancy Whilton
Project Manager: Beth Collins
Program Manager: Katie Conley
Development Manager: Cathy Murphy
Program and Project Management Team Lead: Kristen Flathman
Production Management, Composition, Illustration, and Proofreading: Lumina Datamatics
Marketing Manager: Will Moore



Copyright ©2016, 2012, 2008 Pearson Education, Inc. All Rights Reserved. Printed in the United States of America. This publication is protected by copyright, and permission should be obtained from the publisher prior to any prohibited reproduction, storage in a retrieval system, or transmission in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise. For information regarding permissions, request forms and the appropriate contacts within the Pearson Education Global Rights & Permissions department, please visit www.pearsoned.com/permissions/.

PEARSON, ALWAYS LEARNING and MasteringPhysics are exclusive trademarks in the U.S. and/or other countries owned by Pearson Education, Inc. or its affiliates.

Unless otherwise indicated herein, any third-party trademarks that may appear in this work are the property of their respective owners and any references to third-party trademarks, logos or other trade dress are for demonstrative or descriptive purposes only. Such references are not intended to imply any sponsorship, endorsement, authorization, or promotion of Pearson's products by the owners of such marks, or any relationship between the owner and Pearson Education, Inc. or its affiliates, authors, licensees or distributors.

PEARSON

www.pearsonhighered.com

ISBN 10: 0-13-397598-3

ISBN 13: 978-0-13-397598-7

CONTENTS

	Preface	v
Part I	Mechanics		
	Chapter 1	Units, Physical Quantities, and Vectors	1-1
	Chapter 2	Motion Along a Straight Line.....	2-1
	Chapter 3	Motion in Two or Three Dimensions	3-1
	Chapter 4	Newton’s Laws of Motion.....	4-1
	Chapter 5	Applying Newton’s Laws.....	5-1
	Chapter 6	Work and Kinetic Energy	6-1
	Chapter 7	Potential Energy and Energy Conservation.....	7-1
	Chapter 8	Momentum, Impulse, and Collisions.....	8-1
	Chapter 9	Rotation of Rigid Bodies.....	9-1
	Chapter 10	Dynamics of Rotational Motion	10-1
	Chapter 11	Equilibrium and Elasticity	11-1
	Chapter 12	Fluid Mechanics	12-1
	Chapter 13	Gravitation.....	13-1
	Chapter 14	Periodic Motion.....	14-1
Part II	Waves/Acoustics		
	Chapter 15	Mechanical Waves.....	15-1
	Chapter 16	Sound and Hearing	16-1
Part III	Thermodynamics		
	Chapter 17	Temperature and Heat	17-1
	Chapter 18	Thermal Properties of Matter	18-1
	Chapter 19	The First Law of Thermodynamics	19-1
	Chapter 20	The Second Law of Thermodynamics.....	20-1

Part IV Electromagnetism

Chapter 21	Electric Charge and Electric Field.....	21-1
Chapter 22	Gauss's Law	22-1
Chapter 23	Electric Potential	23-1
Chapter 24	Capacitance and Dielectrics	24-1
Chapter 25	Current, Resistance, and Electromotive Force	25-1
Chapter 26	Direct-Current Circuits.....	26-1
Chapter 27	Magnetic Field and Magnetic Forces	27-1
Chapter 28	Sources of Magnetic Field.....	28-1
Chapter 29	Electromagnetic Induction	29-1
Chapter 30	Inductance	30-1
Chapter 31	Alternating Current.....	31-1
Chapter 32	Electromagnetic Waves.....	32-1

Part V Optics

Chapter 33	The Nature and Propagation of Light.....	33-1
Chapter 34	Geometric Optics.....	34-1
Chapter 35	Interference.....	35-1
Chapter 36	Diffraction	36-1

Part VI Modern Physics

Chapter 37	Relativity	37-1
Chapter 38	Photons: Light Waves Behaving as Particles	38-1
Chapter 39	Particles Behaving as Waves.....	39-1
Chapter 40	Quantum Mechanics I: Wave Functions	40-1
Chapter 41	Quantum Mechanics II: Atomic Structure	41-1
Chapter 42	Molecules and Condensed Matter	42-1
Chapter 43	Nuclear Physics	43-1
Chapter 44	Particle Physics and Cosmology	44-1

PREFACE

This Instructor's Solutions Manual contains the solutions to all the problems and exercises in *University Physics*, Fourteenth Edition, by Hugh Young and Roger Freedman.

In preparing this manual, we assumed that its primary users would be college professors; thus the solutions are condensed, and some steps are not shown. Some calculations were carried out to more significant figures than demanded by the input data in order to allow for differences in calculator rounding. In many cases answers were then rounded off. Therefore, you may obtain slightly different results, especially when powers or trig functions are involved.

This edition was constructed from the previous editions authored by Craig Watkins and Mark Hollabaugh, and much of what is here is due to them.

Wayne Anderson
Lewis Ford
Sacramento, CA

1

UNITS, PHYSICAL QUANTITIES, AND VECTORS

- 1.1. IDENTIFY:** Convert units from mi to km and from km to ft.

SET UP: 1 in. = 2.54 cm, 1 km = 1000 m, 12 in. = 1 ft, 1 mi = 5280 ft.

EXECUTE: (a) $1.00 \text{ mi} = (1.00 \text{ mi}) \left(\frac{5280 \text{ ft}}{1 \text{ mi}} \right) \left(\frac{12 \text{ in.}}{1 \text{ ft}} \right) \left(\frac{2.54 \text{ cm}}{1 \text{ in.}} \right) \left(\frac{1 \text{ m}}{10^2 \text{ cm}} \right) \left(\frac{1 \text{ km}}{10^3 \text{ m}} \right) = 1.61 \text{ km}$

(b) $1.00 \text{ km} = (1.00 \text{ km}) \left(\frac{10^3 \text{ m}}{1 \text{ km}} \right) \left(\frac{10^2 \text{ cm}}{1 \text{ m}} \right) \left(\frac{1 \text{ in.}}{2.54 \text{ cm}} \right) \left(\frac{1 \text{ ft}}{12 \text{ in.}} \right) = 3.28 \times 10^3 \text{ ft}$

EVALUATE: A mile is a greater distance than a kilometer. There are 5280 ft in a mile but only 3280 ft in a km.

- 1.2. IDENTIFY:** Convert volume units from L to in.³.

SET UP: 1 L = 1000 cm³. 1 in. = 2.54 cm

EXECUTE: $0.473 \text{ L} \times \left(\frac{1000 \text{ cm}^3}{1 \text{ L}} \right) \times \left(\frac{1 \text{ in.}}{2.54 \text{ cm}} \right)^3 = 28.9 \text{ in.}^3$

EVALUATE: 1 in.³ is greater than 1 cm³, so the volume in in.³ is a smaller number than the volume in cm³, which is 473 cm³.

- 1.3. IDENTIFY:** We know the speed of light in m/s. $t = d/v$. Convert 1.00 ft to m and t from s to ns.

SET UP: The speed of light is $v = 3.00 \times 10^8 \text{ m/s}$. 1 ft = 0.3048 m. 1 s = 10⁹ ns.

EXECUTE: $t = \frac{0.3048 \text{ m}}{3.00 \times 10^8 \text{ m/s}} = 1.02 \times 10^{-9} \text{ s} = 1.02 \text{ ns}$

EVALUATE: In 1.00 s light travels $3.00 \times 10^8 \text{ m} = 3.00 \times 10^5 \text{ km} = 1.86 \times 10^5 \text{ mi}$.

- 1.4. IDENTIFY:** Convert the units from g to kg and from cm³ to m³.

SET UP: 1 kg = 1000 g. 1 m = 100 cm.

EXECUTE: $19.3 \frac{\text{g}}{\text{cm}^3} \times \left(\frac{1 \text{ kg}}{1000 \text{ g}} \right) \times \left(\frac{100 \text{ cm}}{1 \text{ m}} \right)^3 = 1.93 \times 10^4 \frac{\text{kg}}{\text{m}^3}$

EVALUATE: The ratio that converts cm to m is cubed, because we need to convert cm³ to m³.

- 1.5. IDENTIFY:** Convert volume units from in.³ to L.

SET UP: 1 L = 1000 cm³. 1 in. = 2.54 cm.

EXECUTE: $(327 \text{ in.}^3) \times (2.54 \text{ cm/in.})^3 \times (1 \text{ L}/1000 \text{ cm}^3) = 5.36 \text{ L}$

EVALUATE: The volume is 5360 cm³. 1 cm³ is less than 1 in.³, so the volume in cm³ is a larger number than the volume in in.³.