

# **Complete Solutions Manual**

# **GENERAL CHEMISTRY**

## **NINTH EDITION**

Ebbing/Gammon

**David Bookin**

*Mt. San Jacinto College*

**Darrell D. Ebbing**

*Wayne State University, Emeritus*

**Steven D. Gammon**

*Western Washington University*

Find your solutions manual here!

# El Solucionario

[www.elsolucionario.net](http://www.elsolucionario.net)



Subscribe RSS



Find on Facebook



Follow my Tweets

*Encuentra en nuestra página los Textos Universitarios que necesitas!*

*Libros y Solucionarios en formato digital*

*El complemento ideal para estar preparados para los exámenes!*

*Los Solucionarios contienen TODOS los problemas del libro resueltos  
y explicados paso a paso de forma clara..*

*Visítanos para descargarlos GRATIS!*

*Descargas directas mucho más fáciles...*

## WWW.ELSOLUCIONARIO.NET

Biology

Investigación Operativa

Computer Science

Physics

Estadística

Chemistry

Matemáticas Avanzadas

Geometría

Termodinámica

Cálculo

Electrónica

Circuitos

Math

Business

Civil Engineering

Economía

Análisis Numérico

Mechanical Engineering

Electromagnetismo

Electrical Engineering

Álgebra

Ecuaciones Diferenciales

Find your solutions manual here!

*Vice President and Executive Publisher:* George Hoffman

*Vice President and Publisher:* Charles Hartford

*Senior Marketing Manager:* Laura McGinn

*Development Editor:* Kate Heinle

*Assistant Editor:* Amy Galvin

*Editorial Assistant:* Chip Cheek

*Marketing Assistant:* Kris Bishop

Copyright © 2009 by Houghton Mifflin Company. All rights reserved.

Houghton Mifflin Company hereby grants you permission to reproduce the Houghton Mifflin material contained in this work in classroom quantities, solely for use with the accompanying Houghton Mifflin textbook. All reproductions must include the Houghton Mifflin copyright notice, and no fee may be collected except to cover cost of duplication. If you wish to make any other use of this material, including reproducing or transmitting the material or portions thereof in any form or by any electronic or mechanical means including any information storage or retrieval system, you must obtain prior written permission from Houghton Mifflin Company, unless such use is expressly permitted by federal copyright law. If you wish to reproduce material acknowledging a rights holder other than Houghton Mifflin Company, you must obtain permission from the rights holder. Address inquiries to College Permissions, Houghton Mifflin Company, 222 Berkeley Street, Boston, MA 02116-3764.

ISBN 13: 978-0-618-95211-3

ISBN 10: 0-618-95211-X

# Contents

PREFACE.....	XI
CHAPTER 1 – CHEMISTRY AND MEASUREMENT .....	1
<i>Solutions To Exercises</i> .....	1
<i>Answers To Concept Checks</i> .....	3
<i>Answers To Self-Assessment And Review Questions</i> .....	4
<i>Answers To Concept Explorations</i> .....	7
<i>Answers To Conceptual Problems</i> .....	8
<i>Solutions To Practice Problems</i> .....	11
<i>Solutions To General Problems</i> .....	20
<i>Solutions To Strategy Problems</i> .....	29
<i>Solutions To Cumulative-Skills Problems</i> .....	30
CHAPTER 2 – ATOMS, MOLECULES, AND IONS .....	36
<i>Solutions To Exercises</i> .....	36
<i>Answers To Concept Checks</i> .....	38
<i>Answers To Self-Assessment And Review Questions</i> .....	39
<i>Answers To Concept Explorations</i> .....	42
<i>Answers To Conceptual Problems</i> .....	43
<i>Solutions To Practice Problems</i> .....	45
<i>Solutions To General Problems</i> .....	56
<i>Solutions To Strategy Problems</i> .....	63
<i>Solutions To Cumulative-Skills Problems</i> .....	64
CHAPTER 3 – CALCULATIONS WITH CHEMICAL FORMULAS AND EQUATIONS.....	66
<i>Solutions To Exercises</i> .....	66
<i>Answers To Concept Checks</i> .....	71
<i>Answers To Self-Assessment And Review Questions</i> .....	73
<i>Answers To Concept Explorations</i> .....	75
<i>Answers To Conceptual Problems</i> .....	77
<i>Solutions To Practice Problems</i> .....	79
<i>Solutions To General Problems</i> .....	103
<i>Solutions To Strategy Problems</i> .....	109
<i>Solutions To Cumulative-Skills Problems</i> .....	113

## iv      Contents

CHAPTER 4 – CHEMICAL REACTIONS .....	116
<i>Solutions To Exercises</i> .....	116
<i>Answers To Concept Checks</i> .....	120
<i>Answers To Self-Assessment And Review Questions</i> .....	122
<i>Answers To Concept Explorations</i> .....	124
<i>Answers To Conceptual Problems</i> .....	127
<i>Solutions To Practice Problems</i> .....	129
<i>Solutions To General Problems</i> .....	145
<i>Solutions To Strategy Problems</i> .....	155
<i>Solutions To Cumulative-Skills Problems</i> .....	157
CHAPTER 5 – THE GASEOUS STATE .....	164
<i>Solutions To Exercises</i> .....	164
<i>Answers To Concept Checks</i> .....	170
<i>Answers To Self-Assessment And Review Questions</i> .....	172
<i>Answers To Concept Explorations</i> .....	176
<i>Answers To Conceptual Problems</i> .....	177
<i>Solutions To Practice Problems</i> .....	179
<i>Solutions To General Problems</i> .....	192
<i>Solutions To Strategy Problems</i> .....	200
<i>Solutions To Cumulative-Skills Problems</i> .....	202
CHAPTER 6 – THERMOCHEMISTRY .....	207
<i>Solutions To Exercises</i> .....	207
<i>Answers To Concept Checks</i> .....	209
<i>Answers To Self-Assessment And Review Questions</i> .....	210
<i>Answers To Concept Explorations</i> .....	213
<i>Answers To Conceptual Problems</i> .....	214
<i>Solutions To Practice Problems</i> .....	216
<i>Solutions To General Problems</i> .....	225
<i>Solutions To Strategy Problems</i> .....	233
<i>Solutions To Cumulative-Skills Problems</i> .....	235
CHAPTER 7 – QUANTUM THEORY OF THE ATOM.....	242
<i>Solutions To Exercises</i> .....	242
<i>Answers To Concept Checks</i> .....	243
<i>Answers To Self-Assessment And Review Questions</i> .....	244
<i>Answers To Concept Explorations</i> .....	246

<i>Answers To Conceptual Problems</i> .....	248
<i>Solutions To Practice Problems</i> .....	250
<i>Solutions To General Problems</i> .....	257
<i>Solutions To Strategy Problems</i> .....	262
<i>Solutions To Cumulative-Skills Problems</i> .....	264
<b>CHAPTER 8 – ELECTRON CONFIGURATIONS AND PERIODICITY</b> .....	268
<i>Solutions To Exercises</i> .....	268
<i>Answers To Concept Checks</i> .....	269
<i>Answers To Self-Assessment And Review Questions</i> .....	270
<i>Answers To Concept Explorations</i> .....	273
<i>Answers To Conceptual Problems</i> .....	274
<i>Solutions To Practice Problems</i> .....	276
<i>Solutions To General Problems</i> .....	279
<i>Solutions To Strategy Problems</i> .....	282
<i>Solutions To Cumulative-Skills Problems</i> .....	283
<b>CHAPTER 9 – IONIC AND COVALENT BONDING</b> .....	286
<i>Solutions To Exercises</i> .....	286
<i>Answers To Concept Checks</i> .....	289
<i>Answers To Self-Assessment And Review Questions</i> .....	291
<i>Answers To Concept Explorations</i> .....	294
<i>Answers To Conceptual Problems</i> .....	295
<i>Solutions To Practice Problems</i> .....	298
<i>Solutions To General Problems</i> .....	317
<i>Solutions To Strategy Problems</i> .....	328
<i>Solutions To Cumulative-Skills Problems</i> .....	330
<b>CHAPTER 10 – MOLECULAR GEOMETRY AND CHEMICAL BONDING THEORY</b> .....	336
<i>Solutions To Exercises</i> .....	336
<i>Answers To Concept Checks</i> .....	340
<i>Answers To Self-Assessment And Review Questions</i> .....	341
<i>Answers To Concept Explorations</i> .....	344
<i>Answers To Conceptual Problems</i> .....	345
<i>Solutions To Practice Problems</i> .....	348
<i>Solutions To General Problems</i> .....	361
<i>Solutions To Strategy Problems</i> .....	368
<i>Solutions To Cumulative-Skills Problems</i> .....	370

vi **Contents**

CHAPTER 11 – STATES OF MATTER; LIQUIDS AND SOLIDS .....	375
<i>Solutions To Exercises</i> .....	375
<i>Answers To Concept Checks</i> .....	377
<i>Answers To Self-Assessment And Review Questions</i> .....	379
<i>Answers To Concept Explorations</i> .....	381
<i>Answers To Conceptual Problems</i> .....	384
<i>Solutions To Practice Problems</i> .....	387
<i>Solutions To General Problems</i> .....	399
<i>Solutions To Strategy Problems</i> .....	407
<i>Solutions To Cumulative-Skills Problems</i> .....	410
CHAPTER 12 – SOLUTIONS .....	413
<i>Solutions To Exercises</i> .....	413
<i>Answers To Concept Checks</i> .....	417
<i>Answers To Self-Assessment And Review Questions</i> .....	418
<i>Answers To Concept Explorations</i> .....	421
<i>Answers To Conceptual Problems</i> .....	422
<i>Solutions To Practice Problems</i> .....	424
<i>Solutions To General Problems</i> .....	435
<i>Solutions To Strategy Problems</i> .....	445
<i>Solutions To Cumulative-Skills Problems</i> .....	448
CHAPTER 13 – RATES OF REACTION .....	453
<i>Solutions To Exercises</i> .....	453
<i>Answers To Concept Checks</i> .....	455
<i>Answers To Self-Assessment And Review Questions</i> .....	457
<i>Answers To Concept Explorations</i> .....	460
<i>Answers To Conceptual Problems</i> .....	461
<i>Solutions To Practice Problems</i> .....	464
<i>Solutions To General Problems</i> .....	478
<i>Solutions To Strategy Problems</i> .....	490
<i>Solutions To Cumulative-Skills Problems</i> .....	492
CHAPTER 14 – CHEMICAL EQUILIBRIUM .....	496
<i>Solutions To Exercises</i> .....	496
<i>Answers To Concept Checks</i> .....	500
<i>Answers To Self-Assessment And Review Questions</i> .....	501
<i>Answers To Concept Explorations</i> .....	504

<i>Answers To Conceptual Problems</i> .....	505
<i>Solutions To Practice Problems</i> .....	507
<i>Solutions To General Problems</i> .....	521
<i>Solutions To Strategy Problems</i> .....	536
<i>Solutions To Cumulative-Skills Problems</i> .....	541
CHAPTER 15 – ACIDS AND BASES .....	543
<i>Solutions To Exercises</i> .....	543
<i>Answers To Concept Checks</i> .....	545
<i>Answers To Self-Assessment And Review Questions</i> .....	545
<i>Answers To Concept Explorations</i> .....	548
<i>Answers To Conceptual Problems</i> .....	549
<i>Solutions To Practice Problems</i> .....	550
<i>Solutions To General Problems</i> .....	561
<i>Solutions To Strategy Problems</i> .....	568
<i>Solutions To Cumulative-Skills Problems</i> .....	571
CHAPTER 16 – ACID-BASE EQUILIBRIA .....	572
<i>Solutions To Exercises</i> .....	572
<i>Answers To Concept Checks</i> .....	582
<i>Answers To Self-Assessment And Review Questions</i> .....	583
<i>Answers To Concept Explorations</i> .....	587
<i>Answers To Conceptual Problems</i> .....	589
<i>Solutions To Practice Problems</i> .....	591
<i>Solutions To General Problems</i> .....	624
<i>Solutions To Strategy Problems</i> .....	648
<i>Solutions To Cumulative-Skills Problems</i> .....	655
CHAPTER 17 – SOLUBILITY AND COMPLEX-ION EQUILIBRIA .....	657
<i>Solutions To Exercises</i> .....	657
<i>Answers To Concept Checks</i> .....	661
<i>Answers To Self-Assessment And Review Questions</i> .....	662
<i>Answers To Concept Explorations</i> .....	664
<i>Answers To Conceptual Problems</i> .....	666
<i>Solutions To Practice Problems</i> .....	667
<i>Solutions To General Problems</i> .....	683
<i>Solutions To Strategy Problems</i> .....	698
<i>Solutions To Cumulative-Skills Problems</i> .....	702

**viii      Contents**

CHAPTER 18 – THERMODYNAMICS AND EQUILIBRIUM .....	706
<i>Solutions To Exercises</i> .....	706
<i>Answers To Concept Checks</i> .....	710
<i>Answers To Self-Assessment And Review Questions</i> .....	710
<i>Answers To Concept Explorations</i> .....	713
<i>Answers To Conceptual Problems</i> .....	714
<i>Solutions To Practice Problems</i> .....	716
<i>Solutions To General Problems</i> .....	728
<i>Solutions To Strategy Problems</i> .....	738
<i>Solutions To Cumulative-Skills Problems</i> .....	743
CHAPTER 19 – ELECTROCHEMISTRY .....	750
<i>Solutions To Exercises</i> .....	750
<i>Answers To Concept Checks</i> .....	756
<i>Answers To Self-Assessment And Review Questions</i> .....	757
<i>Answers To Concept Explorations</i> .....	760
<i>Answers To Conceptual Problems</i> .....	761
<i>Solutions To Practice Problems</i> .....	764
<i>Solutions To General Problems</i> .....	795
<i>Solutions To Strategy Problems</i> .....	808
<i>Solutions To Cumulative-Skills Problems</i> .....	811
CHAPTER 20 – NUCLEAR CHEMISTRY .....	816
<i>Solutions To Exercises</i> .....	816
<i>Answers To Concept Checks</i> .....	819
<i>Answers To Self-Assessment And Review Questions</i> .....	820
<i>Answers To Conceptual Problems</i> .....	822
<i>Solutions To Practice Problems</i> .....	824
<i>Solutions To General Problems</i> .....	836
<i>Solutions To Strategy Problems</i> .....	844
<i>Solutions To Cumulative-Skills Problems</i> .....	848
CHAPTER 21 – CHEMISTRY OF THE MAIN-GROUP ELEMENTS .....	852
<i>Answers To Concept Checks</i> .....	852
<i>Answers To Self-Assessment And Review Questions</i> .....	852
<i>Answers To Conceptual Problems</i> .....	860
<i>Solutions To Practice Problems</i> .....	861
<i>Solutions To General Problems</i> .....	880

<i>Solutions To Strategy Problems</i> .....	887
CHAPTER 22 – THE TRANSITION ELEMENTS AND COORDINATION COMPOUNDS .....	894
<i>Solutions To Exercises</i> .....	894
<i>Answers To Concept Checks</i> .....	896
<i>Answers To Self-Assessment And Review Questions</i> .....	896
<i>Answers To Conceptual Problems</i> .....	900
<i>Solutions To Practice Problems</i> .....	901
<i>Solutions To General Problems</i> .....	912
<i>Solutions To Strategy Problems</i> .....	915
CHAPTER 23 – ORGANIC CHEMISTRY .....	918
<i>Solutions To Exercises</i> .....	918
<i>Answers To Concept Checks</i> .....	922
<i>Answers To Self-Assessment And Review Questions</i> .....	922
<i>Answers To Conceptual Problems</i> .....	925
<i>Solutions To Practice Problems</i> .....	927
<i>Solutions To General Problems</i> .....	938
<i>Solutions To Strategy Problems</i> .....	943
CHAPTER 24 – POLYMER MATERIALS: SYNTHETIC AND BIOLOGICAL .....	946
<i>Solutions To Exercises</i> .....	946
<i>Answers To Concept Checks</i> .....	946
<i>Answers To Self-Assessment And Review Questions</i> .....	947
<i>Answers To Conceptual Problems</i> .....	949
<i>Solutions To Practice Problems</i> .....	951
<i>Solutions To General Problems</i> .....	956
<i>Solutions To Strategy Problems</i> .....	959
APPENDIX A – MATHEMATICAL SKILLS .....	967
<i>Solutions To Exercises</i> .....	967