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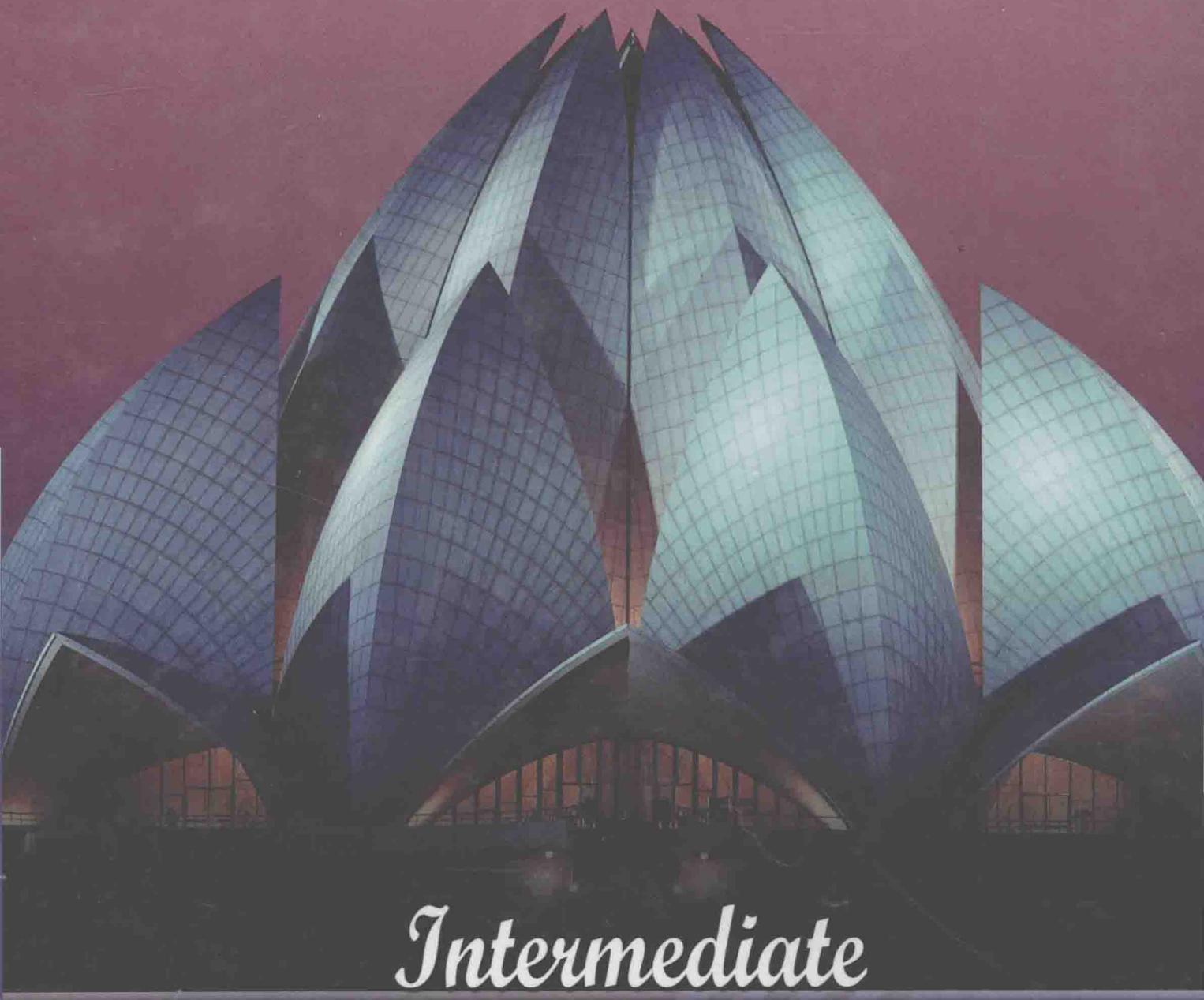

Intermediate Algebra

SECOND EDITION

Intermediate Algebra

Second Edition

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Preface

Welcome to the second edition of *Intermediate Algebra* by Carson, Gillespie, and Jordan! Revising this series has been both exciting and rewarding. It has given us the opportunity to respond to valuable instructor and student feedback and suggestions for improvement. It is with great pride that we share with you both the improvements and additions to this edition as well as the hallmark features and style of the Carson/Gillespie/Jordan series.

Intermediate Algebra, Second Edition, is the fifth book in a series that includes *Prealgebra*, Second Edition, *Elementary Algebra*, Second Edition, *Elementary Algebra with Early Systems of Equations*, and *Elementary and Intermediate Algebra*, Second Edition. This text is designed to be versatile enough for use in a standard lecture format, a self-paced lab, or even in an independent study format. Written in a relaxed, nonthreatening style, *Intermediate Algebra* takes great care to ensure that students who have struggled with math in the past will be comfortable with the subject matter. Explanations are carefully developed to provide a sense of why an algebraic process works the way it does, instead of just an explanation of how to follow the process. In addition, problems from science, engineering, accounting, health, the arts, and everyday life link algebra to the real world. A complete study system beginning with a Learning Styles Inventory and supported by frequent Learning Strategy boxes, is also provided to give students extra guidance and to help them be successful. (See page xxiii.)

Changes to the Second Edition

This revision includes refinements to the presentation of the material as well as the addition of many more examples and applications throughout the text. However, the primary focus of this revision is the exercise sets. The section-level exercise sets have been scrutinized and reworked to create a gradation that slowly progresses from easy to more difficult. There is also better pairing between odd and even exercises, and many more midlevel problems have been added.

In addition to the exercise sets, the Learning Strategy boxes and Algebra Pyramid references have been enhanced and increased in number to provide students with even more guidance.

We have added section number references to the review exercises at the end of each section as well as in the Chapter Review Exercises and Cumulative Review Exercises.

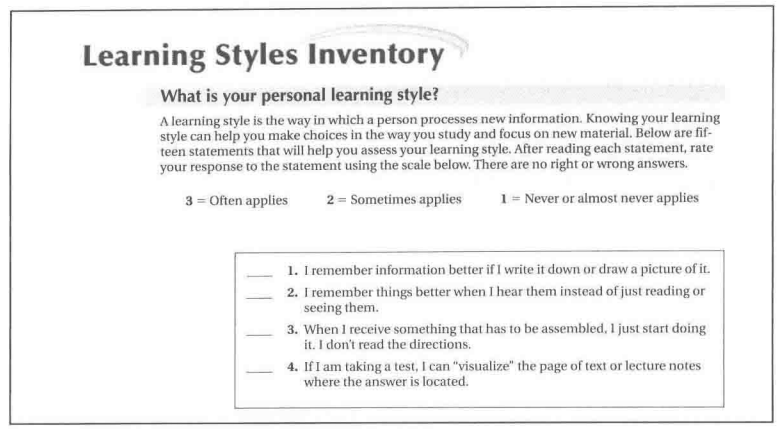
Small versions of the Algebra Pyramid have been added to the Chapter Review Exercises and the Cumulative Review Exercises to help students distinguish groups of expression exercises from groups of equation or inequality exercises.

Finally, the number of exercises included in MyMathLab and MathXL has been increased dramatically for an even stronger correlation between the book and the technology that supports it.

Key Features

Study System A study system is presented in the *To the Student* section on pages xvii–xxii. This system is then reinforced throughout the text. The system recommends color codes for taking notes. The color codes are consistent in the text itself: red for definitions, blue for procedures and rules, and black for notes and examples. In addition, the study system presents strategies for succeeding in the course. These learning strategies have been expanded and are revisited in the chapter openers and throughout the body of the text.

Learning Styles Inventory A Learning Styles Inventory is presented on page xxiii to help students assess their particular learning style. Learning Strategy boxes are then presented throughout the book with different learning styles in mind.



Learning Styles Inventory

What is your personal learning style?

A learning style is the way in which a person processes new information. Knowing your learning style can help you make choices in the way you study and focus on new material. Below are fifteen statements that will help you assess your learning style. After reading each statement, rate your response to the statement using the scale below. There are no right or wrong answers.

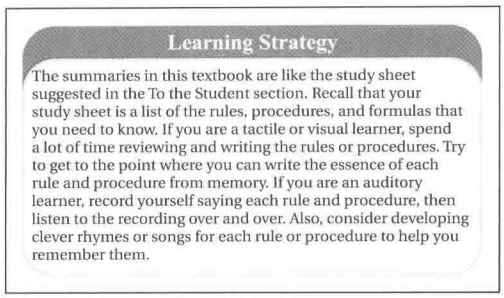
3 = Often applies **2** = Sometimes applies **1** = Never or almost never applies

____ **1.** I remember information better if I write it down or draw a picture of it.

____ **2.** I remember things better when I hear them instead of just reading or seeing them.

____ **3.** When I receive something that has to be assembled, I just start doing it. I don't read the directions.

____ **4.** If I am taking a test, I can "visualize" the page of text or lecture notes where the answer is located.

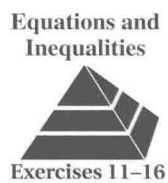


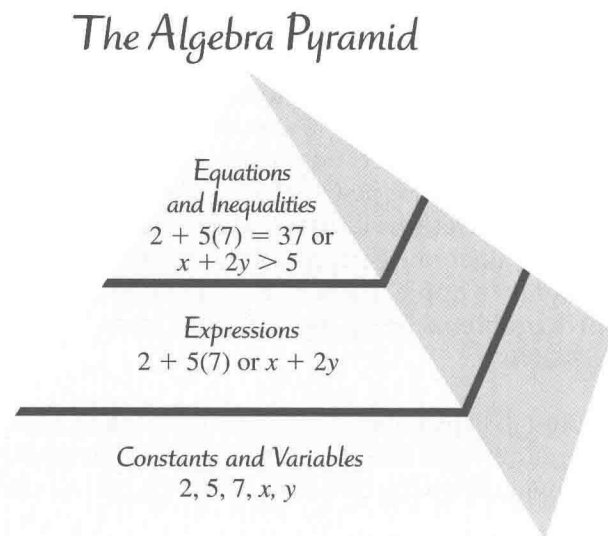
Learning Strategy

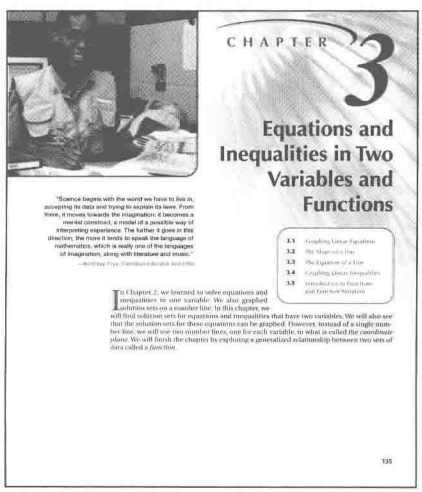
The summaries in this textbook are like the study sheet suggested in the To the Student section. Recall that your study sheet is a list of the rules, procedures, and formulas that you need to know. If you are a tactile or visual learner, spend a lot of time reviewing and writing the rules or procedures. Try to get to the point where you can write the essence of each rule and procedure from memory. If you are an auditory learner, record yourself saying each rule and procedure, then listen to the recording over and over. Also, consider developing clever rhymes or songs for each rule or procedure to help you remember them.

Learning Strategy Boxes Learning Strategy boxes appear where appropriate in the text to offer advice on how to effectively use the study system and how to study specific topics based on a student's individual learning style (see pages 2, 121, 154, and 394).

The Algebra Pyramid An Algebra Pyramid is used throughout the text to help students see how the topic they are learning relates to the big picture of algebra—particularly focusing on the relationship between constants, variables, expressions, and equations (see pages 56, 326, and 417). In Chapter Review Exercises and Cumulative Review Exercises, an Algebra Pyramid icon indicates the level of the pyramid that correlates to a particular group of exercises to help students determine what actions are appropriate with these exercises, for example, whether to "simplify" or "solve" (see pages 50, 378, and 527).







CHAPTER 3

Equations and Inequalities in Two Variables and Functions

"Science begins with the world we have to live in, accepting its data and trying to explain its laws. From there, it moves towards the imagination: it becomes a mental construct, a model of a possible way of interpreting experience. The farther it goes in this direction, the more it tends to speak the language of mathematics, which is really one of the languages of imagination, along with literature and music."

In Chapter 2, we learned to solve equations and inequalities in one variable. We also graphed solution sets on a number line. In this chapter, we will find solution sets for equations and inequalities that have two variables. We will also see that the solution sets for these equations can be graphed. However, instead of a single number line, we will use two number lines, one for each variable, in what is called the *coordinate plane*. We will finish the chapter by exploring a generalized relationship between two sets of data called a *function*.

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Chapter Openers Like the Algebra Pyramid, chapter openers are designed to help students see how the topics in the upcoming chapter relate to the big picture of the entire course. The chapter openers give information about the importance of the topics in each chapter and how they fit into the overall structure of the course (see pages 1, 55, and 135).

Connection Boxes Connection boxes bridge concepts and ideas that students have learned elsewhere in the text so they see how the concepts are interrelated and build on each other (see pages 151, 194, and 343).

PROCEDURE Finding the Value of a Function

Given a function $f(x)$, to find $f(a)$, where a is a real number in the domain of f, replace x in the function with a, then simplify.

EXAMPLE 3 a. For the function $f(x) = -5x + 3$, find $f(4)$.

Connection For the function in part a, we found the ordered pair $(4, -17)$. For part b, the ordered pair is $(n, 4n^2 - 3)$.

Solution $f(4) = -5(4) + 3$ Replace x with 4, then simplify.
$= -20 + 3$
$= -17$

b. For the function $f(x) = 4x^2 - 3$, find $f(n)$.

Solution $f(n) = 4(n)^2 - 3$ Replace x with n, then simplify.
$= 4n^2 - 3$ Square n.

YOUR TURN

a. For the function $f(x) = 0.5x - 2$, find $f(-6)$.

b. For the function $f(x) = x^2 - 4x - 3$, find $f(a)$.

ANSWERS

a. -5 b. $a^2 - 4a - 3$

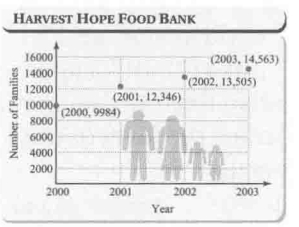
YOUR TURN Write the solution set in set-builder notation and interval notation, then graph the solution set.

a. $x < 3$ b. $h \geq -2$

Your Turn Practice Exercises Your Turn practice exercises are found after most examples to give students an opportunity to work problems similar to the examples they have just seen. This practice step makes the text more interactive and provides immediate feedback so students can build confidence in what they are learning (see pages 36, 83, and 190).

Real, Relevant, and Interesting Applications A large portion of application problems in examples and exercise sets are taken from real situations in science, engineering, health, finance, the arts, or just everyday life. The real-world applications illustrate the everyday use of basic algebraic concepts and encourage students to apply mathematical concepts to solve problems (see pages 199, 205, and 259–266).

15. The graph shows the number of families helped by Harvest Hope Food Bank in a group of 18 counties during each year.



Source: Harvest Hope Food Bank; U.S. Dept. of Labor Bureau of Labor Statistics

Thorough Explanations Great care is taken to explain not only how to do the math, but also why the math works the way it does, where it comes from, and how it is relevant to students' everyday lives. Knowing all of this gives students a context in which to remember the concept.

Problem-Solving Outline A five-step problem-solving outline is introduced on page 66 of Section 2.2 with the following headings:

1. Understand
2. Plan
3. Execute
4. Answer
5. Check

Application examples throughout the rest of the text follow the steps given in this outline, presenting the headings to model the thinking process clearly (see pages 74, 254, and 505).

PROCEDURE Problem-Solving Outline

1. **Understand** the problem.
   a. Read the question(s) (not the whole problem, just the question at the end) and note what it is you are to find.
   b. Now read the whole problem, underlining the key words.
   c. If possible and useful, make a list or table, simulate the situation, or search for a related example problem.
2. **Plan** your solution strategy by searching for a formula or translating the key words to an equation.
3. **Execute** the plan by solving the formula or equation.
4. **Answer** the question. Look at your note about what you were to find and make sure you answered that question. Include appropriate units.
5. **Check** the results.
   a. Try finding the solution in a different way, reversing the process, or estimating the answer and make sure the estimate and actual answer are reasonably close.
   b. Make sure the answer is reasonable.

Warning Boxes Warning boxes alert students to common mistakes and false assumptions that students often make and explain *why* these are incorrect (see pages 28, 62, and 227).

Warning: Notice that FOIL does not make sense with the trinomial in Example 3 because there are too many terms. FOIL handles only the four terms from two binomials.

Now consider an example of multiplication involving a larger polynomial, such as a trinomial. Remember that no matter how many terms are in the polynomials, we multiply every term in the second polynomial by every term in the first polynomial.

EXAMPLE 3 Multiply. $(2x + 3)(4x^2 + x - 5)$

Solution Multiply each term in $4x^2 + x - 5$ by each term in $2x + 3$.

$$\begin{aligned}(2x + 3)(4x^2 + x - 5) &= 2x \cdot 4x^2 + 2x \cdot x + 2x \cdot (-5) \\ &\quad + 3 \cdot 4x^2 + 3 \cdot x + 3 \cdot (-5) \\ &= 8x^3 + 2x^2 - 10x + 12x^2 + 3x - 15 \\ &= 8x^3 + 14x^2 - 7x - 15\end{aligned}$$

Multiply each term in $4x^2 + x - 5$ by each term in $2x + 3$.

Simplify.

Combine like terms.

YOUR TURN Multiply. $(5x - 1)(2x^2 - 9x + 4)$

Of Interest Boxes Of Interest boxes are positioned throughout the text to offer a unique perspective on content that some students might otherwise consider to be ho-hum mathematics. Sometimes containing trivia and other times historical notes, Of Interest boxes are designed to enhance the learning process by making concepts fun, interesting, and memorable (see pages 45, 136, and 513).

Of Interest

René Descartes was born in 1596 at La Haye, near Tours, France. While serving in the military, Descartes had a series of dreams in which he became aware of a new way of viewing geometry using algebra. In 1637, after some urging by his friends, he reluctantly allowed one work known as the *Method* to be printed. It was in this book that the rectangular coordinate system and analytical geometry was given to the world.

Puzzle Problems These mathematical brain-teasers, often solved without a formulaic approach, appear at the end of selected exercise sets to encourage critical thinking (see pages 107, 266, and 405).

PUZZLE PROBLEM

A cyclist is involved in a multiple-day race. She feels she needs to complete today's 40 kilometers part in somewhere between 1 hour and 45 minutes and 2 hours. Find the range of values her rate can be to complete this leg of the race in her desired time frame.

Collaborative Exercises These exercises, which appear once per chapter, encourage students to work in groups to discuss mathematics and use the topics from a particular section or group of sections to solve a problem (see pages 23, 43, and 163).

Collaborative Exercises OPTICAL ILLUSION OR CONFUSION?

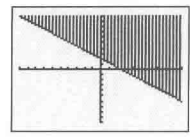
An optical shop at a local mall advertises the sale shown to the right. The total cost for a pair of glasses is the sum of the costs of the frame and lenses.

1. Let F represent the regular price of a frame and L the regular price for lenses. Write an expression that describes the total cost of a pair of glasses at regular price.
2. Does the expression $F + 0.60L$ give the cost of the glasses during the advertised 40% off sale? Explain why or why not.
3. The regular price for Anna's lenses is \$90. Anna chooses frames listed at \$120. How much did Anna save by buying her glasses during the sale?
4. Write and solve an inequality to determine the price of the most expensive frame Anna can choose during the sale if she wishes to keep the cost of her glasses to at most \$125.
5. The optical shop gives a discount of 25% on frames and lenses every day to seniors. Pat has chosen a \$140 frame. She wears bifocals, so her lenses are \$260. The shop will apply only one of the discounts, so which would be better for Pat, the 25% senior discount or the advertised 40% off sale?
6. The optical shop has a complete series of economy frames for \$60. Write and solve an inequality showing for which lens prices the 40% off sale would be more economical than the senior discount if an economy frame is used.
7. College students are eligible for a 15% discount on glasses that cost over \$100. Using F to represent the regular price of a frame and L for the regular price of lenses, write an expression that describes the total cost of a pair of glasses with the student discount.
8. If a student uses the economy \$80 frames, write and solve an inequality showing for which lens prices the 40% off sale would be better than the everyday student discount.

Calculator Tips The relevant functions of calculators (scientific or graphing, depending on the topic) are explained and illustrated throughout the text in the optional Calculator Tips feature. In addition, an occasional calculator icon in the exercise sets indicates that the problem is designed to be solved using a calculator, though one is not required (see pages 143, 183, and 319).

Calculator
TIPS

Shading can be added to a graph on a graphing calculator. Using the [Y=] *key, enter the related equation for the given inequality. For* $y \geq -\frac{4}{5}x + 2$, *for example, at* $Y1 =$, *enter* $-\frac{4}{5}x + 2$ *by typing* [(-)] [4] [÷] [5] [)] [X,T,θ,n] [+] [2]. *On that same line, use the arrow keys to move the cursor to the left of Y1. The slash you usually see there indicates the graph will be a solid line. Pressing* [ENTER] *will change this slash to other options for the graph. If the inequality is in the form* $y \geq mx + b$ *or* $y > mx + b$, *select* ◥. *If the inequality is* $y \leq mx + b$ *or* $y < mx + b$, *select* ◣. *For example, for* $y \geq -\frac{4}{5}x + 2$, *select* ◥, *then press* [GRAPH] *to see the screen to the right.*



REVIEW EXERCISES

For Exercises 1 and 2, graph the solution set.

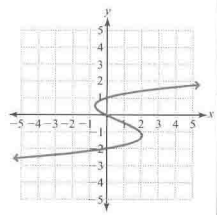
[2.6] **1.** $|2x - 5| \geq 1$

[4.6] **2.** $\begin{cases} x + y < 5 \\ 2x - y \geq 4 \end{cases}$

[5.1] **3.** Write 0.0004203 in scientific notation.

[5.4] **4.** Divide: $\dfrac{x^3 + x^2 - 10x + 11}{x + 4}$

[3.5] **5.** Is the relation graphed to the right a function?



[5.2] **6.** If $f(x) = 5x^3 + 6x - 19$ and $g(x) = 3x^2 - 6x - 8$, find $(f + g)(x)$.

Review Exercises Since continuous review is important in any mathematics course, this text includes Review Exercises at the end of each exercise set. These exercises review previously learned concepts not only to keep the material fresh for students, but also to serve as a foundational review for the discussion in the upcoming section (see pages 107, 432, and 499).

Chapter Summaries and Review Exercises An extensive Summary at the end of each chapter provides a list of defined terms referenced by section and page number, a two-column summary of key concepts, and a list of important formulas appearing in that chapter. A set of Review Exercises is also provided with answers to all Review Exercises provided in the back of the book (see pages 127–131, 212–216, and 297–306).

Chapter 3 Summary

Defined Terms

Section 3.1
Linear equation in two variables (p. 137)
x-intercept (p. 139)
y-intercept (p. 139)

Section 3.2
Slope (p. 152)

Section 3.4
Linear inequality in two variables (p. 179)

Section 3.5
Relation (p. 189)
Domain (p. 189)
Range (p. 189)
Function (p. 189)

Procedures, Rules, and Key Examples

Procedures/Rules	Key Examples
Linear Equations	
an equation in two variables, e variables with a chosen number	**Example 1:** Find two solutions for the equation $y = 3x - 1$.
n for the value of the other variable.	First solution: Let $x = 0$: $y = 3(0) - 1$, $y = -1$. Solution: $(0, -1)$. Second solution: Let $x = 1$: $y = 3(1) - 1$, $y = 3 - 1$, $y = 2$. Solution: $(1, 2)$.

Chapter 3 Review Exercises

For Exercises 1–6, answer true or false.

[3.1] **1.** When writing coordinates, the vertical coordinate is written first.

[3.1] **2.** There are an infinite number of solutions to every linear equation in two variables.

[3.2] **3.** The slope-intercept form of a linear equation is $y = mx + b$.

[3.1] **4.** Both coordinates in Quadrant I are positive.

[3.3] **5.** We can find the equation of a line given any two points on that line.

[3.1] **6.** We must have at least three points to correctly graph a straight line.

For Exercises 7–10, complete the rule.

[3.2] **7.** The slope of a line connecting two points is found by the equation _____.

[3.5] **8.** A function must pass the _____ line test.

Chapter Practice Tests A Practice Test follows each set of chapter review exercises. The problem types in the practice tests correlate to the short-answer tests in the *Printed Test Bank*. This is especially comforting for students who have math anxiety or who experience test anxiety (see pages 54, 132, and 217).

Chapter 3 Practice Test

1. Determine the coordinates for each point in the graph to the right.

2. State the quadrant in which $\left(3.6, -50\frac{2}{3}\right)$ is located.

3. Determine whether $(-3, 5)$ is a solution for $y = -\frac{1}{4}x + 3$.

For Exercises 4 and 5, determine the slope and the coordinates of the y-intercept, then graph.

4. $y = -\frac{4}{3}x + 5$

5. $x - 2y = -8$

For Exercises 6 and 7, determine the slope of the line through the given points.

6. $(-1, -4), (-2, -4)$

7. $(-3, -9), (4, -1)$

8. Write the equation of a line in slope-intercept form with y-intercept $(0, 5)$ and slope $\frac{2}{7}$.

9. Write the equation of a line in slope-intercept form that passes through the points $(4, 2), (-5, -1)$.

10. Write the equation of a line through the points $(1, 4)$ and $(-3, -1)$ in the form $Ax + By = C$, where A, B, and C are integers and $A > 0$.

11. Are the graphs of $y = \frac{3}{4}x - 2$ and $y = \frac{4}{3}x + 2$ parallel, perpendicular, or neither?

For Exercises 12 and 13, graph the linear inequality.

12. $y \geq 3x - 1$

13. $2x - 3y < 6$

Cumulative Reviews Cumulative Review Exercises appear after Chapters 3, 6, 9, and 11. These exercises help students stay current with all the material they have learned and help prepare them for midterm and final exams (see pages 219 and 443).

Chapters 1–3 Cumulative Review Exercises

For Exercises 1–6, answer true or false.

[3.1] 1. The first coordinate of an ordered pair is the x-coordinate.

[2.3] 2. The inequality $x > 0$ can also be expressed as $[0, \infty)$ in interval notation.

[3.3] 3. Parallel lines have the same slope.

[1.3] 4. If the base is a negative number and the exponent is odd, then the product is negative.

[1.2] 5. $a(b + c) = ab + ac$

[3.1] 6. $y = 3x^2 + 2$ is a linear equation.

For Exercises 7–10, fill in the blank.

[2.1] 7. To clear decimal numbers in an equation, we multiply by an appropriate power of _____ as determined by the decimal number with the most decimal places.

[1.3] 8. The radical symbol $\sqrt{}$ denotes only the _____ square root.

[1.3] 9. List the order in which we perform operations of arithmetic.

[1.4] 10. Two expressions, like $5x$ and $7x$, that have the same variable raised to the same exponent are called _____ terms.

[1.1] 11. Write a set containing the vowels.

[2.4] 12. Find the intersection and union of the given sets.
$A = \{u, e, i, o, v\}$ $B = \{m, a, t, h\}$

[1.3] ***For Exercises 13–16, evaluate.***

13. $(-3)^2$

14. $\sqrt[3]{27}$

15. $\sqrt{-25}$

16. $\sqrt[4]{\frac{16}{81}}$

[1.3] ***For Exercises 17–18, simplify.***

17. $-|4 + 3| - 8(1 - 5)^2$

18. $5[2 - [2 - (3 - 1)]] + 5 \cdot 3$

[1.4] ***For Exercises 19 and 20, evaluate the expression using the given values.***

19. $\sqrt{x + y}$; $x = 9$, $y = 16$

20. $\frac{3x}{x - 5}$; $x = 5$

Supplements for *Intermediate Algebra,* Second Edition

Student Supplements

Student's Solutions Manual
- By Doreen Kelly, *Mesa Community College.*
- Contains complete solutions to the odd-numbered section exercises and solutions to all of the section-level Review Exercises, Chapter Review Exercises, Practice Tests, and Cumulative Review Exercises.
  ISBN: 0-321-37512-2

Digital Video Tutor
- Complete set of digitized videos on CD-ROM for student use at home or on campus.
- Ideal for distance learning or supplemental instruction.
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- Provides algorithmically generated practice exercises that correlate to the exercises in the textbook.
- Every exercise is accompanied by an example and a guided solution, and selected exercises may also include a video clip to help students visualize concepts.
- The software provides helpful feedback for incorrect answers and can generate printed summaries of students' progress.
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- Accessible via toll-free telephone, toll-free fax, e-mail, or the Internet.
- White Board technology allows tutors and students to actually see problems worked while they "talk" in real time over the Internet during tutoring sessions.
  www.aw-bc.com/tutorcenter

Instructor Supplements

Annotated Instructor's Edition
- Includes answers to all exercises, including Puzzle Problems and Collaborative Exercises, printed in bright blue near the corresponding problems.
- Useful teaching tips are printed in the margin.
- A ★ icon, found in the AIE only, indicates especially challenging exercises in the exercise sets.
  ISBN: 0-321-35836-8

Instructor's Solutions Manual
- By Doreen Kelly, *Mesa Community College.*
- Contains complete solutions to all even-numbered section exercises, Puzzle Problems, and Collaborative Exercises.
  ISBN: 0-321-37519-X

Instructor and Adjunct Support Manual
- Includes resources designed to help both new and adjunct faculty with course preparation and classroom management.
- Offers helpful teaching tips specific to the sections of the text.
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To the Student

Why do I have to take this course?

Often this is one of the first questions students ask when they find out they must take an algebra course, especially when they believe that they will never use the math again. You may think that you will not use algebra directly in daily life, and you may assume that you can get by knowing enough arithmetic to balance a checkbook. So, what is the real point of education? Why don't colleges just train students for the jobs they want? The purpose of education is not just job training but also exercise—mental exercise. An analogy that illustrates this quite well is the physical training of athletes.

During the off-season, athletes usually develop an exercise routine that may involve weight lifting, running, swimming, aerobics, or maybe even dance lessons. Athletes often seek out a professional trainer to push them further than they might push themselves. The trainer's job is not to teach an athlete better technique in his or her sport, but to develop the athlete's raw material—to work the body for more strength, stamina, balance, etc. Educators are like physical trainers, and going to college is like going to the gym. An educator's job is to push students mentally and work the "muscle" of the mind. A college program is designed to develop the raw material of the intellect so the student can be competitive in the job market. After the athlete completes the off-season exercise program, he or she returns to the coach and receives specific technique training. Similarly, when students complete their college education and begin a job, they receive specific training to do that job. If the trainer or teacher has done a good job with hardworking clients, the coaching or job training should be absorbed easily.

Taking this analogy a step further, a good physical trainer finds the athlete's weaknesses and designs exercises that the athlete has never performed before, and then pushes him or her accordingly. Teachers do the same thing—their assignments are difficult in order to work the mind effectively. If you feel "brain-strained" as you go through your courses, that's a good sign that you are making progress, and you should keep up the effort.

The following study system is designed to help you in your academic workouts. As teachers, we find that most students who struggle with mathematics have never really *studied* math. A student may think, "Paying attention in class is all I need to do." However, when you watch a teacher do math, keep in mind that you are watching a pro. Going back to the sports analogy, you can't expect to shoot a score of 68 in golf by watching Tiger Woods. You have to practice golf yourself in order to learn and improve. The study system outlined in the following pages will help you get organized and make efficient use of your time so that you can maximize the benefits of your course work.

What do I need to do to succeed?

We believe there are four prerequisites one must have or acquire in order to succeed in college:

1. **Positive Attitude**
2. **Commitment**
3. **Discipline**
4. **Time**

A **Positive Attitude** is most important because commitment and discipline flow naturally from it. Consider Thomas Edison, inventor of the lightbulb. He tried more than 2000 different combinations of materials for the filament before he found the successful combination. When asked by a reporter about all his failed attempts, Edison replied, "I didn't fail once, I invented the lightbulb. It was just a 2000-step process." Recognize that learning can be uncomfortable and difficult, and mistakes are part of the process. So, embrace the learning process with its discomforts and difficulties, and you'll see how easy it is to be committed and disciplined.

Commitment means giving everything you've got with no turning back. Consider Edison again. Imagine the doubts and frustrations he must have felt trying material after material for the filament of his lightbulb without success. Yet he forged ahead. In Edison's own words, "Our greatest weakness lies in giving up. The most certain way to succeed is always to try just one more time."

Discipline means doing things you should be doing even when you don't want to. According to author W. K. Hope, "Self-discipline is when your conscience tells you to do something and you don't talk back." Staying disciplined can be difficult given all the distractions in our society. The best way to develop discipline is to create a schedule and stick to it.

Make sure you have enough **Time** to study properly, and make sure that you manage that time wisely. Too often, students try to fit school into an already full schedule. Take a moment to complete the exercise that follows under "How do I do it all?" to make sure you haven't overcommitted yourself. Once you have a sense of how much time school requires, read on about the study system that will help you maximize the benefits of your study time.

How do I do it all?

Now that we know a little about what it takes to be successful, let's make sure that you have enough time for school. In general, humans have a maximum of 60 hours of productivity per week. Therefore, as a guide, let's set the maximum number of work hours, which means time spent at your job(s) and at school combined, at 60 hours per week. Use the following exercise to determine the time you commit to your job and to school.

Exercise: Calculate the time that you spend at your job and at school.

1. Calculate the total hours you work in one week.
2. Calculate the number of hours you are in class each week.
3. Estimate the number of hours you should expect to spend outside of class studying. *A general rule is to double the number of hours spent in class.*
4. Add your work hours, in-class hours, and estimated out-of-class hours to get your total time commitment.
5. Evaluate the results. *See below.*

Evaluating the Results

a. If your total is greater than 60 hours, you will probably find yourself feeling overwhelmed. This feeling may not occur at first, but doing that much for an extended period of time will eventually catch up with you, and something may suffer. It is in your best interest to cut back on work or school until you reduce your time commitment to under 60 hours per week.

b. If your total is under 60 hours, good. Be sure you consider other elements in your life, such as your family's needs, health problems, commuting, or anything that could make demands on your time. Make sure that you have enough time for everything you put in your life. If you do not have enough time for everything, consider what can be cut back. It is important to note that it is far better to pass fewer classes than to fail many.

How do I make the best use of my time? How should I study?

We've seen many students who had been making D's and F's in mathematics transform their grades to A's and B's by using the study system that follows.

The Study System

Your Notebook

1. Get a loose-leaf binder so that you can put papers in and take them out without ripping any pages.
2. Organize the notebook into four parts:
   a. Class notes
   b. Homework
   c. Study sheets (a single piece of paper for each chapter onto which you will transfer procedures from your notes)
   d. Practice tests

In Class

Involve your mind completely.

1. **Take good notes.** Use three different colors. Most students like using red, blue, and black (pencil).
   - Use the red pen to write *definitions*. Also, use this color to mark problems or items that the instructor indicates will be covered on a test.
   - Use the blue pen to write procedures and rules.
   - Use the pencil to write problems and explanations.

When taking notes, don't just write the solutions to the problems that the instructor works out, but write the explanations as well. To the side of the problem, make notes about each step so that you remember the significance of the steps. Pay attention to examples or issues the instructor emphasizes: they will usually appear on a test, so make an effort to include them in your notes. Include common errors that the instructor points out or any words of caution. If you find it is difficult to write and pay attention at the same time, ask your instructor if you can record the lectures with a tape recorder. If your instructor follows the text closely, when he or she points out definitions or procedures in the text, highlight them or write a page reference in your notes. You can then write these referenced items in their proper place in your notes after class.

2. **Answer the instructor's questions.** This does not mean you have to answer every question verbally, but you should think through every question and answer in your mind, write an answer in your notes, or answer out loud.
3. **Ask questions.** You may find it uncomfortable to ask questions in front of other people, but keep in mind that if you have a question, then it is very likely that someone else has the same question. If you still don't feel like asking in class, then be sure to ask as soon as class is over. The main thing is to get that question answered as soon as possible because in mathematics, one misconception can grow and cause confusion in the future.

After Class

Prepare for the next class meeting as if you were going to have a test on everything covered so far. To make the most of your time, set aside a specific time that is reserved for math. Since there are often many distractions at home, study math while on campus in a quiet place such as the library

or tutorial lab. Staying on campus also allows you to visit your instructor or tutorial services if you have a question that you cannot resolve. Here is a systematic approach to organizing your math study time outside of class:

1. As soon as possible, go over your notes. Clarify any sentences that weren't quite complete. Fill in any page-referenced material.
2. Read through the relevant section(s) in the text again, and make sure you understand all the examples.
3. Transfer each new procedure or rule to your study sheet for that chapter. You might also write down important terms and their definitions. Make headings for each objective in the section(s) you covered that day. Write the procedures and definitions in your own words.
4. Study the examples worked in class. Transfer each example (without the solution) to the practice test section of your notebook, leaving room to work it out later.
5. Use your study sheet to do the assigned practice problems. As soon as you finish each problem, check your answer in the back of the book or in the *Student's Solutions Manual.* If you did not get it correct, then immediately revisit the problem to determine your error (see the box on troubleshooting). If you are asked to do even-numbered problems, then work odd-numbered problems that mirror the even problems. This way you can check your answers for the odd-numbered problems and then work the even-numbered problems with confidence.
6. After completing the homework, prepare a quiz for yourself. Select one of each type of homework problem. Don't just pick the easy ones! Set the quiz aside for later.
7. After making the quiz, study your study sheet. To test your understanding, write the rules and procedures in your own words. Do not focus on memorizing the wording in the textbook.
8. Now it is time to begin preparing for the next class meeting. Read the next section(s) to be covered. Don't worry if you do not understand everything. The idea is to get some feeling for the topics to be discussed so that the class discussion will actually be the second time you encounter the material, not the first. While reading, you might mark points that you find difficult so that if the instructor does not clear them up, you can ask about them. Also, attempt to work through the examples. The idea is for you to do as much as possible on your own before class so that the in-class discussion merely ties together loose ends and solidifies the material.
9. After you have finished preparing for the next day, go back and take the quiz that you made. If you get all the answers correct, then you have mastered the material. If you have difficulty, return to your study sheet and repeat the exercise of writing explanations for each objective.

Troubleshooting: For the problems that you do not get correct, first look for simple arithmetic errors. If you find no arithmetic errors, then make sure you followed the procedure or rules correctly. If you followed the or rules correctly, then you have likely interpreted something incorrectly, either with the problem or the rules. Read the instructions again carefully and try to find similar examples in your notes or in the book. If you still can't find the mistake, go on to something else for a while. Often after taking a fresh look you will see the mistake right away. If all these tips fail to resolve the problem, then mark it as a question for the next class meeting.