

1-1**A Plan for Problem Solving** (pages 6–9)

You can use a four-step plan to solve problems.

Explore	Determine what information is given in the problem and what you need to find. Do you have all the information you need? Is there too much information?
Plan	Select a strategy for solving the problem. There may be several strategies that you could use. Estimate the answer.
Solve	Solve the problem by carrying out your plan. If your plan does not work, try another, and maybe even a third plan.
Examine	Examine the answer carefully. See if it fits the facts given in the problem. Compare it to your estimate. If your answer is not correct, make a new plan and start again.

EXAMPLE

Sergio bought a 30-minute long distance phone card for \$4.50. On his home telephone, long distance costs 10 cents per minute. Which is less expensive?

Explore	You need to find out whether a long distance call using the calling card or Sergio's home phone is less expensive.
Plan	You need to find the per-minute rate of the calling card and then compare to the per-minute rate on the home phone. Divide the price of the calling card by the number of minutes, and then compare to the home phone rate. You estimate that the home phone is less expensive.
Solve	$450 \div 30 = 15$ cents per minute. $10 < 15$
Examine	The calling card rate is 15 cents per minute, so the home phone rate is less expensive.

Try This Together

- The Washington family is going on a 775-mile vacation. Their car gets 31 miles per gallon of gas. If gas costs \$1 per gallon, how much will they spend on gas? *HINT: You need to find the number of gallons of gas the car will use.*

PRACTICE

Use the four-step plan to solve each problem.

- Hobbies** Tristen is making a quilt with his mother. The quilt has a total of 40 squares. Tristen wants to have an equal number of squares with 8 different colors. How many squares of each color will he have?
- Standardized Test Practice** The school is buying new risers for the choir to stand on during concerts. There are 120 people in the choir and each riser will hold 20 people. How many risers will they need to buy?

A 5**B** 6**C** 12**D** 10

Answers: 1. \$25 2. 5 3. B

1-2

Powers and Exponents (pages 10–13)

When you multiply two or more numbers, each number is called a **factor** of the product. When the same factor is repeated, you can use an exponent to simplify the notation. An **exponent** tells you how many times a number, called the **base**, is used as a factor. A **power** is a number that is expressed using exponents.

Examples of Powers	4^2	4×4	four to the second power, or four squared
	2^3	$2 \times 2 \times 2$	two to the third power, or two cubed
	5^4	$5 \times 5 \times 5 \times 5$	five to the fourth power

EXAMPLES

A Write $8 \cdot 8 \cdot 8$ in exponential form.
The base is 8. Since 8 is a factor three times, the exponent is 3.
 $8 \cdot 8 \cdot 8 = 8^3$

B Write 2^5 as a product, then evaluate.
The base is 2. The exponent 5 means that 2 is a factor five times.
 $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
 $= 32$

Try These Together

- Write $14 \cdot 14 \cdot 14 \cdot 14$ in exponential form.
HINT: How many factors are there?
- Evaluate 4^3 .
HINT: The exponent tells how many factors there are.

PRACTICE

Write each power as a product of the same factor.

- | | | | |
|----------|----------|----------|-----------|
| 3. 3^3 | 4. 6^2 | 5. a^4 | 6. b^3 |
| 7. 4^2 | 8. x^5 | 9. 7^3 | 10. 2^5 |

Write each product in exponential form.

- | | | | |
|---------------------------------|---|-------------------------|---------------------------------|
| 11. $5 \cdot 5 \cdot 5$ | 12. $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$ | 13. $6 \cdot 6$ | 14. $z \cdot z \cdot z \cdot z$ |
| 15. $8 \cdot 8 \cdot 8 \cdot 8$ | 16. $1 \cdot 1 \cdot 1 \cdot 1 \cdot 1$ | 17. $d \cdot d \cdot d$ | 18. $9 \cdot 9$ |

Evaluate each expression

- | | | | |
|-----------|------------|-----------|-----------|
| 19. 8^3 | 20. 12^2 | 21. 3^5 | 22. 6^4 |
| 23. 2^6 | 24. 10^4 | 25. 1^9 | 26. 7^3 |



27. **Standardized Test Practice** Which is equivalent to 5^3 ?
A $5 \cdot 5 \cdot 5$ **B** $5 + 5 + 5$ **C** $3 \cdot 5$ **D** $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$

Answers: 1. 14^4 2. 48 3. $3 \cdot 3 \cdot 3$ 4. $6 \cdot 6$ 5. $a \cdot a \cdot a \cdot a$ 6. $b \cdot b \cdot b$ 7. $4 \cdot 4$ 8. $x \cdot x \cdot x \cdot x \cdot x$ 9. $7 \cdot 7 \cdot 7$ 10. $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$ 11. 5^3 12. 2^6 13. 6^2 14. z^4 15. 1 16. 1^5 17. d^3 18. 9^2 19. 512 20. 144 21. 243 22. $1,296$ 23. 64 24. $10,000$ 25. 1 26. 343 27. A

1-3**Order of Operations** (pages 14–17)

When you evaluate an expression, the **order of operations** ensures that the expression always has only one value. The order of operations tells you which operation to use first.

Order of Operations

1. Do all operations within grouping symbols first.
2. Evaluate all powers before other operations.
3. Multiply and divide in order from left to right.
4. Add and subtract in order from left to right.

EXAMPLES

Evaluate each expression.

A $15 + 6^2 \div 3$

$$\begin{aligned} 15 + 6^2 \div 3 &= 15 + 36 \div 3 && \text{First evaluate } 6^2. \\ &= 15 + 12 && \text{Second, divide 36 by 3.} \\ &= 27 && \text{Finally, add 15 and 12.} \end{aligned}$$

B $(15 + 6) \div 3$

$$\begin{aligned} (15 + 6) \div 3 &= 21 \div 3 && \text{First add 15 and} \\ &= 7 && \text{6 within the parentheses.} \\ &&& \text{Second, divide 21 by 3.} \end{aligned}$$

Try These Together Evaluate each expression.

1. $7 \times 4 + 12$

HINT: Multiply first.

2. $(11 - 4) \times 3^2$

HINT: Do operations in parentheses first.

PRACTICE

Name the operation that should be done first in each expression.

3. $2 \times 8 + 5$

4. $9 - 2^3 \times 4$

5. $22 \div (2 + 9)$

6. $(4 - 2) \times 5$

Evaluate each expression

7. $4^2 \div 2 \times 3$

8. $(10 + 12) \div 11$

9. $(15 - 8) \times 3$

10. $6^2 \times (9 - 9)$

11. $12 - 4 \div 2$

12. $54 \div 6 + 2^4$

13. $24 \div (3 \times 4)$

14. $7^2 - (2 \times 3)$

Insert parentheses to make each sentence true.

15. $12 + 3 - 1 \times 2 = 16$

16. $1 + 8 + 4 \div 2 = 7$

17. $16 - 12 \times 3 + 2^3 = 20$

18. $7 + 3 \times 8 + 1 = 90$

19. **Shopping** Sonny bought 2 comic books that cost \$3 each, 5 comic books that cost \$2 each and 1 comic book that cost \$4. How much did he spend?



20. **Standardized Test Practice** Carlotta scored a 25 on her math test. Her friend scored twice as many points as she did. When Carlotta retook the test, she scored 4 points less than her friend did the first time. Which expression could you use to find Carlotta's score on her second test?

A $25 - 4 \div 2$

B $(4 \times 25) \div 2$

C $(25 \times 2) - 4$

D $25 - 4 \times 2$

Answers: 1. 40 2. 63 3. multiplication 4. evaluate the power 5. addition 6. subtraction 7. 24 8. 2 9. 21 10. 0 11. 10 12. 25 13. 2 14. 43 15. 12 + (3 - 1) × 2 = 16 16. 1 + (8 + 4) ÷ 2 = 7 17. (16 - 12) × 3 + 2³ = 20 18. (7 + 3) × (8 + 1) × 20 = 20

1-4**Variables and Expressions** (pages 18–21)

Variables, usually letters, are used to represent numbers in some expressions. The branch of mathematics that involves expressions with variables is called **algebra**. **Algebraic expressions** are combinations of variables, numbers, and at least one operation. If you replace variables with numbers, you can **evaluate**, or find the value of, an algebraic expression.

Showing Multiplication in Algebra	$2 \cdot n$	means	$2 \times n$
	$2n$	means	$2 \times n$
	np	means	$n \times p$

EXAMPLES

Evaluate each expression if $b = 12$.

A $43 - b$

$$\begin{aligned} 43 - b &= 43 - 12 && \text{Replace } b \text{ with } 12. \\ &= 31 && \text{Subtract } 12 \text{ from } 43. \end{aligned}$$

B $3b + 6$

$$\begin{aligned} 3b + 6 &= 3 \times 12 + 6 && \text{Replace } b \text{ with } 12. \\ &= 36 + 6 && \text{Multiply } 3 \text{ by } 12. \\ &= 42 && \text{Add } 36 \text{ and } 6. \end{aligned}$$

Try These Together

Evaluate each expression if $r = 8$ and $s = 5$.

1. $s + r - 2$

HINT: Replace the variables.

2. $9r + s$

HINT: Replace the variables, then multiply.

PRACTICE

Evaluate each expression if $x = 8$, $y = 4$, and $z = 2$.

3. $x - y$

4. $y + z$

5. $x \div y$

6. $x + y + z$

7. $y \div z$

8. xy

9. $yz - x$

10. $xz \div 2$

11. $2y - 3z$

12. $3x - 10$

13. $3yz$

14. $x + y - 2z$

15. Evaluate $20x + 3x$ if $x = 6$.

16. **Business** Gerod grows tomatoes on his family's farm and sells them at the market every Saturday. He earns \$2 for every pound of tomatoes. Write an algebraic expression to show how much money he earns for n pounds of tomatoes.

17. **Standardized Test Practice** Marco works at a car wash in the summer. He earns \$2 for each car he washes and \$3 for each car he vacuums. The amount of money he earns is represented by the expression $2w + 3v$. If he washes 10 cars and vacuums 20 cars, how much money will he earn?

A \$70

B \$80

C \$50

D \$90

Answers: 1. 11 2. 77 3. 4 4. 6 5. 2 6. 14 7. 2 8. 32 9. 0 10. 8 11. 2 12. 14 13. 24 14. 8 15. 138 16. $2n$ 17. B

1-5**Equations** (pages 24–27)

In mathematics, an **equation** is a sentence that contains an equals sign, =. You **solve** the equation when you replace the variable with a number that makes the equation true. Any number that makes the equation true is called a **solution**. When you write an equation that represents a real-world problem, you are **modeling** the problem.

EXAMPLES**A** Solve $y + 7 = 10$ mentally.

$$y + 7 = 10$$

$$3 + 7 \stackrel{?}{=} 10 \text{ You know that } 3 + 7 = 10.$$

$$10 = 10 \checkmark$$

*The solution is 3.***B** Solve $5a = 35$ mentally.

$$5a = 35$$

$$5(7) \stackrel{?}{=} 35 \text{ You know that } 5(7) = 35.$$

$$35 = 35 \checkmark$$

*The solution is 7.***Try These Together****Solve each equation.**

1. $s + 9 = 22$

HINT: What plus 9 equals 22?

2. $13n = 39$

*HINT: 13 times what equals 39?***PRACTICE****Name the number that is the solution of the given equation.**

3. $17 - x = 15$; 2, 3, 4

4. $12 + y = 17$; 3, 4, 5

5. $2 + z = 10$; 7, 8, 9

6. $m + 5 = 10$; 4, 5, 6

7. $15 \div n = 3$; 3, 4, 5

8. $2j = 6$; 1, 2, 3

Solve each equation.

9. $a + 5 = 11$

10. $10 - b = 2$

11. $4 + w = 25$

12. $p - 30 = 10$

13. $q = 3 + 6$

14. $r = 2(9)$

15. $4s = 8$

16. $9 - t = 2$

17. $24 \div f = 6$

18. $3g = 36$

19. $h + 23 = 33$

20. $j = 5 - 2$

21. **Food** If Deepak drinks 28 glasses of milk every week, what is the average number of glasses of milk he drinks each day? Use the equation $28 = 7m$, where m is the number of glasses of milk per day.



22. **Standardized Test Practice** Gabriel has 20 minutes to take a math quiz. The quiz has 10 problems on it. Which equation shows how to find how many minutes Gabriel can spend on each problem?

A $20 \times 10 = p$

B $p = 10 \div 20$

C $p = 20 + 10$

D $20 \div 10 = p$

Answers: 1. 13 2. 3 3. 2 4. 5 5. 8 6. 5 7. 5 8. 3 9. 6 10. 8 11. 21 12. 40 13. 9 14. 18 15. 2 16. 7 17. 4 18. 12 19. 10 20. 3 21. 4 22. D

1-6**Properties** (pages 30–33)

In algebra, **properties** are statements that are true for any number. They often provide a method for writing equivalent expressions. For example, the expressions $4(9 + 2)$ and $4(9) + 4(2)$ are **equivalent expressions** because they have the same value, 44. This shows how the **Distributive Property** combines addition and multiplication.

Commutative Property	$a + b = b + a$	$a \times b = b \times a$
Associative Property	$(a + b) + c = a + (b + c)$	$(a \times b) \times c = a \times (b \times c)$
Identity Property	$a + 0 = a$	$a \times 1 = a$
Distributive Property	$a(b + c) = a(b) + a(c)$	

EXAMPLES

A Evaluate $3(4 + 8)$.

$$\begin{aligned} 3(4 + 8) &= 3 \cdot 4 + 3 \cdot 8 && \text{Rewrite the expression using the Distributive Property.} \\ &= 12 + 24 && \text{Multiply} \\ &= 36 && \text{Add.} \end{aligned}$$

B Use the Associative Property to write an expression equivalent to $(5 + 6) + 2$.

$$\begin{aligned} (5 + 6) + 2 &= 5 + (6 + 2) && \text{Rewrite the expression using the Associative Property.} \\ 11 + 2 &= 5 + 8 && \text{Add.} \\ 13 &= 13 && \text{Add. The expressions are equivalent.} \end{aligned}$$

Try These Together

Name the property shown.

1. $\left(\frac{2}{5} + \frac{4}{5}\right) + \frac{3}{8} = \frac{2}{5} + \left(\frac{4}{5} + \frac{3}{8}\right)$

HINT: Notice that the grouping or associating is changed.

2. $\frac{5}{9} \times 1 = \frac{5}{9}$

HINT: Notice that a fraction is multiplied by 1.

PRACTICE

Name the property shown by each statement.

3. $1.45 \times 1 = 1.45$

4. $(1 \times 2) \times 7 = 1 \times (2 \times 7)$

5. $9(6 + 4) = 9 \cdot 6 + 9 \cdot 4$

6. $6 + 3 = 3 + 6$

7. Standardized Test Practice Name the property shown by this statement.

$$\frac{7}{11} \times \left(\frac{4}{9} + \frac{2}{3}\right) = \frac{7}{11} \times \frac{4}{9} + \frac{7}{11} \times \frac{2}{3}$$

A identity

B associative

C commutative

D distributive

Answers: 1. associative (+) 2. identity (×) 3. identity (×) 4. associative (×) 5. distributive 6. commutative (+) 7. D

1-7**Sequences** (pages 34–36)

A **sequence** of numbers is a list in a specific order. The numbers in a sequence are called **terms**. If you can always add the same number to the previous term to find the next term, the sequence is an **arithmetic sequence**. If you can always multiply the previous term by the same number to find the next term, the sequence is a **geometric sequence**.

Finding the Pattern in a Sequence	<ul style="list-style-type: none"> To test for an arithmetic sequence, try subtracting the first term from the second. Then test to see if this same number separates each term of the sequence. To test for a geometric sequence, try dividing the second term by the first. Then test to see if this same quotient multiplies each term to give the next term in the sequence.
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EXAMPLES

- A** What is the pattern in this sequence?
1, 2, 1, 3, 1, 4, 1, 5, ...
Is it *arithmetic*, *geometric*, or *neither*?
The pattern is that the first number, and every other number, is 1 and the numbers between are the counting numbers, starting with 2. This sequence is neither arithmetic nor geometric.
- B** What is the pattern in this sequence?
0, 3, 6, 9, 12, 15, ... What is the next number? Is this sequence *arithmetic*, *geometric*, or *neither*?
Each term is equal to the previous term plus 3. The next number is 18. This is an arithmetic sequence.

Try These Together

- Describe the pattern in 1, 3, 5, 7, ... and find the next three terms. Identify the sequence as *arithmetic*, *geometric*, or *neither*.
HINT: Can you add the same number to 1 to get 3 as you can add to 3 to get 5?
- Give four terms of a sequence with this rule: Begin with 1 and multiply each term by 5.
HINT: The first term is 1 and the second is 5.

PRACTICE

Describe the pattern in each sequence. Identify the sequence as arithmetic, geometric, or neither. Then find the next three terms.

3. 10, 20, 40, 80, 160, ... 4. 0, 1, 3, 6, 10, ... 5. 30, 33, 36, 39, 42, ...

Create a sequence using each rule and give four terms beginning with the given number. State whether the sequence is arithmetic, geometric, or neither.

6. Add 4 to each term; 8. 7. Add 2 to each term; 50.



- 8. Standardized Test Practice** What is the missing term in this sequence?
6, 12, 18, , 30, 36, 42, ...

A 24**B** 20**C** 23**D** 19

Answers: 1. Add 2; 9, 11, 13; arithmetic. 2. 1, 5, 25, 125. 3. Multiply by 2; geometric; 320, 640, 1,280. 4. Add one more to each term than was added to the previous term; neither; 15, 21, 28. 5. Add 3; arithmetic; 45, 48, 51. 6. 8, 12, 16, 20; arithmetic. 7. 50, 52, 54, 56; arithmetic. 8. A

1-8

The Metric System (pages 38–41)

The following table describes the basic units of measurement in the **metric system**.

Length	The metric unit of length is the meter (m) . A meter is about the distance from the floor to a doorknob.
Mass	The metric unit of mass is the kilogram (kg) . Mass is the amount of matter that an object contains. Your math textbook has a mass of about one kilogram.
Capacity	The liter (L) is the basic unit of capacity in the metric system. Capacity is the amount of dry or liquid material an object can hold. Soft drinks often come in 2-liter plastic containers.

The basic metric units can be changed into larger or smaller units by dividing or multiplying by powers of 10. For example, 1 kilometer is 1×10^3 m. The chart below shows the relationship between the metric units and the powers of 10.

	<p>To change from a larger unit to a smaller unit, you need to multiply. To change from a smaller unit to a larger unit, you need to divide.</p> <p>MULTIPLY</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>1,000</td> <td>100</td> <td>10</td> <td></td> </tr> <tr> <td>km</td> <td>↔</td> <td>m</td> <td>↔</td> <td>cm</td> </tr> <tr> <td></td> <td>1,000</td> <td>100</td> <td>10</td> <td></td> </tr> </table> <p style="text-align: right;">DIVIDE</p>		1,000	100	10		km	↔	m	↔	cm		1,000	100	10	
	1,000	100	10													
km	↔	m	↔	cm												
	1,000	100	10													

EXAMPLES

A $4.6 \text{ L} = ? \text{ mL}$

To change from liters to milliliters, multiply by 1,000 since $1 \text{ L} = 1,000 \text{ mL}$.
 $4.6 \times 1,000 = 4,600$
 $4.6 \text{ L} = 4,600 \text{ mL}$

B $122 \text{ cm} = ? \text{ m}$

To change from centimeters to meters, divide by 100 since $1 \text{ m} = 100 \text{ cm}$.
 $122 \div 100 = 1.22$
 $122 \text{ cm} = 1.22 \text{ m}$

PRACTICE

Complete.

1. $5 \text{ m} = ? \text{ cm}$

2. $96 \text{ cm} = ? \text{ mm}$

3. $150 \text{ mm} = ? \text{ cm}$

4. $2.5 \text{ kL} = ? \text{ L}$

5. $1,200 \text{ g} = ? \text{ kg}$

6. $1,565 \text{ mL} = ? \text{ L}$



7. Standardized Test Practice There are 8,000 milligrams of protein in one serving of peanut butter. How many grams of protein are there in 5 servings of peanut butter?

A 0.4 g

B 40 g

C 4 g

D 400 g

Answers: 1. 500 2. 960 3. 15 4. 2,500 5. 1.2 6. 1.565 7. B

1-9


Scientific Notation (pages 43–45)

You can write numbers such as 4.5 billion in **scientific notation** by using a power of ten.

Scientific Notation	<p>Numbers expressed in scientific notation are written as the product of a number that is at least one but less than ten and a power of ten. The power of ten is written with an exponent.</p> <p>To write a number in scientific notation, move the decimal point to the right of the first nonzero digit, and multiply this number by a power of ten. To find the power of ten, count the number of places you moved the decimal point. The decimal part of a number written in scientific notation is often rounded to the hundredths place.</p>
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EXAMPLES

A Write 45,692 in scientific notation.

4.5692

 4.5692×10^4
 4.57×10^4

Move the decimal point 4 places to get a number between 1 and 10.
You moved the decimal point 4 places so the power of ten is 4.
Round to the nearest hundredth.

B Write 4.5×10^9 in standard form.

$10^9 = 1,000,000,000$
 $4.5 \times 10^9 = 4.5 \times 1,000,000,000$
 $= 4,500,000,000$ or 4.5 billion
Notice the decimal point moved 9 places to the right.

Try These Together

1. Write 734 in scientific notation.
HINT: Move the decimal point to the right of the 7. Count the number of places you moved the decimal point.

2. Write 9.3×10^7 in standard form.
HINT: The power of 10 indicates the number of places the decimal moves.

PRACTICE

Write numbers already in standard form in scientific notation, and numbers already in scientific notation, write in standard form.

- | | | |
|----------------------|-----------------------|-----------------------|
| 3. 650 | 4. 5,000 | 5. 8.5×10^3 |
| 6. 1.5×10^6 | 7. 6.07×10^3 | 8. 640,000 |
| 9. 3,300 | 10. 28,000,000 | 11. 3.0×10^2 |

Replace each ● with <, >, or = to make a true sentence.

12. 6,000 ● 6×10^2 13. 1,200 ● 1.2×10^4 14. 30,500 ● 3.05×10^2

15. Money Matters The national debt of a country is the amount of money it has borrowed from its people or other countries. In 1919, the national debt of the United States was \$25.5 billion dollars. Write \$25.5 billion in scientific notation.



16. Standardized Test Practice Comets are clumps of dust and frozen gases floating in the solar system. Recently, pieces of a comet slammed into Jupiter's atmosphere at 210,000 km/h. Write 210,000 in scientific notation.

- A** 2.1×10^4 **B** 2.1×10^2 **C** 2.1×10^3 **D** 2.1×10^5

Answers: 1. 7.34×10^2 2. 93,000,000 3. 6.5×10^2 4. 5.0×10^3 5. 8,500 6. 1,500,000 7. 6,070 8. 6.4×10^5 9. 3.3×10^3 10. 28,000 11. 3.0×10^2 12. < 13. < 14. > 15. \$2.55 × 10 ¹⁰ 16. D

1

Chapter 1 Review

Treasure Hunt

For the Math Club party, Mitch plans a treasure hunt for the members. Each clue is a math problem. All of the clues together spell out the name of the treasure.

Find each clue.

- One step in the four-step problem-solving plan involves looking at your answer carefully and seeing if it fits the facts in the problem. What is the name of this step? For Clue 1, use the first letter of this word.
- Evaluate this expression using the order of operations.

$$20 \div 4 + 1(6 - 1) + 3(4)$$

For Clues 3–6, find the value of each expression.

- $6^2 + 2^2 - 5(4)$
- $2^4 - 3$
- $5(t - s) + r$ if $t = 7$, $s = 6$, and $r = 4$
- $3^3 - 4^2$
- Solve the equation $\frac{t}{5} = 3$ mentally.
- Find the next number in this pattern.
1 2 3 1 1 2 2 3 3 1 1 1 2 2 2

To discover what the treasure is, make each numbered clue from 2 to 26 into a letter by using the corresponding letter of the alphabet, so $2 = B$, $3 = C$, and so on, down to $26 = Z$. Remember that you found the letter for Clue number 1 in Exercise 1 above.

Write the letters in the blanks that correspond to the numbers of the clues to read the name of the treasure.

Clue:
 4 7 2 5 1 3 5 8 6 1 3

Answers are located on page 105.