

CHAPTER 1

Number Sense

Key Words

power
base
exponent
scientific notation
order of operations
distributive property
commutative property
associative property

Get Ready Words

standard form
expanded form
factors
prime number
composite number
multiple
arrays

Specific Curriculum Outcomes

Major Outcomes

- A1 model and use power, base, and exponent to represent repeated multiplication
- A2 rename numbers among exponential, standard, and expanded forms
- A3 rewrite large numbers from standard form to scientific notation and vice versa
- A4 solve and create problems involving common factors and greatest common factors (GCF)
- A5 solve and create problems involving common multiples and least common multiples (LCM)
- A6 develop and apply divisibility rules for 3, 4, 6, and 9
- B5 apply the order of operations for problems involving whole numbers

Contributing Outcomes

- D1 identify, use, and convert among the SI units to measure, estimate, and solve problems that relate to length, area, volume, mass, and capacity
- D2 apply concepts and skills related to time in problem situations

Chapter Problem

A chapter problem is introduced in the chapter opener. This chapter problem has students design a treasure map and mathematical clues to find the treasure. The chapter problem is revisited in section 1.2 question 17 and section 1.3 question 16. You may wish to have students complete the chapter problem revisits that occur throughout the chapter. These simpler versions provide scaffolding for the chapter problem and offer struggling students some support. The revisits will assist students in preparing their response for the Chapter Problem Wrap-Up on page 51.

Alternatively, you may wish to assign only the Chapter Problem Wrap-Up when students have completed Chapter 1. The Chapter Problem Wrap-Up is a summative assessment.

Planning Chart

Section Suggested Timing	Teacher's Resource Blackline Masters	Assessment Tools	Adaptations	Materials and Technology Tools
Chapter Opener • 15 min (optional)				
Get Ready • 60 min	• BLM 1GR Parent Letter • BLM 1GR Extra Practice			• base-10 materials • hundred charts
1.1 Understand Exponents • 120 min	• BLM 1.1 Extra Practice	Formative Assessment: • BLM 1.1 Assessment Question, #17	• BLM 1.1 DTM Winnings Table	• calculators
1.2 Scientific Notation • 90 min	• BLM 1.2 Extra Practice	Formative Assessment: • BLM 1.2 Assessment Question, #16	• BLM 1.2 DTM Heart Rate Activity	• watch or clock with a second hand, or stop- watch • calculators
1.3 Divisibility Rules • 180 min	• BLM 1.3 Extra Practice	Formative Assessment: Question #19		• yellow and blue coloured pencils • hundred charts
1.4 Factors and Multiples • 120 min	• BLM 1.4 Extra Practice	Formative Assessment: • BLM 1.4 Assessment Question, #21		• grid paper, square tiles, two different coloured counters, or linking cubes • calendars (optional)
1.5 Order of Operations • 150 min	• BLM 1.5 Extra Practice	Formative Assessment: • BLM 1.5 Assessment Question, #20		• calculators
Use Technology: Use Spreadsheets to Calculate • 60 min				• <i>Excel</i> ® spreadsheet software • computers
Chapter 1 Review • 90 min	• BLM 1R Extra Practice			
Chapter 1 Practice Test • 90 min		Summative Assessment: • BLM 1PT Chapter 1 Test		
Chapter Problem Wrap- Up • 60 min		• BLM 1CP Chapter Problem Wrap-Up Rubric		

Get Ready

WARM - UP

Materials

- base-10 materials
- hundred charts

Related Resources

- BLM 1GR Parent Letter
- BLM 1GR Extra Practice

Suggested Timing

60 min

Evaluate. Rearrange the numbers for easier calculation.

1. $5 \times 7 \times 4$ <140>
2. $6 \times 3 \times 5$ <90>
3. $5 \times 9 \times 8$ <360>
4. $4 \times 9 \times 25$ <900>

Evaluate. Which strategy did you use?

5. $12 \times 25 = 3 \times 4 \times 25 = \blacksquare$ <300>
6. 60×90 <5400>
7. 12.5×6 <75>

Divide.

8. $2800 \div 7$ <400>
9. $81\,000 \div 9$ <9000>

Evaluate. Use the halve/double strategy.

10. 12×35 <420>
11. 2.5×14 <35>

Evaluate. Try doubling the number then adding one more set.

12. $3 \times 35 = 2 \times 35 + 1 \times 35 = \blacksquare$ <105>
13. 3×55 <165>

Evaluate. Try the double/double strategy.

14. $45 \times 4 = 45 \times 2 \times 2 = \blacksquare$ <180>
15. 7.5×4 <30>

ASSESSMENT FOR LEARNING

Before starting Chapter 1, explain that the topic is number sense. The chapter involves the study of exponents, scientific notation, factors and multiples, including greatest common factors (GCF) and least common multiples (LCM), divisibility rules, and order of operations. Discuss with students when they have used factors, multiples, divisibility rules, and exponents with a base of 10 before, and what they know about these concepts. You may wish to brainstorm and develop a mind map for each topic or start the development of a graphic organizer to be used throughout the chapter.

After students have discussed these concepts, have them complete the assessment suggestions below in pairs or individually. This assessment is designed to provide you and your students with information about their readiness for the chapter. After strengths and weaknesses have been identified, students can work on appropriate sections of the Get Ready.

Method 1: Have students develop a journal entry to explain what they know about the topics and how they use number sense in their everyday language or in their everyday lives.

Method 2: Challenge students to show how much they know about each topic. Encourage them to use words, numbers, and diagrams to show what they know.

Reinforce the Concepts

Have those students who need more reinforcement of the prerequisite skills complete **BLM 1GR Extra Practice**.

TEACHING SUGGESTIONS

The Get Ready provides students with the skills they need to fully understand the topics developed in Chapter 1. You can have students complete all of the Get Ready before starting the chapter. Or, due to the varied nature of the concepts covered in Chapter 1, you may wish to have students complete each part of the Get Ready before they work on the related section.

When working through **Different Ways of Writing Numbers**, check that students understand that place value is based on groups of ten with each position representing 10 times as much as the position to its right and $\frac{1}{10}$ as much as the position to its left. All students should work with base-10 materials in this section.

When working through **Factors**, check that students understand that the factors of a number are never greater than the number, that 1 is a factor of every number, and that division can be used to find factors. Drawing rectangular arrays for **question 11** may be helpful to some students. For **part c**) of **question 11**, remind students that a square is a rectangle. Since the length and width are the same, the only array for 36 is a 6 by 6 and the factor 6 is only listed once.

When working through **Prime and Composite Numbers**, check that students understand that any prime number has exactly two factors. Have students make rectangular arrays out of square tiles or linking cubes for each number from 2 to 24. Any number for which only one array is possible is a prime number. Ensure students understand that 1 is neither prime nor composite as it has only one factor. Hundred charts can be found in the Resource Masters.

When working through **Properties of Operations**, check that students understand that these properties are used when we recall basic facts. Modelling multiplication problems with rectangular arrays helps students to see that order does not matter when multiplying. Draw an array on an overhead and rotate the array to demonstrate this. It is important to draw students' attention to the correct use of the equal sign when solving problems involving order of operations. For example, students might incorrectly solve the problem like this:

$$5 + 3 \times 6 - 7 = 3 \times 6 = 18 + 5 = 23 - 7 = 16$$

instead of like this:

$$\begin{aligned} 5 + \underline{3 \times 6} - 7 \\ = 5 + 18 - 7 \\ = 23 - 7 \\ = 16 \end{aligned}$$

Students must remember to keep all terms until they have operated on them. For example, they need to write the 5 in the second line above before they write the product of 3 and 6.

Common Errors

- Students may not record the units of area correctly.
- R_x** Remind students that areas are expressed in square units.

- Students make errors in the values of the digits in a number.
R_x Encourage students to use place-value charts. If necessary, use manipulatives such as base-10 blocks to review place value.
- Students write factors that are not prime.
R_x Remind students that prime factors are only divisible by themselves and by 1.
- Students may not record the units of volume correctly.
R_x Remind students that volumes are expressed in cubic units.
- Students may not recall that the factors of a natural number include the number itself and the number 1.
R_x Provide more examples of natural numbers and their factors.
- Students may put an equal sign in the wrong place when solving a problem involving order of operations.
R_x Remind students that each line of work must equal the line before and after it.

Literacy Connections

One of the common mistakes students tend to make with a text is to skim the page, possibly missing information needed to solve a problem. It would be useful to take students through the format of the text, pointing out the text features and the layout of the chapters, and stressing the importance of using the text to its greatest advantage.

Journal

Journal writing provides a tool for developing students' skills and attitudes. It is an opportunity for you to support, encourage, and challenge students in a non-threatening way. It is very important for the writing to have a purpose such as reflection or self-assessment, summarizing, defining, translating from one type of information to another, reporting, giving instruction, explaining findings, or creating word problems.

Many students do not know what is expected in a journal response, so it is important to teach the response format and expectations by modelling. Teaching journal writing should be done in stages for each different type of response. The first stage would be through whole-class discussion where you would ask students for individual responses or ideas and record them on the board or chart paper. Pose questions to bring out the ideas and expectations that show students' understanding of the concept. The second stage would be a group response where the students share. This is less threatening to students as they have the opportunity to exchange ideas with one another and come to a consensus on what is expected. The third stage would be the personal response. Once students feel comfortable writing the different types of responses then they can write independently. It is very important to provide feedback.

If you start with teacher-led journal writing and then go into group journal writing, students can still be assigned a short, individual response question to reflect on their learning.

Journal Prompts

These prompts could be used for individual response questions.

For a teacher led activity:

- The hardest thing I found about understanding [the topic] was _____ because I didn't understand ...

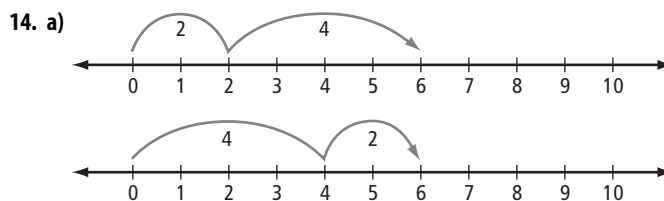
- I understand _____ about [the topic], but I still don't understand _____ because ...

For group journal writing:

- Our group could not agree on _____ because ...

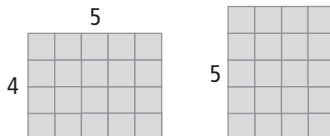
Get Ready Answers

1. 64 m^2 2. 4 cm^2 3. 27 cm^3 4. 64 m^3
5. **a)** $5 \times 100 + 8 \times 10 + 3 \times 1$ **b)** $5 \times 10\,000 + 0 \times 1000 + 6 \times 100 + 0 \times 10 + 1 \times 1$ **c)** $5 \times 100\,000 + 6 \times 10\,000 + 7 \times 1000 + 2 \times 100 + 3 \times 10 + 3 \times 1$ **d)** $4 \times 1\,000\,000 + 0 \times 100\,000 + 3 \times 10\,000 + 5 \times 1000 + 1 \times 100 + 2 \times 10 + 0 \times 1$
6. **a)** 7 flats, 2 rods, 1 unit cube **b)** 2 large cubes, 3 flats, 7 unit cubes
7. **a)** four hundred seventy-five **b)** two thousand thirty-six **c)** fifty-three thousand, four hundred ten **d)** two hundred ninety-one thousand, three hundred eighty-five **e)** four million, two hundred five thousand, one hundred ninety-six
8. Answers may vary. **a)** 12.3 thousand; 1.23 ten thousands **b)** 6.2 million, 62.0 hundred thousands
9. **a)** 45 020 **b)** 4910 **c)** 3457
10. Millions: 1000 large cubes or 10 000 flats; $(10 \times 10 \times 10) \times (10 \times 10 \times 10)$; 10^6 ; 1 000 000. Hundred Thousands: 100 large cubes or 1000 flats; $(10 \times 10) \times (10 \times 10 \times 10)$; 10^5 ; 100 000. Ten Thousands: 10 large cubes or 100 flats; $10 \times (10 \times 10 \times 10)$; 10^4 ; 10 000. Thousands: 10^3 . Tens: 10^1 . Ones: 10^0 .
11. **a)** 1, 2, 3, 4, 6, 12 **b)** 1, 2, 4, 5, 10, 20 **c)** 1, 2, 3, 4, 6, 9, 12, 18, 36 **d)** 1, 2, 5, 10, 25, 50
12. **a)** The last digit is not an even number. A number is divisible by 2 if the last digit is even. **b)** The last digit is not a 5 or 0. A number is divisible by 5 if the last digit is either 0 or 5. **c)** The last digit is not a 0. A number is divisible by 10 if the last digit is 0.
13. **a)** 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97 **b)** They are all prime numbers.



b) No. $7 - 4 = 3$ but $4 - 7 \neq 3$.

15. **a)**



b) No. $8 \div 4 = 2$ but $4 \div 8 = 0.5$.

16. **a)** 84; group 48 and 12 **b)** 73; group 23 and 37 or group 13 and 37
17. **a)** $(4 \times 15) \times 8$; 480 **b)** $(25 \times 4) \times 7$; 700
18. **a)** 105, 144 **b)** Answers may vary. It makes multiplication easier by splitting up large numbers into smaller ones that you can evaluate mentally.
19. **a)** 13 and 54 **b)** 18 and 37
20. **a)** Models may vary. **b)** 195

1.1 Understand Exponents

WARM - UP

Materials

- calculators

Related Resources

- BLM 1.1 DTM Winnings Table
- BLM 1.1 Assessment Question
- BLM 1.1 Extra Practice

Specific Curriculum

Outcomes

- A1** model and use a power, base, and exponent to represent repeated multiplication
- A2** rename numbers among exponential, standard, and expanded forms

Suggested Timing

120 min

Link to Get Ready

Students should have demonstrated understanding of Area of a Square, Volume of a Cube, and Different Ways of Writing Numbers in the Get Ready prior to beginning this section.

Evaluate.

- | | | | |
|----------------------|------|--------------------|-------|
| 1. 8^2 | <64> | 2. 1^4 | <1> |
| 3. 4^2 | <16> | 4. 0^5 | <0> |
| 5. 3^3 | <27> | 6. 5^3 | <125> |
| 7. 0^7 | <0> | 8. 1^7 | <1> |
| 9. $5^2 + 5^2$ | <50> | 10. $7^2 \times 5$ | <245> |
| 11. $3^2 \times 2^3$ | <72> | 12. $10^3 - 10^2$ | <900> |

Evaluate. Try working by parts.

13. 9^3 <729>
14. 21^2 <441>
15. 6^3 <216>

Working With Exponents

It is very important to remember that the exponent shows how many times the base is a factor in a power.

2^4 means $2 \times 2 \times 2 \times 2$ and equals 16.

3^2 means 3×3 and equals 9.

When working with some of the more difficult powers, try to work by parts.

$7^3 = 7 \times 7 \times 7$	$13^2 = 13 \times 13$
$= 49 \times 7$	$= 10 \times 13 + 3 \times 13$
$= 50 \times 7 - 1 \times 7$	$= 169$
$= 343$	

TEACHING SUGGESTIONS

In this section, students use exponents to express repeated multiplication in a compact form. Students have previously seen exponential notation when writing numbers in different ways.

Discover the Math

This activity addresses the notion that exponential notation is a short way to write repeated multiplication. Distribute copies of **BLM 1.1 DTM Winnings Table**. The activity may be done alone or with a partner, but it is recommended that students have their own recording table. You may wish to have students fill out the repeated multiplication column before filling in the exponential column. Have students refer to the table when answering **question 2**.

Discover the Math Answers

1. Week 1: 2^1 ; 2¢. Week 2: 2^2 ; 4¢. Week 3: 2^3 ; 8¢. Week 4: 2^4 ; 16¢. Week 5: 2^5 ; 32¢. Week 6: 2^6 ; 64¢. Week 7: 2^7 ; 128¢. Week 8: 2^8 ; 256¢. Week 9: 2^9 ; 512¢. Week 10: 2^{10} ; 1024¢. Week 11: 2^{11} ; 2048¢. Week 12: 2^{12} ; 4096¢. Week 13: 2^{13} ; 8192¢. Week 14: 2^{14} ; 16 384¢. Week 15: 2^{15} ; 32 768¢. Week 16: 2^{16} ; 65 536¢. Week 17: 2^{17} ; 131 072¢. Week 18: 2^{18} ; 262 144¢. Week 19: 2^{19} ; 524 288¢. Week 20: 2^{20} ; 1 048 576¢. Week 21: 2^{21} ; 2 097 152¢. Week 22: 2^{22} ; 4 194 304¢. Week 23: 2^{23} ; 8 388 608¢. Week 24: 2^{24} ; 16 777 216¢. Week 25: 2^{25} ; 33 554 432¢. Week 26: 2^{26} ; 67 108 864¢. Week 27: 2^{27} ; 134 217 728¢. Week 28: 2^{28} ; 268 435 456¢. Week 29: 2^{29} ; 536 870 912¢. Week 30: 2^{30} ; 1 073 741 824¢.
2. Answers may vary. In the second column, each row has one more factor of 2 than the previous row. In the third column, the exponent increases by one each time. In the last column, each number is double the number in the previous row.
3. Exponential form is a short way to express each value.
4. Week 20 5. Week 21 6. Predictions may vary.
7. The base tells what number is being multiplied and the exponent tells how many times the number is multiplied. Examples may vary.
8. Beginning: 10^6 . Pothole: 100 000; 10^5 . Shopping Cart: 10 000; 10^4 . Broken Branch: 1000; 10^3 . Snowman: 100; 10^2 . Spare Tire: 10; 10^1 . Red Pylon: 1; 10^0 .
9. Answers may vary.

Journal

Students could use this prompt for **question 9**.

Dear _____.

Yesterday we learned how to write numbers in different forms. There are two ways: standard form and exponential form. Here's how you can tell the difference ...

In **Example 1**, stress that just as multiplication is a short form for writing repeated addition, exponential form is a short form for writing repeated multiplication. For **Example 2**, remember that students often use the words *power* and *exponent* interchangeably. It is important that students learn to read powers properly. The entire expression 5^4 is called a power, where 4 is the exponent and 5 is the base. If students are asked to write 256 as a power of 2, they may answer 16^2 instead of 2^8 . **Example 3** could be treated as another Discover the Math activity depending on how many base-10 materials are available. You may wish to demonstrate this to the class, if there are not enough materials.

Communicate the Key Ideas

Use a *think-pair-share* activity to have students answer and discuss all of the Communicate the Key Ideas questions. Use this opportunity to assess student readiness for the Check Your Understanding questions.

Communicate the Key Ideas Answers

1. a) Sarah. The base is 6 and the exponent is 3. b) Jai. 6^3 means to multiply 6 three times not to multiply 6 times 3.
2. a) 5 b) 5 c) 5

Ongoing Assessment

- Can students do multiplication facts with a three second response?
- Can students identify the place value of a number?
- Can students state the standard form of a number that is in exponential notation?
- Can students calculate the area of a square and the volume of a cube?
- Can students write squares and cubes using exponential notation?

Check Your Understanding

Question Planning Chart

Level 1 Knowledge and Understanding	Level 2 Comprehension of Concepts and Procedures	Level 3 Application and Problem Solving
1–3, 11, 12a)	4–10, 12 b), e), 13, 16, 19	14, 15, 17, 18, 20, 21

For **question 9**, have students compare their answers with those of other students. For **questions 14** and **15**, encourage students to make a table. For **question 16**, some students may need to see more examples modelled by another student or by you before doing their own.

Common Errors

- Students often confuse squaring a number with multiplying it by 2 and cubing a number with multiplying it by 3.
- R_x Students should model each multiplication and power using square tiles or linking cubes, and then draw their answers on grid paper.

Intervention

- For some students, you may need to review how to identify and continue a pattern. Suggest that students subtract each term from the next term to look for a common difference. If there is no common difference, have them look for a common factor between consecutive terms.
- Some students may need to review multiplication facts using patterns and memory tricks to help them. For multiplication charts, see the Nova Scotia Department of Education's *Mathematics Blackline Masters Grades P to 9*, pages 139 to 143.
- For some students, you may need to reinforce that the exponent tells the number of times the base is multiplied by itself. **Questions 8** and **16** should help with this.
- For some students, you may need to do more review with expanded notation format before using powers of 10. You might start with questions like: $2346 = 2000 + 300 + 40 + 6$, then $2346 = 2 \times 1000 + 3 \times 100 + 4 \times 10 + 6 \times 1$, and finally $2346 = 2 \times 10^3 + 3 \times 10^2 + 4 \times 10^1 + 6 \times 10^0$. For place value charts, see *Mathematics Blackline Masters Grades P to 9*, pages 215 to 222.

- For some students, you may need to point out the connection between the 2 in cm^2 and when a number is squared, and the 3 in cm^3 and when a number is cubed. Explain this is why cm^2 is read as *square* centimetres and cm^3 is read as *cubic* centimetres.

ASSESSMENT



Question 17, page 21, Answers

- a) 1 day: $64, 4^3, 6 \times 10^1 + 4 \times 10^0$. 2 days: $124, 4^5, 1 \times 10^2 + 2 \times 10^1 + 4 \times 10^0$.
- b) 1 day: $1024, 4^5, 1 \times 10^3 + 0 \times 10^2 + 2 \times 10^1 + 4 \times 10^0$. 2 days: $262\ 144, 4^9, 2 \times 10^5 + 6 \times 10^4 + 2 \times 10^3 + 1 \times 10^2 + 4 \times 10^1 + 4 \times 10^0$.

ADAPTATIONS

BLM 1.1 DTM Winnings Table allows students to organize their response to the Discover the Math activity.

BLM 1.1 Assessment Question provides scaffolding for question 17.

BLM 1.1 Extra Practice provides additional reinforcement for those who need it.

Visual/Perceptual/Spatial/Motor

- Enlarge **BLM 1.1 DTM Winnings Table** for students who need more space for recording answers.
- Encourage students who are having difficulty to build models of square and cubic numbers.
- Provide a template of an organizational tool for questions, such as **question 15**, for those who need one.

Extension

Assign **questions 18 to 21**. You may wish to reduce the number of Check Your Understanding questions to provide students with extra time to work on the Extend questions. For **question 18**, suggest that students record their work in a chart to keep it organized. For **question 19**, check that students are familiar with magic squares. If they are not, give them one or two examples using whole numbers before assigning this question. Students may wish to complete the magic square using numbers in standard form, then convert the numbers to expressions using powers.

Literacy Connections

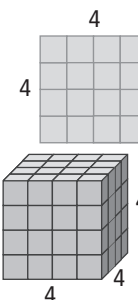
Question 11 gives example of words to use in a concept map for powers. Student are expected to include the words *power*, *base*, *exponent*, *squared*, *cubed*, and *repeated multiplication* as well as other words they might think of. Students should also provide examples to reinforce their understanding.

Concept or semantic mapping could also be used at the beginning of chapter. Each outcome for the section is clearly stated in student-friendly language. You could

create a cover page using concept mapping or make a chart with key words for each outcome as headings. Students could add information they already know and add to the chart as they go through each section. By the end of the unit, they will have a great study chart. Unit word walls also help students with vocabulary. Add new terms to the wall or bulletin board as they are introduced.

Check Your Understanding Answers

- a) 4 b) 7 c) 3 d) 5 2. C
- a) base 3, exponent 4 b) base 4, exponent 5 c) base 6, exponent 3
d) base 3, exponent 6
- a) 5^2 ; twenty-five b) 4^3 ; sixty-four
- a) 3^5 ; 243 b) 5^3 ; 125 c) 6^6 ; 1 679 616 d) 10^4 ; 10 000
- a) $3 \times 10^4 + 7 \times 10^2 + 5 \times 10^0 + 7 \times \frac{1}{10^2}$
b) $4 \times 10^2 + 3 \times 10^0 + 1 \times \frac{1}{10^3}$ c) $2 \times 10^6 + 5 \times 10^3 + 4 \times 10^1$
d) $3 \times 10^7 + 4 \times 10^4 + 9 \times 10^0 + 5 \times \frac{1}{10^2}$
- a) 2^5 b) 4^4 c) 11^3 d) 10^5
- No. $3^4 = 3 \times 3 \times 3 \times 3 = 81$ and $3 \times 4 = 3 + 3 + 3 + 3 = 12$.
- a) When a number is multiplied by itself, it is like calculating the area of a square with that side length.



b) When a number is multiplied by itself twice, it is like calculating the volume of a cube with that side length.

- a) 2^6 , 4^3 , 8^2 b) 2^{12} , 4^6 , 8^4
- Answers may vary.
- a) $2^4 = 2 \times 2 \times 2 \times 2 = 16$, $2^3 = 2 \times 2 \times 2 = 8$, $2^2 = 2 \times 2 = 4$, $2^1 = 2$
b) Each number is half the number in the previous step. c) 1
d) $3^4 = 3 \times 3 \times 3 \times 3 = 81$, $3^3 = 3 \times 3 \times 3 = 27$, $3^2 = 3 \times 3 = 9$, $3^1 = 3$
=Numbers are decreasing by a multiple of 3 in each step. 1. e) 1; 357 998
- a) i) multiply by 2 ii) The base increases by 1 each term and is always raised to the exponent 3. b) i) 32, 64, 128, 256, 512 ii) 125, 216, 343, 512, 729 c) i) $2^1, 2^2, 2^3, 2^4, \dots$
ii) $1^3, 2^3, 3^3, 4^3, \dots$ d) Answers may vary.
- 32 or 2^5 ; 1024 or 2^{10}
- 5 days. Assume that every person does tell 3 new people.
- Answers may vary.
- 69
- Answers may vary.

4^2	$2^2 - 1^2$	$1^2 + 1^2$	$3^2 + 2^2$
$2^2 + 1^2$	$3^2 + 1^2$	$3^2 + 2$	2^3
3^2	$2^2 + 2$	$2^3 - 1^2$	$4^2 - 2^2$
2^2	$4^2 - 1^2$	$5^2 - 11$	1^2

- a) 49 m² b) about 54 rolls
- 1

1.2 Scientific Notation

WARM - UP

Materials

- watch or clock with a second hand, or stopwatch
- calculators

Related Resources

- BLM 1.2 DTM Heart Rate Activity
- BLM 1.2 Assessment Question
- BLM 1.2 Extra Practice

Specific Curriculum Outcomes

- A3** rewrite large numbers from standard form to scientific notation and vice versa

Suggested Timing

90 min

Link to Get Ready

Students should have demonstrated understanding of Different Ways of Writing Numbers in the Get Ready prior to beginning this section.

Multiply.

1. 6.5×10 <65>
2. 0.81×100 <81>
3. 0.7×1000 <700>
4. 1.72×1000 <1720>

Divide.

5. $7000 \div 10$ <700>
6. $1600 \div 100$ <16>
7. $95\,000 \div 1000$ <95>
8. $2000 \div 10$ <200>

Write each number using exponential notation. The first one is partially completed for you.

9. $12 = 1 \times 10^1 + 2 \times \blacksquare$ <10⁰>
10. 204 < $2 \times 10^2 + 4 \times 10^0$ >
11. 326 < $3 \times 10^2 + 2 \times 10^1 + 6 \times 10^0$ >
12. 1345 < $1 \times 10^3 + 3 \times 10^2 + 4 \times 10^1 + 5 \times 10^0$ >

Evaluate.

13. $9^2 + 4^2$ <97>
14. $3^2 + 3^1 + 3^0$ <13>
15. $6^2 - 5^2$ <11>

TEACHING SUGGESTIONS

In this section, students are introduced to scientific notation. Discuss situations in which large numbers are used. Students should recognize that scientific notation is a more efficient way to express large numbers.

Discover the Math

Distribute copies of **BLM 1.2 DTM Heart Rate Activity** to students who need scaffolding for the activity. Time one minute so students can complete **question 1, part a)**. Some students may need assistance to calculate the number of beats per hour, day, and year for **part b)**. In **part c)**, remind students of Get Ready, page 11, where large numbers can be represented using a combination of rounding and decimal notation.

Before assigning **question 3**, give two large numbers to students to multiply and then discuss the importance of, and uses for, scientific notation. Mention how easy it can be to make an error when writing large numbers and that scientific notation makes it easier to deal with large numbers.

Discover the Math Answers

1. a), b), c) Answers may vary. d) 4.0×10^{11} e) one billion; million f) Answers may vary.
2. Answers may vary.
3. Answers may vary.

Journal

Students could use this prompt for **question 3**.

Dear _____,

Yesterday we learned about scientific notation. The difference between a number written in standard form and a number written in scientific notation is ... For example ... [Standard form/Scientific notation] is best to use for numbers that are ...

Example 1 has students write numbers in scientific notation. Encourage students to use the method demonstrated in the thought balloons rather than counting the number of places the decimal point has moved. Remind students that the first factor has exactly one non-zero digit to the left of the decimal point. **Example 2** has students convert a number from scientific notation to standard form. Review the thought bubbles to explain the method. **Example 3** has students write numbers in scientific notation. Make sure students understand why 35.6×10^2 is not written in scientific notation.

Communicate the Key Ideas

Have students work in groups to answer and discuss all of the Communicate the Key Ideas questions. Use this opportunity to assess student readiness for the Check Your Understanding questions. The exercise is meant to be completed orally but students may wish to take notes.

Communicate the Key Ideas Answers

1. Tanika. Samir used a number greater than 10 for the first number. James did not use the right power of 10.
2. Answers may vary.

Ongoing Assessment

- Can students multiply by 10, 100, 1000, and so on, mentally?
- Are students selecting a power of 10 so that the number before the decimal is a single digit?
- Can students round numbers appropriately?

Check Your Understanding

Question Planning Chart

Level 1 Knowledge and Understanding	Level 2 Comprehension of Concepts and Procedures	Level 3 Application and Problem Solving
1	2–12, 17	13–16, 18–20

Have newspapers and magazines available for **question 7**. Encourage students to use a calculator to check their results. Have students compare their calculator display with those of other students. Discuss any differences. Calculators are required for **question 12**.

Common Errors

- Students often write numbers in scientific notation without a power of 10:
 $264\ 000 = 2.64^5$
R_x Have students compute 2.64^5 on a calculator to see if it is correct. Discuss that in scientific notation every number is written as a decimal number greater than or equal to 1 but less than 10, multiplied by a power of 10.
- Students sometimes write numbers so there are no zeros and think it is in scientific notation: $264\ 000 = 264 \times 10^3$
R_x Remind students that the first number must be between 1 and 10.

Intervention

- For some students, you may need to review how to enter numbers in scientific notation on a calculator and how to interpret the results.
- For some students, you may need to review place value names and values.
- For some students, you may need to point out the word *dozen* after the word *thousand* in **question 15**.

ASSESSMENT



Question 16, page 26, Answers

- a) 6.0×10^{10}
b) Answers may vary.

ADAPTATIONS

BLM 1.2 DTM Heart Rate Activity allows students to organize their response to the Discover the Math activity.

BLM 1.2 Assessment Question provides scaffolding for question 16.

BLM 1.2 Extra Practice provides additional reinforcement for those who need it.

Visual/Perceptual/Spatial/Motor

- Some students may benefit from writing numbers in a place value chart before converting them to scientific notation.

Extension

Assign **questions 18 to 20**. You may wish to reduce the number of Check Your Understanding questions to provide students with extra time to work on the Extend questions. For **question 18**, ensure students know that a radio station is usually identified by the frequency at which it broadcasts.

Literacy Connections

Question 8 has the students write a paragraph for a science magazine using numbers expressed in scientific notation. Here is an opportunity for students to be creative, use their mathematical understanding, and also connect to their science topics, such as writing distances in the Earth Sciences or writing population growth in the Ecology unit.

Check Your Understanding Answers

1. a) B b) D
2. a) 3.75×10^8 b) 5.63×10^5 c) 3.03×10^7 d) 4.52×10^7
3. a) 579 000 b) 35 000 000 c) 207 000 000 d) 6 250 000
4. a) 1.35×10^7 b) 1.56×10^7 c) 3.19×10^7 d) 9.0×10^5 e) 5.0×10^6 ; 1.0×10^9
5. a) 1.0×10^{14} b) 1.24×10^{10} c) 9.1×10^9
6. a) 5.84×10^{17} ; 584 000 000 000 000 000 b) 2.64×10^{11} ; 264 000 000 000
7. Answers may vary. 8. Answers may vary. 9. 1.32×10^5
10. a) 3.2×10^6 b) 4.1×10^8 c) 5.6×10^{20}
11. They both equal 256, 000. 2.56×10^5 . The first factor is at least 1 and less than 10 and the second factor is written in a power of 10.
12. a) Mercury: 4847.28; 4847.28; 4.85×10^3 . Venus: 12 118.2; 12 118.2; 1.21×10^4 . Mars: 6760.68; 6760.68; 6.80×10^3 . Jupiter: 142 994.76; 142 994.76; 1.43×10^5 . Saturn: 120 671.76; 120 671.76; 1.21×10^5 . Uranus: 51 151.56; 51 151.56; 5.11×10^4 . Neptune: 49 493.28; 49 493.28; 5.00×10^4 . Pluto: 2296.08; 2296.08; 2.30×10^3 . Sun: 1 391 934.72; 1 391 934.72; 1.39×10^6 .
b) Pluto, Mercury, Mars, Venus, Earth, Neptune, Uranus, Saturn, Jupiter, Sun
13. 1.4×10^5 14. 1.248×10^7 15. 214 320 000; 2.1432×10^8
17. a) 2.0×10^6 b) $\$4.92 \times 10^6$ c) Answers may vary.
18. a) 8.6×10^5 b) 9.11×10^7 c) Answers may vary.
19. $\$3.06408 \times 10^8$ 20. 7.2×10^3 L

Additional Student Textbook Answers

Making Connections

a), b), c) Answers may vary.

1.3 Divisibility Rules

WARM - UP

Materials

- yellow and blue coloured pencils
- hundred charts

Related Resources

- BLM 1.3 Extra Practice

Specific Curriculum

Outcomes

- A6** develop and apply divisibility rules for 3, 4, 6, and 9

Suggested Timing

180 min

Link to Get Ready

Students should have demonstrated understanding of the Divisibility Rules for 2, 5, and 10 in the Get Ready prior to beginning this section.

Each number is missing a digit. If the number is divisible by the given number as shown, what is the missing digit? (Some questions may have more than one answer.)

1. $67\blacksquare$ is divisible by 2 <0, 2, 4, 6, or 8>
2. $775\blacksquare$ is divisible by 10 <0>
3. $602\blacksquare$ is divisible by 5 <5>
4. $59\blacksquare$ is divisible by 5 <0 or 5>

Write each number as multiplication statement using the indicated factor.

5. 1000 using 10s < $10 \times 10 \times 10$ >
6. 16 using 2s < $2 \times 2 \times 2 \times 2$ >
7. 16 using 4s < 4×4 >
8. 27 using 3s < $3 \times 3 \times 3$ >
9. 216 using 6s < $6 \times 6 \times 6$ >

Evaluate.

10. $8^2 + 4^2$ <80>
11. $7^2 - 6^2$ <13>

Complete the number sentence.

12. $3.4 \times \blacksquare = 3400$ <1000>
13. $3.4 \div \blacksquare = 3400$ <0.001>
14. $0.9 \times \blacksquare = 90$ <100>
15. $5.9 \div \blacksquare = 59$ <0.1>

Divisibility Rules

Divisibility rules are very important in mental calculations. You will also find them very useful when working with fractions.

A number is divisible by ...

- | | | |
|----|--|----------------------|
| 2 | if the number is even. | e.g. 4, 998, 1330 |
| 3 | if the sum of the digits is divisible by 3. | e.g. 372, 978, 771 |
| 4 | if the last 2 digits are divisible by 4. | e.g. 512, 1364, 7748 |
| 5 | if the units digit is 5 or 0. | e.g. 85, 110, 5775 |
| 6 | if the number is even and is divisible by 3. | e.g. 420, 5112, 636 |
| 9 | if the sum of the digits is divisible by 9. | e.g. 531, 8469, 4455 |
| 10 | if the units digit is 0. | e.g. 660, 4110, 7930 |

TEACHING SUGGESTIONS

In this section, students explore and develop divisibility rules for 3, 4, 6, and 9.

Discover the Math

Students use yellow and blue coloured pencils in this activity so the numbers that are divisible by 6 will show up green. Distribute copies of the hundred chart from the Resource Masters. In **question 1**, students develop divisibility rules for 3 and 6. Discuss the examples of 2-digit multiples of 3 that students tested in **part b)** and compare them to 2-digit numbers that are not divisible by 3. It is recommended that **questions 2 and 3** be done as a class. However, you may wish to arrange students in

small groups prior to a class discussion. Use an overhead of the hundred chart for class discussion.

Discover the Math Answers

- b)** Yes. Examples may vary. **c)** A number is divisible by 3 if the sum of the digits in the number is divisible by 3. **e)** 6, 12, 18, 24, 30, 36, 42, 48, 54, 60, 66, 72, 78, 84, 90, 96. All divisible by 6. A number is divisible by 6 if the sum of the digits is divisible by 3 and the number is even. Examples may vary.
- a)** They are all even. **b)** 4. **c)** They are all divisible by 4. A number is divisible by 4 if the last two digits are divisible by 4. **d)** No. 18 is not divisible by 4.
- a)** 9, 18, 27, 36, 45, 54, 63, 72, 81, 90, 99, 108, 117, 126, 135, 144, 153, 162, 171, 180 **b)** 9 for 9 to 90 and 180, 18 for 99 to 171 **c)** The sum of the digits is 9 or 18. **d)** A number is divisible by 9 if the sum of the digits is divisible by 9. **e)** It works. **f)** $4 + 6 + 6 = 16$, and 16 is not divisible by 9.
- a)** A number is divisible by 2 if the number is even; by 3 if the sum of the digits is divisible by 3; by 4 if the last 2 digits in the number are divisible by 4; by 5 if the units digit is 5 or 0; by 6 if the number is even and is divisible by 3; by 9 if the sum of the digits is divisible by 9; by 10 if the units digit in the number is 0. **b)** 7 427 466 391 is likely a prime number.

Communicate the Key Ideas

Have students work in groups to answer and discuss all of the Communicate the Key Ideas questions. Use this opportunity to assess student readiness for the Check Your Understanding questions.

Communicate the Key Ideas Answers

- No. All even numbers are divisible by 2. Examples may vary.
- 100 and all the multiples of 100 are divisible by 4, so everything after the last two digits can be ignored.
- Yes. No. Explanations may vary.

In **Example 1**, students examine a number greater than those previously examined in the hundred chart. Provide other examples of large numbers that are and are not divisible by 3, and have students check them. For **Examples 2** and **3**, provide other examples of numbers greater than 1000 that are and are not divisible by 6 or 4. Have students check the numbers. **Example 4** could be an alternative Discover the Math activity for divisibility rules for 9 as it helps students understand why this rule works. An alternate way to test if a number is divisible by 9 is to add the digits, then add the digits in the result. Continue until the sum of the digits is a one-digit number. If this digit is 9, the number is divisible by 9. For example, test if 321 489 is divisible by 9: $3 + 2 + 1 + 4 + 8 + 9 = 27$ and $2 + 7 = 9$. So, 321 489 is divisible by 9.

Ongoing Assessment

- Can students explain the divisibility rules for 2, 3, 4, 5, 6, 9, and 10?
- Can students apply the divisibility rules to determine if a number is divisible by 2, 3, 4, 5, 6, 9, 10?

Check Your Understanding

Question Planning Chart

Level 1 Knowledge and Understanding	Level 2 Comprehension of Concepts and Procedures	Level 3 Application and Problem Solving
1–8	9, 11, 12, 15, 16a), 19	10, 13, 14, 16b), 18, 20–24

For **questions 11** and **12**, some students may benefit from using systematic trial. They can use each digit from 0 to 9 for the missing digit, then check each result. For **question 14**, you may need to review Venn diagrams with two circles first, then with three circles.

Common Errors

- Students think that any even number is divisible by 4 or 6.
- R_x Remind students that all even numbers are divisible by 2. To be divisible by 6, the number must also be divisible by 3. To be divisible by 4, the number formed by the last two digits of the number must be divisible by 4. Have students use a calculator to check their work.

Intervention

- Some students may benefit from using a hundred chart to develop the divisibility rules.

ASSESSMENT



Question 19, page 32, Answers

- a), c), e)** Yes. Number could be divided by an odd number.
b), d), f) No. Number cannot be divided by an even number.
Examples may vary.

ADAPTATIONS

BLM 1.3 Extra Practice provides additional reinforcement for those who need it.

Visual/Perceptual/Spatial/Motor

- Some students may benefit from using linking cubes when testing for divisibility by 4.

Extension

Assign **questions 21** to **24**. You may wish to reduce the number of Check Your Understanding questions to provide students with extra time to work on the Extend questions. For **question 22**, students may find it helps to find the multiples of 5 up to 50 first, then to find the number that is one more than a multiple of 2, 3, and 4. For **question 23**, students may find it helps to look at divisibility rules for the factors of 12 when developing a divisibility rule for 12.

Literacy Connections

Venn diagrams are useful for comparing and contrasting divisibles and multiples. Once the diagram is filled in using the divisibility rules, students have a visual representation from which they can describe their understanding.

Journal

Students could use these prompts for **question 9**.

- Knowing how to use the divisibility rules is important because ...
- Even if I had a calculator, knowing my divisibility rules lets me ...

Check Your Understanding Answers

1. **a), d)** No. Sum of digits is not divisible by 3. **b), c)** Yes. Sum of digits is divisible by 3.
2. Answers may vary.
3. **a)** No. Last two digits are not divisible by 4. **b), c), d)** Yes. Last two digits are divisible by 4.
4. Answers may vary.
5. **a), c)** Yes. Divisible by 2 and 3. **b), d)** No. Not divisible by 2 or 3.
6. Answers may vary.
7. **a), c)** Yes. Sum of digits is divisible by 9. **b), d)** No. Sum of digits is not divisible by 9.
8. Answers may vary. 9. Answers may vary. 10. No. 226 belts
11. **a)** 4311 **b)** 711 **c)** 8361 **d)** 312 543
12. Answers may vary. **a)** 5312 **b)** 824 **c)** 9160 **d)** 12 048
13. Answers may vary. The coach is using the wrong divisibility rule for 6. 52 is not divisible by 3 so it cannot be divisible by 6.
14. **a)** Divisible by 5: 55; divisible by 3: 9, 33; divisible by 2: 8; divisible by 5 and 3: 45; divisible by 5 and 2: 20; divisible by 3 and 2: 36; divisible by 5, 3, 2: 150, 60.
b) They are divisible by 2, 3, and 5.
15. Answers may vary.
16. **a)** Answers may vary. 648. **b)** Answers may vary.
17. yes 18. yes 20. yes
21. The first set is divisible by 4. The second set is not divisible by 4.
22. 25 broken eggs
23. A number is divisible by 12 if it is divisible by 3 and 4. Examples may vary.
24. **a)** 135 **b)** Answers may vary. 225. **c)** Answers may vary. 40.

Additional Student Textbook Answers

Puzzler

G	P	Y	R	B
P	G	B	Y	R
R	Y	P	B	G
Y	B	R	G	P
B	R	G	P	Y

B = blue
G = green
P = purple
R = red
Y = yellow

Making Connections

- 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60
- 36, 40, 45, 60, 72, 90, 120, 180, 360
- A circle is 360° .

1.4 Factors and Multiples

WARM - UP

Materials

- grid paper, square tiles, two different coloured counters, or linking cubes
- calendars (optional)

Related Resources

- BLM 1.4 Assessment Question
- BLM 1.4 Extra Practice

Specific Curriculum

Outcomes

- A4** solve and create problems involving common factors and greatest common factors (GCF)
- A5** solve and create problems involving common multiples and least common multiples (LCM)

Suggested Timing

120 min

Link to Get Ready

Students should have demonstrated understanding of Factors and Prime and Composite Numbers in the Get Ready prior to beginning this section.

List the first five multiples of each number. Include the number as the first multiple.

1. 4 <4, 8, 12, 16, 20>
2. 3 <3, 6, 9, 12, 15>
3. 6 <6, 12, 18, 24, 30>
4. 9 <9, 18, 27, 36, 45>

List the factors of each number starting with 1.

5. 12 <1, 2, 3, 4, 6, 12>
6. 18 <1, 2, 3, 6, 9, 18>
7. 27 <1, 3, 9, 27>
8. 56 <1, 2, 4, 7, 8, 16, 28, 56>

Complete the number sentence. Think: halve and double.

9. $6 \times 350 = 3 \times \blacksquare$ <700>
10. $15 \times 26 = 30 \times \blacksquare$ <13>
11. $42 \times 2.5 = \blacksquare \times 5$ <21>

Evaluate.

12. $6^2 + 6^1 + 6^0$ <43>
13. $12^2 - 11^2$ <23>

Complete the number sentence.

14. $0.42 \times \blacksquare = 42$ <100>
15. $0.9 \div \blacksquare = 90$ <0.01>

TEACHING SUGGESTIONS

In this section, students find factors of a number and the common factors of numbers, including the greatest common factor. They also find multiples and common multiples, including the least common multiple. Students use factors and multiples to solve problems.

Discover the Math

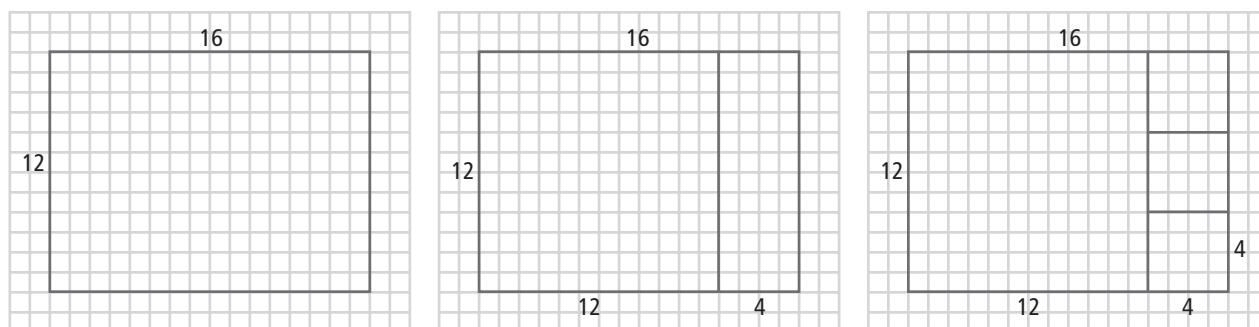
In **Part A**, help students make the connection that the symbolic placing of counters on a calendar is the same as listing multiples to find the LCM. This idea leads to finding least common denominator in Grade 8, but is only dealt with as LCM at this level. **Part B** also makes the connection from concrete or pictorial to the symbolic.

Students create a list of all factors by drawing or building all possible rectangles and then listing the factors.

Discover the Math Answers

1. **b)** day 15 **c)** It is the smallest number that has both 3 and 5 as a factor.
2. **a)** 1×16 , 2×8 , 4×4 **b)** 1×20 , 2×10 , 4×5 **c)** 1, 2, and 4 **d)** 4
3. **a), b)** Answers may vary.

Example 1 shows three methods of finding the GCF. Review each method, paying close attention to the comments in the thought bubbles. **Method 3** can be simplified by drawing a 12×16 rectangle on grid paper. Ask students to state the dimensions of the largest square that can fit inside the rectangle. (12×12)



Ask students to state the dimensions of the largest square that can fit the remaining rectangle. (4×4) The 12×12 square could also be tiled or filled with the 4×4 squares, so a 4×4 square is the largest that will fit the 12×16 rectangle. **Example 2** lists two methods of finding LCM. Be sure to point out the difference between finding the GCF and LCM when using prime factorization.

Communicate the Key Ideas

Have students work in groups to answer and discuss all of the Communicate the Key Ideas questions. Use this opportunity to assess student readiness for the Check Your Understanding questions.

Communicate the Key Ideas Answers

1. A factor tree breaks a number down into its smallest factors. A factor tree is complete when the bottom row contains only prime numbers.
2. Noel. A number can only have one set of prime factors.
3. 15 is a factor of both numbers. The only factor of 45 greater than 15 is 45, which is not a factor of 60. So 15 is the GCF of both numbers.
4. The prime factorization method breaks the number into its prime factors. To find the LCM, multiply the common factors by all of the remaining factors.

Ongoing Assessment

- Can students make factor trees?
- Can students distinguish between the factors of a number and the multiples of the same number?
- Can students identify the prime factors of a number?

Check Your Understanding

Question Planning Chart

Level 1 Knowledge and Understanding	Level 2 Comprehension of Concepts and Procedures	Level 3 Application and Problem Solving
	1–3, 5–7, 16, 19, 20, 22, 23	4, 8–15, 17, 18, 21, 24, 25

Have grid paper, square tiles, two-coloured counters, or linking cubes available for all questions. For **question 12**, blank calendars are available in *Mathematics Blackline Masters Grades P to 9*, pages 15 and 16.

Common Errors

- Students sometimes do not remember that the factors of a natural number include the number itself and the number 1.
 R_x Have students list all the factors of more numbers and point out that 1 and each number itself are always factors.
- Students sometimes use 1 as a factor in a factor tree.
 R_x Remind students that 1 is not used in factor trees because it is neither prime nor composite. All numbers have 1 as a factor.
- Students sometimes miss factors when listing all the factors.
 R_x Remind students that every factor has a partner unless it can be multiplied by itself to give the number.

Intervention

- For some students, you may need to review prime numbers.
- Students having difficulty may benefit from using manipulatives or grid paper to identify factors of a number.
- Students may wish to use a hundred chart to find multiples.

ASSESSMENT



Question 21, page 39, Answers

- a) Red: 5 s, 10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s, 45 s, 50 s, 55 s, 60 s
Green: 6 s, 12 s, 18 s, 24 s, 30 s, 36 s, 42 s, 48 s, 54 s, 60 s
Blue: 8 s, 16 s, 24 s, 32 s, 40 s, 48 s, 56 s
- b) 4 times: at 30 s, 60 s, 90 s, and 120 s. c) 24 s d) 120 s e) 20 s later
f) package of 6 bulbs

ADAPTATIONS

BLM 1.4 **Assessment Question** provides scaffolding for question 21.

BLM 1.4 **Extra Practice** provides additional reinforcement for those who need it.

Visual/Perceptual/Spatial/Motor

- Area models and Venn diagrams for GCF and LCM are useful tools for visual learners.

Extension

Assign **questions 22 to 25**. You may wish to reduce the number of Check Your Understanding questions to provide students with extra time to work on the Extend questions. For **questions 22 and 23**, encourage students to do the example as laid out in each question before trying **parts a) and b)**. Review the terms *divisor* and *remainder* for **question 22**.

Check Your Understanding Answers

- 36, 72, 108, 144
- a) 21 b) 18 c) 24 d) 20
- a) 140 b) 90 c) 225 d) 900
- Answers may vary.
- 2, 4
- a) 12 b) 25 c) 1 d) 2
- a) 12 b) 4 c) 12 d) 3
- Answers may vary. 55 and 66.
- Answers may vary.
- Answers may vary.
- Answers may vary. 72 students or 96 students.
- Answers may vary. 5 and 10.
- Answers may vary. 30 and 45.
- 32 tables with 4 people each, 16 tables with 8 people each, 8 tables with 16 people each, 4 tables with 32 people each.
- 2 months
- Lei Mei. 1 is not a prime number.
- 12th day
- 60th customer
- a) 3 b) 7
8. Explanations may vary.
- a) 8 b) 15
- a) 176 b) 84
- Brittany: 5 laps. Megan: 6 laps. Byung: 10 laps.
- 27 and 63

Additional Student Textbook Answers

Puzzler

No, there is only one solution.

6	7	5	4	9	2	3	1	8
4	8	3	6	7	1	2	5	9
9	2	1	8	3	5	4	7	6
5	9	8	3	1	7	6	2	4
1	3	6	5	2	4	8	9	7
2	4	7	9	6	8	5	3	1
7	1	4	2	5	6	9	8	3
3	6	2	7	8	9	1	4	5
8	5	9	1	4	3	7	6	2

1.5 Order of Operations

WARM-UP

Materials

- calculators

Related Resources

- BLM 1.5 Assessment Question
- BLM 1.5 Extra Practice

Specific Curriculum

Outcomes

- B5** apply the order of operations for problems involving whole and decimal numbers

Suggested Timing

150 min

Link to Get Ready

Students should have demonstrated understanding of Properties of Operations in the Get Ready prior to beginning this section.

Each number is missing a digit. If the number is divisible by the given number as shown, what is the missing digit? (Some questions may have more than one answer.)

1. $9\blacksquare$ is divisible by 2 <0, 2, 4, 6, or 8>
2. $675\blacksquare$ is divisible by 10 <0>
3. $602\blacksquare$ is divisible by 3 <1, 4 or 7>
4. $19\blacksquare$ is divisible by 5 <0 or 5>
5. $117\blacksquare$ is divisible by 9 <0 or 9>
6. $6011\blacksquare$ is divisible by 4 <2 or 6>
7. $11\blacksquare$ is divisible by 6 <4>
8. $\blacksquare1352$ is divisible by 9 <7>

Add. Try finding compatible addends or working by parts.

9. $23 + 79$ <107>
10. $107 + 25 + 87$ <219>

Divide.

11. $0.16 \div 0.02$ <8>
12. $0.245 \div 0.005$ <49>
13. $440 \div 5$ <88>
14. $650 \div 50$ <13>

Complete the number sentence.

15. $0.823 \times \blacksquare = 823$ <1000>
16. $0.67 \div \blacksquare = 670$ <0.001>
17. Which number is a multiple of 4?
A 1126 B 3456 C 2354 D 1330
18. Which number is a factor of 8649?
A 4 B 5 C 6 D 9 <D>

Compatible Numbers

You can add two numbers quickly, if you break the original numbers into parts and add the parts that have a sum of 10, 100, 1000, and so on.

$$\begin{aligned} 78 + 29 &= 75 + 3 + 25 + 4 \\ &= (75 + 25) + 3 + 4 \\ &= 100 + 7 \\ &= 107 \end{aligned}$$

Multiplying by 10, 100, 1000

You can eliminate working with decimals if you multiply pairs of number by the same multiple of 10.

$$\begin{aligned} 0.45 \div 0.05 &= \frac{(0.45 \times 100)}{(0.05 \times 100)} \\ &= 45 \div 5 \\ &= 9 \end{aligned}$$

Double and Halve Strategy

If working with numbers that end in 5, you can double the numbers to make one number a multiple of 10.

$$\begin{aligned} 480 \div 5 &= (480 \times 2) \div (5 \times 2) \\ &= 960 \div 10 \\ &= 96 \end{aligned}$$

TEACHING SUGGESTIONS

In this section, students create and solve numerical problems involving the order of operations.

Discover the Math

The purpose of the investigation is to have students identify the need for the order of operations and to understand the usefulness of brackets. Have students work through each scenario and answer **questions 1 to 5** in their notebooks. After this, create the following table on the board or on an overhead:

Student number sentences	Student Answers	Calculator answers	Corrected number sentence

Ask students to share their number sentences and record them in the chart. Ask what their answers were. Ask students if a calculator would give them the same answer. Have them use the calculator to find the answer. Correct the number sentence, if needed. Discuss why brackets are necessary. Students should intuitively see that order is important.

Discover the Math Answers

- $4 \times 20 + 3 \times 35$; \$185
- $4 \times 20 + 3 \times 20$; \$140
- $(4 + 3) \times 20$
- $7 \times 20 - 2 \times 20$
- $(7 - 2) \times 20$
- Answers may vary.

Example 1 deals with a number sentence with brackets. Have students solve the question without brackets, then use the brackets and follow the instructions. Have them compare answers. **Example 2** shows how to evaluate expressions with two sets of brackets. Students will not be familiar with inner and outer brackets. Discuss the context of the question to help students understand the usefulness of the second set of brackets in the expression.

Example 3 shows how to apply the order of operations to an expression that includes both an exponent and brackets. This example goes beyond the degree of difficulty that students have seen before. Emphasize the usefulness of the memory aid BEDMAS. Note also that clearly recording and rechecking the steps in the calculation minimizes the chance of errors.

Example 4 shows how to handle fraction bars with the order of operations. Explain that **Methods 1** and **2** in the solution are equivalent. Because a fraction bar is both a grouping symbol and a division symbol, each method involves brackets and division. Students should use whichever method they prefer. You might ask students if they have a preference and, if so, to explain why.

Communicate the Key Ideas

Have students work in groups to answer and discuss all of the Communicate the Key Ideas questions. Use this opportunity to assess student readiness for the Check Your Understanding questions.

Communicate the Key Ideas Answers

1. Without rules, the same expression could have different answers.
2. $4^2 - 2^2$. Explanations may vary.
3. Answers may vary.

Ongoing Assessment

- Can students use the order of operations to evaluate expressions?
- Can students record their work correctly with the proper use of the equal sign?

Check Your Understanding

Question Planning Chart

Level 1 Knowledge and Understanding	Level 2 Comprehension of Concepts and Procedures	Level 3 Application and Problem Solving
3	1, 2, 4, 5, 7–11, 15–17, 21–23	6, 12–14, 18–20

In **questions 8 and 9**, it is important that students show their work so you can see if they are placing the brackets correctly.

Common Errors

- Students fail to apply the order of operations correctly.
R_x Encourage students to describe the operations as they complete the steps in a calculation, as shown in **Examples 1 and 2**. Students can then check the list of operations in the solution to make sure that the operations were applied in the correct order.
- Students may put an equal sign in the wrong place when solving an order of operations question.
R_x Remind students that each line of work must equal the line before and after it.

Intervention

- For some students, especially ESL students, you may need to review the meaning of the term *operation*.

ASSESSMENT



Question 20, page 45, Answers

a) $8.55 \times (8 \times 3 + 6 \times 2)$; \$307.80. b) \$145.35. c) \$162.45 more d) \$1231.20.

ADAPTATIONS

BLM 1.5 **Assessment Question** provides scaffolding for question 20.

BLM 1.5 **Extra Practice** provides additional reinforcement for those who need it.

Extension

Assign **questions 21 to 23**. You may wish to reduce the number of Check Your Understanding questions to provide students with extra time to work on the Extend questions. **Question 21** is a good inquiry/patterning question. Predicting the 20th line in **part c**) will encourage students to verbalize and apply the general pattern that they found. If students can only find this result after completing the previous 19 patterns, ask them to look for a general pattern based on the starting number. Then, have them write the 200th line of the pattern. **Question 22** is an excellent inquiry question involving order of operations, particularly with exponents. Encourage students to find at least two solutions for each number (e.g., $99 = 9^2 + 4^2 + 1^2 + 1^2$ and $99 = 5^2 + 5^2 + 7^2$).

Check Your Understanding Answers

- 31
- a) 16 b) 2 c) 8 d) 2 e) 40 f) 21
- a) brackets b) multiplication c) multiplication in brackets d) brackets
- a) 31 b) 14 c) 71 d) 171
- a) multiplication b) brackets c) division
- Answers may vary.
- a) 11.4 b) 2.1 c) 5 d) 8 e) 5
- a) $4 + (6 - 5) \times 2 = 6$; $(4 + 6) - 5 \times 2 = 0$; $(4 + 6 - 5) \times 2 = 10$ b) Without following the order of operations, the same expression could have different answers. c) Second expression. Explanations may vary.
- a) $(7 - 5)^4 \div 8 = 2$ b) $(3 \times 2 - 5)^{10} = 1$ c) $39 - (4 + 6 \div 3)^2 = 3$
- In her second step, she multiplied 2×3 before she had evaluated 3^2 . In her third step, she added 8 instead of subtracting it. The correct answer is 22.
- No. $(2 + 3 + 4)^2 = 9^2 = 81$ and $2^2 + 3^2 + 4^2 = 4 + 9 + 16 = 29$.
- $12 \times (1217 - 179) + 6.25 \times 395$
- a) Answers may vary. $4 \times 4 - 2 \times 3$ b) 10 m^2
- Answers may vary.

3			
5			
- a) all equal 0 b) $6^3 - (5 \times 6 \times 7 + 6) = 0$; $7^3 - (6 \times 7 \times 8 + 7) = 0$
- a) $3^3 \div 9 + 5 = 8$ b) $(5 + 3)^2 - 40 \div 2 = 44$ c) $4 \left(\frac{6 + 3}{3} \right) - 9 = 3$
- d); \$60
- $4 \times 100 + 2 \times 80$; 560 km
- $25 \times 4^2 + 295 - 75$; \$620
- a) 4; 9; 16; 25 b) $5^2 + 7^2 - 38 = 36$; $6^2 + 8^2 - 51 = 49$ c) $20^2 + 22^2 - 443 = 441$
- a) $5^2 + 1^2 + 1^2$; $3^2 + 3^2 + 3^2$; $4^2 + 3^2 + 1^2 + 1^2$ b) $5^2 + 2^2 + 1^2$; $4^2 + 3^2 + 2^2 + 1^2$ c) $7^2 + 1^2$; $6^2 + 3^2 + 2^2 + 1^2$ d) $9^2 + 4^2 + 1^2 + 1^2$ e) $11^2 + 3^2$; $10^2 + 5^2 + 2^2 + 1^2$
- Answers may vary. a) $1 = 2 \times 2 - 2 \div 2 - 2$; $2 = 2 + 2 + 2 - 2 - 2$; $3 = 2^2 + 2 \div 2 - 2$; $4 = (2^2 + 2^2) \div 2$; $5 = 2 + 2 + 2 - 2 \div 2$; $6 = 2 + 2 + 2 + 2 - 2$; $7 = 2 + 2 + 2 + 2 \div 2$; $8 = 2 \times 2 \times 2 \times 2 \div 2$; $9 = 2 \times 2 \times 2 + 2 \div 2$ b) $1 = 4 \div 4 + (4 - 4)$; $2 = 4 - (4 + 4) \div 4$; $3 = (4 + 4 + 4) \div 4$; $4 = 4 - (4 - 4) \div 4$; $5 = (4 \div 4)^4 + 4$; $6 = 4 + (4 + 4) \div 4$; $7 = 44 \div 4 - 4$; $8 = 4 + 4 + (4 - 4)$; $9 = 4 + 4 + 4 \div 4$ c) $1 = 3 \div 3 + (3 - 3)$; $2 = 3 \div 3 + 3 \div 3$; $3 = (3 - 3)^3 + 3$; $4 = (3 \div 3)^3 + 3$; $5 = 3 + 3 - 3 \div 3$; $6 = 3 + 3 + 3 - 3$; $7 = 3 \div 3 + 3 + 3$; $8 = 3 \times 3 - 3 \div 3$; $9 = 3 \times 3 + (3 - 3)$ d) $1 = (5 + 5) \div 5 - 5 \div 5$; $2 = (5 + 5) \div 5 + 5 - 5$; $3 = 5 - 5 \div 5 - 5 \div 5$; $4 = 5 + 5 - 5 - 5 \div 5$; $5 = 5 + 5 + 5 - 5 - 5$; $6 = 5 + 5 - 5 + 5 \div 5$; $7 = 5 + 5 \div 5 + 5 \div 5$; $8 = 5 + (5 + 5 + 5) \div 5$; $9 = (5 \times 5 - 5) \div 5 + 5$

Use Technology: Use Spreadsheets to Calculate

TEACHING SUGGESTIONS

Materials

- Excel® spreadsheet software
- computers

Suggested Timing

60 min

This technology feature provides directions that will allow students to find multiples and factors of numbers, to determine if a number is prime or composite, to calculate squares of numbers, and to convert fractions to decimals.

In **Part 1**, students use a spreadsheet to find the multiples of 7. Ensure students understand the meaning of the formula they enter in cell B1. In **Part 2**, students find the factors of 1998. Again, ensure they understand the meaning of the formula. As students work through **Part 3**, they should realize that if a number is not divisible by any of the numbers 2 to 50, it is a prime number.

In **Part 4**, students should enter the formula $= A1^2$ in cell E1. They will find the square of the number in cell A1. In **Part 5**, students explore fractions with a numerator of 1 and denominators from 1 to 50. Students use a formula to convert each of these fractions to a decimal.

Use Technology Answers

7., 10. c) 2021 is not prime. Its factors are 1, 43, 47, 2021.

Chapter 1 Review

WARM - UP

Related Resources

- BLM 1R Extra Practice

Suggested Timing

90 min

Evaluate.

- 4^3 <64>
- $2^3 + 2^3 + 2^3 + 2^3$ <32>
- $9^2 + 9^1 + 9^0$ <91>
- $5^2 \times 2^3$ <200>
- 1.6×100 <160>
- $0.95 \div 0.001$ <950>

Complete the number sentence.

- $0.015 \times \blacksquare = 1.5$ <100>
- $2.7 \div \blacksquare = 27$ <0.1>

Each number is missing a digit. If the number is divisible by the number as shown, what is the missing digit in the number? (Some questions may have more than one answer.)

- $7\blacksquare 2$ is divisible by 4. <1, 3, 5, 7, or 9>
- $49\blacksquare$ is divisible by 3. <2, 5, or 8>

- Which is a multiple of 6?
A 746 B 999 C 816 <C>
- Which is a multiple of 9?
A 474 B 837 C 795

Evaluate. Use the order of operations.

- $7 + 3^2$ <16>
- $(7 + 3)^2$ <100>
- $81 - 9 \times 8$ <9>

TEACHING SUGGESTIONS

Using the Chapter Review

The students might work independently to complete the Chapter Review, and then compare solutions in pairs. Alternatively, the Chapter Review could be assigned for reinforcing skills and concepts in preparation for the Practice Test. Provide an opportunity for the students to discuss any questions, consider alternative strategies, and ask about questions they find difficult.

For **question 7**, suggest that students do the prime factorization of 12 first and then multiply the answer by 3. For **questions 10** and **14**, suggest that students insert brackets to make the number sentences easier to interpret. For **question 17**, suggest that students calculate the number of seconds in an hour first.

After students complete the Chapter Review, encourage them to make a list of questions they found difficult, and to include the related sections. They can use this list as a guide on what to concentrate their efforts on when preparing for the final chapter test.

ASSESSMENT

Chapter Review

This is an opportunity for the students to assess themselves by completing selected questions and checking the answers. They can then revisit any questions that they found difficult.

Upon completing the Chapter Review, students can also answer questions such as the following:

- Did you work by yourself or with others?
- What questions did you find easy? difficult? Why?
- How often did you have to ask a classmate to help you with a question? For which questions?

ADAPTATIONS

Have students use **BLM 1R Extra Practice** for more practice.

Review Answers

1. power 2. base 3. expanded form 4. scientific notation
5. a) GCF: 6, LCM: 48 b) GCF: 6, LCM: 48
6. a) 256 b) 59 049
7. Answers may vary. The factors of 12 are 2, 2, and 3. Multiplying these by 3, you get $2 \times 2 \times 3 \times 3$. This can also be written as $(2 \times 3) \times (2 \times 3) = (2 \times 3)^2$.
8. a) 1; 121; 12 321; 1 234 321 b) 1 234 567 654 321 c) 1 111 111 111². There are ten numbers 0 to 9, so the pattern breaks down after all the numbers have been used in 111 111 111².
9. a) 32 b) 24 c) 5
10. $7 \times 6 + 4 \times 13.50$; \$96
11. In $3 + 5^2$, the exponent is calculated first: $3 + 25 = 28$. In $(3 + 5)^2$, the brackets are calculated first: $(8)^2 = 64$.
12. a) $4^3 - 3^3$ b) 37 cm^3
13. a) $3 \times 10^3 + 5 \times 10^2 + 6 \times 10^1 + 2 \times 10^0$ b) $2 \times 10^5 + 4 \times 10^3 + 3 \times 10^2 + 1 \times 10^1$
14. $4 \times 6.79 + 3 \times 1.95 + 1 \times 1.79 + 2 \times 3.75$; \$42.30
15. a) 1×10^6 b) 9.3×10^5 c) 1.45×10^{10} d) 4.2005×10^5
16. $5 \times 10^5 + 4 \times 10^4 + 2 \times 10^2$, 542 000, 5.421×10^5
17. 5.76×10^5
18. a) Yes. If the bases are the same, a greater exponent will result in a greater number. b) No. When 1 is the base, the result will always be 1 for any exponent.
19. GCF: 7; LCM: 420
20. Answers may vary.
21. In 2227.
22. a) 100 nails b) 138 cartons
23. a) 16; 1156; 111 556; 11 115 556 b) 1 111 111 155 555 556

Chapter 1 Practice Test

TEACHING SUGGESTIONS

Related Resources

- BLM 1PT Chapter 1 Test

Suggested Timing

90 min

Using the Practice Test

This Practice Test can be assigned as an in-class or take-home assignment. If it is used as an assessment, use the following guidelines to help you evaluate the students.

- Can students express repeated multiplications as powers?
- Can students evaluate powers?
- Can students interpret numbers written as powers?
- Can students determine the GCF and LCM of numbers?
- Can students use divisibility rules for 3, 4, 6, and 9?
- Can students express large numbers in scientific notation?
- Can students express numbers in expanded form using powers of 10?
- Can students solve problems that involve the order of operations?
- Can students evaluate expressions involving brackets, exponents, and/or fraction bars?

Study Guide

Use the following study guide to direct students who have difficulty with specific questions to appropriate areas to review.

Questions	Refer to Section
1, 2, 9	1.1
6, 8, 11	1.2
7, 12	1.3
4, 5, 13, 14	1.4
3, 10, 15–17	1.5

ASSESSMENT

After students complete the Practice Test, you may wish to use **BLM 1PT Chapter 1 Test** as a summative assessment.

ADAPTATIONS

Visual/Perceptual/Spatial/Motor

- Allow the use of calculators.
- Let students give their answers verbally, either in an interview setting or recorded.

Language/Memory

- Allow students to refer to personal math dictionaries, journals, index card files, or notes.

Practice Test Answers

1. A
2. C
3. C
4. C
5. D
6. A
7. Levi. Explanations may vary.
8. $2 \times 10^5 + 4 \times 10^1 + 5 \times 10^0$
9. a) 32 b) 64
10. a) 12 b) 132 c) 8
11. a) $7 \times 10^4 + 5 \times 10^3$ kg; 7.5×10^4 kg
b) $5 \times 10^5 + 3 \times 10^4 + 9 \times 10^3$ km²; 5.39×10^5 km²
c) $1 \times 10^8 + 8 \times 10^6$ km; 1.08×10^8 km
12. Divisible by 2, 3, and 6.
13. 2. Methods may vary.
14. 132
15. 1419.5 calories
16. \$8.15
17. 2 P.M.

Chapter 1 Chapter Problem Wrap-Up

1. Introduce the problem.
2. Clarify the assessment criteria by reviewing **BLM 1CP Chapter Problem Wrap-Up Rubric** with students.
3. Remind individual students that they have worked on the chapter problem during chapter problem revisits throughout the chapter and that these will help them. Students can also be directed to section 1.2 question 17 and section 1.3 question 16 at this point.
4. Brainstorm with students the topics covered in this chapter and be sure that they include all topics in their own problems for encoding their message. Have them solve the message in the book before creating their own clues for a message.
5. Allow students time to work on the problem, either individually or in a group. Students should prepare separate reports.
6. Possibly share with all students the example from this Teacher's Resource after they have completed their work on the problem. Keep copies of your own students' work to show in future years.

Overview of the Problem

Refer to section 1.3 question 16 on page 32, where there is an example of a divisibility-rules riddle. Remind students about the riddles they have already made up. You could have students to use these riddles again as a starting point to their encoded message. Students could also design a treasure map to accompany their message.

ASSESSMENT

Use **BLM 1CP Chapter Problem Wrap-Up Rubric** to assess student achievement.

High Scoring Sample Response

Refer to the Exemplar at the end of this Teacher's Resource chapter.

Criteria for a High Scoring Response

- Student makes original clues for the new message.
- Student uses no more than 5 clues, which accurately give the letter that each number represents.
- Student uses all the concepts introduced in the chapter in the clues.
- Student uses appropriate math vocabulary.
- Student accurately decodes the original message.
- Student accurately encodes the new message.
- Solutions to the messages are clearly worked out and with sufficient detail so that *anyone* could understand the problems being solved.

What Distinguishes Lower Scoring Responses

- Student makes a new message but the clues might not be original.
- Student uses more than 8 clues, which accurately give the letter that each number represents.
- Student uses some of the concepts introduced in the chapter in the clues.
- Student uses some math vocabulary.
- Student decodes the original message with some errors.
- Student encodes the new message with some errors.
- Solutions to the messages are not clearly worked out.
- Student basically understands the problem and can make an attempt at solving it – just cannot finish.

Chapter Problem Wrap-Up Answer

Walk eight paces from the waterfall toward platinum pond. Dig four metres beneath the surface to find the gold and diamonds.

Student Exemplar

Decode questions + answer code		
$A = (6+2)^2 - 56$ $= 8^2 - 56$ $= 64 - 56$ $A = 8$	$B = 19$ $C = 20$ $D = 4$ $E = 5$ $F = 11$	$F = (8-2) \div 3 + 3^2$ $= 6 \div 3 + 3^2$ $= 2 + 9$ $G = 2$ $H = 3$ $I = 16$ $K = 1$ $O = 14$ $R = 12$
$L = 9$ $M = 0$ $N = 3$ $P = 17$ $S = 15$ $U = 18$ $T = 6$ $W = 7$	WALK EIGHT PACES FROM THE WATERFALL TOWARD PLATINUM POND. DIG FOUR METRES BENEATH THE SURFACE TO FIND THE GOLD AND DIAMONDS.	
New message and code		
$A = (3+2) - 4(5)$ $B = (3+1)^2 (16)$ $C = \text{The 9th prime number}$ in the hundreds chart (11)	$L = 60$ is divisible by these numbers: 1, 2, 3, 4, 5, 6, 10, 15, 20, 30, 60 and (12)	$O = 4^2 + 2 (18)$ $P = 3$ $R = 13$ $S = 100,000,000 (10)$ $T = \text{The GCF of 12}$ and 16 (4)
$D = (144 \div 12)^0 (1)$ $E = 21$ $F = 0$ $G = \text{The LCM of 3 and 5 (15)}$ $H = 3^2 (9)$ $K = (12 \div 3) + 4 (8)$	$M = \text{The side length of a}$ square with an area of 36 is (6)	$U = 17$ $V = (8+1) \div 3 + 4^2 (19)$ $W = 14$ $Y = 20$ $N = \text{The number 25 is}$ divisible by 11 and 5 and is between 265 and 297 (7)
WALK THREE PACES FROM ROCKY 14, 5, 12, 8 4, 9, 13, 21, 21 3, 5, 11, 21, 10 0, 13, 18, 6 13, 18, 11, 8, 20		
LAKE'S TURTLE STATUE TOWARD 12, 5, 8, 21, 10 4, 17, 13, 4, 12, 21 10, 4, 5, 4, 17, 21 4, 18, 14, 5, 13, 1		
KOHAKU MOUNTAIN TURN RIGHT AND 8, 18, 9, 5, 8, 17 6, 18, 17, 7, 4, 5, 2, 7, 4, 17, 13, 7 13, 2, 15, 9, 4 5, 7, 1		
WALK THREE MORE PACES DIG THERE 14, 5, 12, 8 4, 9, 13, 21, 21 6, 18, 13, 21 3, 5, 11, 21, 10, 1, 2, 15 4, 9, 21, 13, 21 TO FIND THE TREASURE! 4, 18 0, 2, 7, 1 4, 9, 21 4, 13, 21, 5, 10, 17, 13, 21!		

