1.1 Focus on Problem Solving
Principles of Mathematics 9, pages 6–9

A

1. Continue each pattern for three more terms. Describe how to find successive terms.
   a) 3, 8, 13
   b) 2, 6, 18
   c) 1, 2, 2, 4, 8
   d) 2, 3, 5, 7, 11, 13

2. You have a toonie, a loonie, and three quarters. How many different sums of money can you make?

3. a) Use a calculator to evaluate each quotient.
   $1 \div 37 = ?$
   $2 \div 37 = ?$
   $3 \div 37 = ?$
   b) Continue and identify a pattern in the results.
   c) Use the pattern to evaluate $25 \div 37$.

B

4. a) Express the fractions $\frac{1}{11}, \frac{2}{11}, \frac{3}{11},$ and so on as decimals. Describe the pattern.
   b) How does the pattern change if the denominator is 111?
   c) What if the denominator is 11 111?

5. How many perfect cubes divide evenly into 13 824?

6. How many diagonals are there in each polygon?
   a) square
   b) pentagon
   c) hexagon
   d) 12-sided polygon (dodecagon)
   e) *n*-sided polygon

7. a) On what day of the week were you born? Explain how you found out.
   b) Describe a method of determining the day of the week for any date.

8. How many times does the digit 3 occur in the numbers from 1 to 1000?

C

9. In the following sum, each letter represents a different digit. T is three times A, W is one third of H, and $Y = 1$. Find the value of each letter.

   T H A T
   + W A S
   ———————
   E A S Y

10. A Sudoku is a Japanese number puzzle that follows a simple set of rules. Each three by three square, each row, and each column must contain each of the numerals 1 through 9 only once. Here is a Sudoku that is almost completed. What must the missing digits be?

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

1.2 Focus on Communicating
Principles of Mathematics 9, pages 10–13

A

1. Describe the pattern in each sequence. Give the next two terms.

a) 18, 15, 12

b) −8, −10, −12

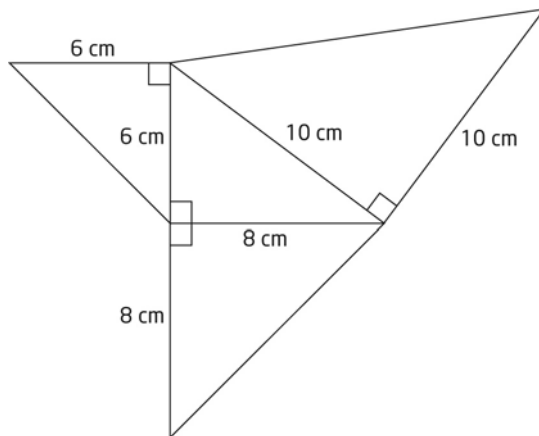**c)** $\dfrac{1}{6}, \dfrac{1}{3}, \dfrac{1}{2}$

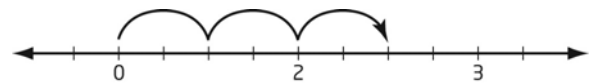**d)** 4, −12, 36, −108

e) 4, 4, 8, 12, 20

f)

B

2. Is there a relationship between the areas of the isosceles right triangles placed on each side of a right triangle? Use the diagram to help you explain your answer.

3. a) Explain how the diagram illustrates the fact that $\dfrac{3}{5} \times \dfrac{2}{3} = \dfrac{6}{15}$.
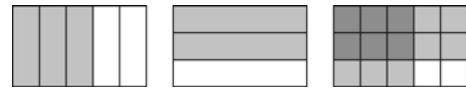
b) What product is modelled by the number line diagram?

4. Anna, Bryce, Coral, and Deepak chose their favourite sport on a survey. Their choices are tennis, swimming, baseball, and hockey, but not in that order. Anna and Deepak do not like team sports. Both Anna and Bryce only like sports with balls. Coral does not play any of the sports with double letters in their names. Match each student with the correct sport. Justify your reasoning.

C

5. In a recycling depot, there are eight recycling checkpoints equally spaced along a 7-m section of the recycling line. A recycling bin is to be located 4 m away from the assembly line. Where is the best location for a recycling bin to be placed so that the workers will have to go the least distance to take the materials to be recycled?

1.3 Focus on Connecting
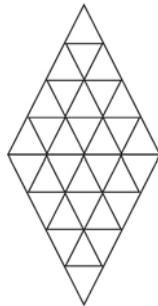*Principles of Mathematics 9*, pages 14–18

A

1. Raza has five Canadian stamps in his wallet. If the wallet contains any combination of 50¢, 2¢, and 1¢ stamps, what are the possible total values of the stamps?

2. How many portable CD players would fit inside your classroom? Explain your reasoning.

6.5 cm
2.5 cm
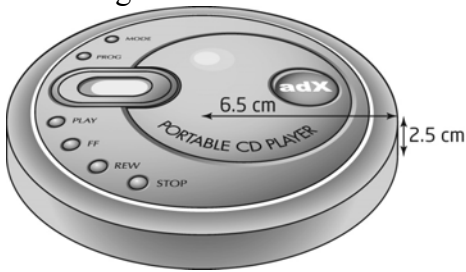
B

3. How many parallelograms of all sizes are there in the diagram?

4. Six friends ate 15 pieces of birthday cake. Kees ate four times as many pieces as Rae. Rae ate one third as many pieces as Jason. Kees ate twice as many pieces as Anil. Anil and Edgar ate the same number of pieces. Ming and Jason ate the same number of pieces. Kees ate the most pieces. What fraction of the 15 pieces of birthday cake did each person eat?

5. How many books are there in all the public libraries in Ontario?

6. A polygon has seven sides. How many diagonals does it have?

C

7. Each small cube measures 1 cm by 1 cm by 1 cm. What is the approximate volume of this 3-D arrow?
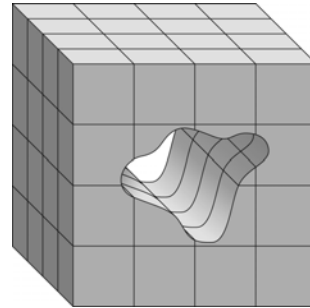
8. Each three by three square, each row, and each column must contain each of the numerals from 1 to 9 only once. Copy and complete this Sudoku puzzle.

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

1.4 Focus on Representing
Principles of Mathematics 9, pages 19–22

A

1. On a bicycle ride to a store, Faiza rode 3 km east, then 5 km south, then 5 km west, and finally 5 km north. Where is the store relative to her starting point?

2. The bottom floor of an office building has 12 offices. Each of the other floors above it has $\frac{1}{2}$ as many offices as the floor below. Use a diagram and a numeric representation to help determine the maximum number of floors that this building can have.

B

3. There are 30 people at a party, not including the host. Each person gets introduced to each other person once by the host. How many introductions are there?

4. The gear ratio on a toy truck compares the number of teeth on the *driver* cog to the number of teeth on the *driving* cog. The driver cog on the toy truck has 50 teeth and the driving cog has 40 teeth.

   a) If the driver cog rotates four turns, how many turns does the driving cog make?

   b) How many turns of the driver cog are required for the driving cog to turn three times?

5. Plot each set of points on a grid. Describe the pattern and plot the next three points.
   a) A(0, 0), B(2, −1), C(4, −2)
   b) P(1, 2), Q(−1, −2), R(1, 2)
   c) D(1, 2), E(2, 4), F(3, 6)

6. The points A(−3, 2) and B(1, 2) are two vertices of right isosceles triangle ΔABC. AB is not one of the equal sides. Find all possible locations of the third vertex so that the area of the triangle is 10 square units.

C

7. The points A(1, 2) and B(−3, −2) are two vertices of an isosceles triangle. Find all possible whole-number coordinates of the other vertex.
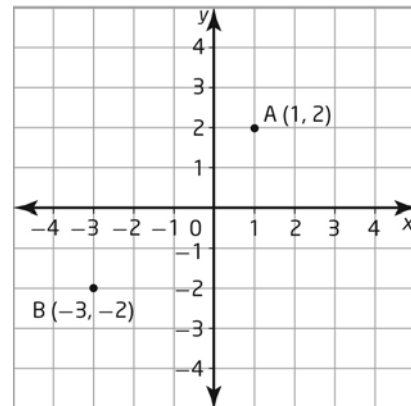
1.5 Focus on Selecting Tools and Computational Strategies
Principles of Mathematics 9, **pages 23–28**

A

1. a) Draw a diagram to illustrate that $8 \div 2 = 4$.

   b) Draw a diagram to illustrate that $15 \div 5 = 3$.

2. Use an appropriate tool and strategy to find the two missing values in each sequence.

   a) 5, 8, 11, …, ☐, ☐, 41

   b) 3, 12, 48, …, ☐, ☐, 49 152

   c) 6, 4, 2, …, ☐, ☐, −12

   d) 4, −36, …, ☐, ☐, −26 244

B

3. Find each sum. Express your answers in lowest terms.

   a) $-\dfrac{3}{5} + \left(-\dfrac{1}{5}\right)$

   b) $-\dfrac{2}{5} + \dfrac{3}{4}$

   c) $\dfrac{2}{9} + \left(-\dfrac{2}{3}\right)$

   d) $\dfrac{1}{7} + \dfrac{2}{21}$

4. Find each difference.

   a) $\dfrac{1}{4} - \left(-\dfrac{1}{4}\right)$

   b) $\dfrac{3}{5} - \dfrac{3}{4}$

   c) $\dfrac{1}{8} - \left(-\dfrac{1}{16}\right)$

   d) $\dfrac{2}{5} - \dfrac{3}{10}$

5. Evaluate.

   a) $\left(-\dfrac{3}{8}\right) \times \dfrac{2}{5}$

   b) $\dfrac{3}{4} \div \left(-\dfrac{5}{6}\right)$

   c) $\dfrac{1}{8} \times \left(-\dfrac{2}{5}\right)$

   d) $\dfrac{1}{8} \div \left(-\dfrac{1}{16}\right)$

6. Use an appropriate tool to help determine the thousandth term in the sequence −25, −21, −17, −13, ….

C

7. A string winds around the cylindrical part of a water bottle a total of five times. The cylindrical part of the water bottle has a circumference of 22 cm and a height of 19 cm. How long is the string?

8. If you fold a piece of string in half, in half again, and so on, up to n folds, and then cut it through the last fold with a pair of scissors, how many pieces of string will you have?

1.6 Focus on Reasoning and Proving

Principles of Mathematics 9, pages 29–33

A

1. Prove that the sum of five consecutive whole numbers is always divisible by 5.

2. Prove that a mathematics textbook always has an even number of pages.

B

3. Give a counter-example to prove each statement false.

    a) All even numbers are evenly divisible by 4.

    b) The sum of any two odd numbers is always odd.

    c) The product of any two fractions is always positive.

4. The integer −7 can be expressed as a difference of cubes.

    $$1^3 - 2^3$$
    $$= 1 - 8$$
    $$= -7$$

    How many integers between 1 and 100 can be expressed as a difference of cubes of whole numbers?

5. a) Copy and complete each sum.

    $1 = ?$
    $1 + 3 = ?$
    $1 + 3 + 5 = ?$
    $1 + 3 + 5 + 7 = ?$

    b) Describe the pattern in the sums.

    c) What is the sum of the first n odd numbers?

6. What is the mass of a subway train, including passengers, during rush hour?

C

7. a) Calculate 2^1.

    b) Calculate $2^2 - 2$.

    c) Calculate $2^1 + 2^2$.

    d) Calculate $2^3 - 2$.

    e) Calculate $2^1 + 2^2 + 2^3$.

    f) Calculate $2^4 - 2$.

    g) Describe a rule that this seems to illustrate.

    h) Verify your rule by trying it with two more examples.

    i) Did your examples work? If not, try to develop a different rule and verify it.

8. For the sequence 1, 1, −2, −2,−2, 3, 3, 3, 3, −4, −4, −4, −4, −4, 5, 5, 5, 5, 5, 5, ...

    a) what is the 50th term?

    b) what is the sum of the first 50 terms?

    c) what is the 100th term?

    d) what is the sum of the first 100 terms?

1.7 Focus on Reflecting
Principles of Mathematics 9, pages 34–36

A

1. If you multiply a number by −5 and then add 13, the result is −7. What is the number?

2. One third of a number, decreased by $\frac{3}{4}$, gives $\frac{1}{3}$. What is the number?

B

3. **a)** How many numbers between 1 and 100 are divisible by 3?

   b) How many numbers between 1 and 100 are divisible by 4?

   c) How many numbers between 1 and 100 are divisible by both 3 and 4?

   d) How many numbers between 1 and 100 are divisible by either 3 or 4?

   e) Explain your strategy and verify that it works.

4. **a)** How many numbers between 1 and 1000 contain the digit 5?

   b) How many numbers between 1 and 1000 contain the digit 0?

   c) How many numbers between 1 and 1000 contain the digit 5 and the digit 0?

   d) How many numbers between 1 and 1000 contain either the digit 5 or the digit 0?

   e) Explain your strategy and verify that it works.

5. In a video game, a character has been programmed to start at 40 pixels to the left of centre. The character moves 70 pixels to the right, then 55 pixels to the left, then 40 pixels to the right, then 25 pixels to the left, and so on.

   a) The character disappears when it lands on zero, the centre. After how many moves will this occur?

   b) Verify that your answer is correct.

6. What number to the exponent 12 is 2 176 782 336?

C

7. How many litres of bottled water are consumed in Ontario in a month?

8. Each three by three square, each row, and each column must contain each of the numerals 1 through 9 only once. Copy and complete this Sudoku puzzle.

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

Chapter 1 Review
Principles of Mathematics 9, **page 37**

1. Continue each pattern for three more terms. Describe how to find successive terms.
   a) 6, 9, 12
   b) 8, 16, 32
   c) 9, 10, 13, 18
   d) 13, 11, 7, 1

2. Plot each set of points on a grid. Describe the pattern and plot the next three points.
   a) A(1, 2), B(4, 4), C(7, 6)
   b) G(4, 5), H(0, 3), I(−4, 1)
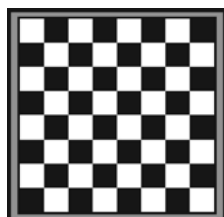   c) P(−6, −1), Q(−9, −3), R(−12, −5)

3. Use appropriate tools or strategies to find the next three terms in each sequence.
   a) $\dfrac{3}{8}, \dfrac{1}{2}, \dfrac{5}{8}$
   b) $0, -\dfrac{1}{4}, -\dfrac{1}{2}$

4. How many quarters will fill up a 4-L milk jug?

5. How many squares of all sizes are on a chessboard? What strategies did you use?

6. a) A cubical box measures 2 cm by 2 cm by 2 cm. What happens to the volume if each dimension is doubled?
   b) Use an appropriate tool to illustrate what happens to the volume of any cube when its dimensions are doubled.

7. Copy the numbers in the order shown. Replace each ☐ with the symbol +, −, ×, ÷, or =, and insert brackets to make a true mathematical statement.
   a) $12\ \square\ 3\ \square\ 5\ \square\ 2\ \square\ 1$
   b) $\dfrac{1}{3}\ \square\ \dfrac{1}{4}\ \square\ \dfrac{5}{6}\ \square\ \dfrac{1}{2}\ \square\ \dfrac{5}{12}\ \square\ \dfrac{1}{12}$

8. Evaluate. Express your answers in lowest terms.
   a) $-\dfrac{2}{5}+\dfrac{3}{4}$
   b) $\dfrac{3}{5}-\left(-\dfrac{2}{3}\right)$
   c) $\left(-\dfrac{2}{3}\right)\times\left(-\dfrac{4}{7}\right)$
   d) $\left(-2\dfrac{1}{5}\right)\div\left(-3\dfrac{1}{2}\right)$

9. a) Use an appropriate tool to determine the hundredth term in the sequence 5, 8, 11, 14, ….
   b) Use an appropriate tool to determine which term in the sequence 144, 139, 134, 129, … is −416.

10. The number 614 656 is what number raised to the exponent 4? Which tool did you use?