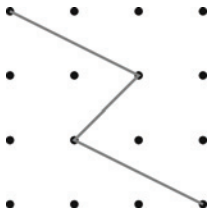# Enrichment Questions 1
Principles of Mathematics 10 Exercise and Homework Book

1. **Product** Copy the diagram. Place the digits from 1 to 5 in the squares so that the product is 3542.


2. **Congruent pieces** The diagram shows one way to divide the grid into two congruent pieces using line segments that connect grid points. Find 12 other ways.

3. **Telephone keypad** A telephone keypad is shown. The distance between the centre of the 1 button and the centre of the 2 button is 2 cm. The distance between the centre of the 1 button and the centre of the 4 button is 2 cm. To enter the number 1-726-567-2194, what is the minimum distance your finger would have to travel, to the nearest centimetre?

4. **Dart board** A dart that lands on a regulation dart board can score a whole number of points from 1 to 20, or double or triple each number. If the dart hits the bull's-eye, it can score 25 or 50 points. Pierre threw three darts. One missed the board, but Pierre scored a total of 35 points with the other two darts. In how many different ways could he have scored 35 points with two darts?
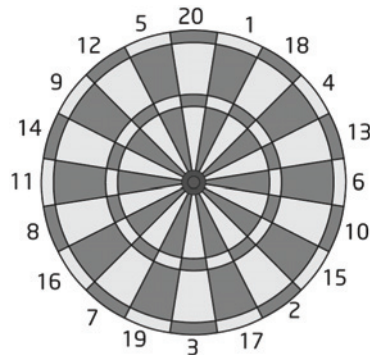
5. **Equilateral triangles** Use an isometric grid with the dimensions shown. How many different-sized equilateral triangles can you make on the grid?

6. **Transatlantic flight** Charles Lindbergh was the first person to fly solo across the Atlantic. He left New York City at 07:52 local time on May 20, 1927, and landed in Paris at 23:21 local time on May 21. He flew 5830 km.

   a) Calculate the time he took to fly from New York City to Paris.

   b) Find his average speed, to the nearest kilometre per hour.

1. **Basketball tournament** St. Mary's High School entered a basketball tournament. In the first round, each team played one game, and the losers dropped out. Each winner from the first round played one game in the second round, and the losers dropped out. This process continued until a winner was declared. St. Mary's won the tournament by winning five games. How many teams were in the tournament?

2. **Large sum** Find the last three digits of the sum $625^{13} + 376^{87}$.

3. **Average ages** The average age of the students in a group was 15. The average age of the teachers in the same group was 45. The average age of the whole group was 19. What was the smallest possible number of people in the group?

4. **Whole numbers** The difference between the squares of two consecutive whole numbers is 63. What are the numbers?

5. **Communication** A rectangular solid is to be made using 60 blocks, each of which is a 1-cm cube. Write a full solution to the following, showing your mathematical model and your reasoning.
   a) How many rectangular solids are possible?
   b) How many different surface areas are possible?

6. **Land area** Suppose the land area of each province were divided equally among all the people living in that province. In which province would a person receive
   a) the most land?
   b) the least land?

7. **Lunch meeting** Dylan is meeting his sister and four of her friends for lunch. The five women are named Alicia, Rachel, Lani, Donna, and Casey. Three of the women are under 30 years old, and two are over 30. Two of the women are lawyers, and three are doctors. Alicia and Lani are in the same age group. Donna and Casey are in different age groups. Rachel and Casey have the same profession. Lani and Donna have different professions. Dylan's sister is a lawyer and is over 30. Who is Dylan's sister?

8. **Toothpicks** There are three piles of toothpicks, one with 11 toothpicks, one with 7, and the third with 6. You are to get 8 toothpicks in each pile in three moves. In each move, you must add to any pile exactly as many toothpicks as it already has, and all the toothpicks moved must come from a single pile.

9. **Coastal communities** What percent of Canadians live in coastal communities?

Enrichment Questions 3
Principles of Mathematics 10 Exercise and Homework Book

1. **Transpacific flight** On Monday at 21:00 local time, a plane leaves Vancouver for Sydney, Australia. The plane cruises at 900 km/h and stops for 1 h in Hawaii to refuel. At about what local time and on what day will the plane land in Sydney?

2. **Cube net** Three views of a cube are shown. Copy the net and label it with the correct letters.
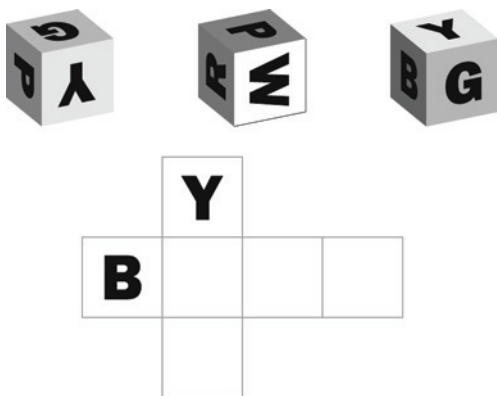
3. **Parking cars** About how many cars could you park on the grounds surrounding your school?

4. **Chess tournament** The contestants in a chess tournament were numbered from 1 to 18. When the players were paired for the first game, the sum of the two numbers for each pair was a perfect square. What were the pairings for the first game?

5. **Measurement** A kite is a quadrilateral with two pairs of adjacent sides equal. If a kite has diagonals that are 10 cm and 12 cm long, what is the area of the kite?

6. **Names** Four students have the first names Tim, Trip, Terry, and Thomas. Their middle names are Bob, Bill, Bevan, and Brooks. Their last names are Sol, Sand, Stone, and Silver. Each student has a different number of letters in each of his names. None of Terry's names has six letters. The name Bill does not belong to Tim or Sol. What is the full name of each student?

7. **Rotation** A sector with an angle of 80° rotates clockwise about the centre of a circle. The sector moves 80° on each move. How many 80° moves will it take for the sector to arrive back at its original position?
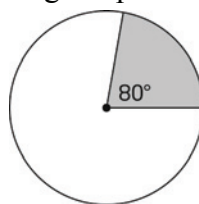
8. **Tiling** Suppose a road from Toronto to Denver is to be tiled with square tiles that have the same dimensions as processed cheese slices. About how many tiles will be needed if the road is 120 tiles wide?

9. **Find paths** In the diagram, the horizontal, vertical, and diagonal line segments join two points. How many paths are there from A to B that consist of exactly five of these line segments?
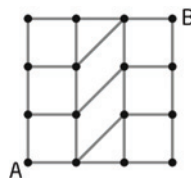
1. **Measurement** The figure is made up of squares. Square B has dimensions 4 cm by 4 cm. Square C has dimensions 5 cm by 5 cm. What is the total area of the figure, in square centimetres?
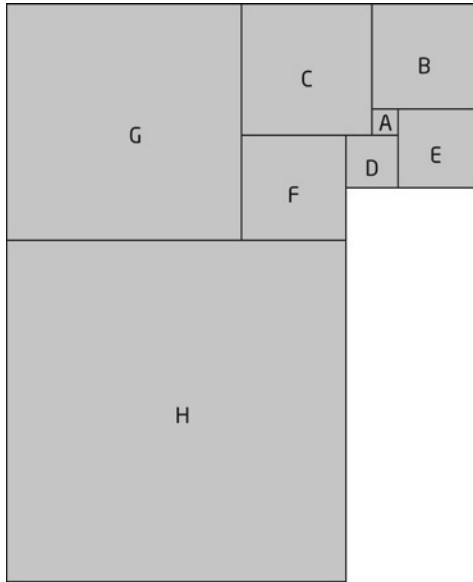
2. **Astronomy research**
   a) The moon has a diameter of 3476 km. How does the surface area of the moon compare with the surface area of the smallest planet in the solar system? What assumption have you made?
   b) How many times as great is the volume of the sun as the combined volumes of all the planets in the solar system?

3. **International travel** You are leaving Calgary at 13:00 on a Friday to fly to Zurich, Switzerland, via Toronto. If your plane averages 850 km/h, and you stop for 1 h in Toronto, at about what time on what day will you land in Zurich?

4. **Coins** Suppose that you
   • place two identical coins as shown in the diagram
   • press firmly on the bottom coin
   • roll the top coin around the bottom one until the top coin returns to its original position

   a) Predict how many times the rolling coin turns around its centre as it rolls around the stationary coin.
   b) Test your prediction.
   c) Explain your observation.

5. **Descending numbers** In a descending number, such as 743, each digit is greater than the digit on the right. How many descending numbers are there between 500 and 600?

6. **Clock hands** A clock's minute hand is 10 cm long, and its hour hand is 7 cm long. Find the total distance moved by the tips of both hands in a 24-h period.

Enrichment Questions 5
Principles of Mathematics 10 Exercise and Homework Book

1. **Grouping numbers** In how many different ways can you place the numbers 1, 2, 3, 4, 5, 6, 7, 8, and 9 into groups so that the sum of the numbers in each group is 15?

2. **Cheese sticks** A restaurant menu includes orders of 6, 9, and 20 cheese sticks. To get 15 sticks, you can order 6 sticks and 9 sticks. You cannot order 16 sticks because no combination of 6, 9, and 20 adds up to 16. What is the largest number of sticks that you *cannot* order?

3. **Number Pattern** If the pattern continues, what will be the number directly below 100?

```
              1
           2  3  4
        5  6  7  8  9
    10 11 12 13 14 15 16
```

4. **Transformations** Draw a square. Rotate the square 45° about one corner and draw the new square. Then, rotate the square another 45° in the same direction about the same corner and draw the next square. Continue the procedure until the square is returned to its original position.
   a) How many squares are in the final diagram?
   b) How many triangles are there?

5. **Painted prism** A rectangular prism made up of 1-cm cubes has dimensions of 3 cm by 4 cm by 5 cm. If the faces of the prism are painted orange, how many cubes have orange paint on only one face?

6. **Cycle races** The first time Rohana and Emma raced 20 km on bicycles, Emma was 2 km from the finish line when Rohana finished. The next day, Rohana agreed to start 2 km behind Emma, so that Rohana would ride 22 km and Emma, 20 km. If each of them rode at the same speed as she did during the first race, who won the second race?

7. **Pianos** Estimate the number of pianos in Ontario.

8. **Travelling times** Chen and Sharif travelled from Acton to Beamsville on foot. Chen walked half the distance and ran half the distance. Sharif walked half the time and ran half the time. If they walked at the same speed and ran at the same speed, who arrived in less time, or was it a tie?

9. **Sightseeing** Tara left her hotel to sightsee in Ottawa. She walked four blocks north, three blocks east, one block south, four blocks east, six blocks north, five blocks west, two blocks south, and six blocks west. How many blocks and in which directions should Tara walk to get back to her hotel in the shortest distance?

10. **Floor tiles** Sarah wants to cover the floor of a kitchen with 20-cm square tiles. The floor is 3 m by 4 m. How many tiles does she need?

Enrichment Questions 6
Principles of Mathematics 10 Exercise and Homework Book

1. **Group photo** Hakim, Rena, Patrice, and Julius line up for a picture. If Patrice and Hakim do not stand beside each other, in how many different ways can the group line up?

2. **Standard form** If each of the following numbers is written in standard form, what is the final digit?
   a) 9^{32} b) 12^{33}

3. **Arranging blocks** In how many different ways can you arrange two identical blue blocks and two identical red blocks in a straight line?

4. **Making change** What is the most money you can have in $1 coins, $2 coins, $5 bills, $10 bills, $20 bills, and $50 bills, and still not be able to make change for a $100 bill?

5. **Population** Estimate the percent of the North American population that lives within a day's drive from your school.

6. **Communication** A valuable gold coin that had been stolen was recovered, along with seven counterfeit copies that had been placed in the same box. If the counterfeit coins are all identical and are slightly lighter than the real coin, how can the real coin be found with only two weighings on a balance scale?

7. **Abundant numbers** The number 12 is the first abundant number, because it is the smallest whole number for which the sum of its factors, not including itself, is greater than itself.
   $$1 + 2 + 3 + 4 + 6 = 16$$
   What are the next three abundant numbers?

8. **Fresh water** Which Canadian province has
   a) the most fresh water?
   b) the most fresh water per person?

9. **Itinerary** Route 66 was a popular two-lane highway that started in Chicago and ended in Los Angeles. Much of Route 66 still exists, but most travellers now use the superhighways that run parallel to it. The cities on Route 66 include Chicago, Springfield (Illinois), St. Louis, Springfield (Missouri), Tulsa, Oklahoma City, Amarillo, Tucumcari, Albuquerque, Gallup, Flagstaff, Needles, Barstow, and Los Angeles. A newspaper reporter who is writing a story about Route 66 leaves Chicago on May 10 at 08:00. Assume that the reporter drives at 80 km/h for a maximum of 6 h/day and sleeps each night at one of the places on the list. Write an itinerary for the reporter.

10. **Summer courses** There are five courses in the School for the Arts summer program—painting, sculpting, music, drama, and film. Terri can choose three of the courses. In how many different combinations can she choose the three courses?

11. **System of equations** Find the values of h and g in the system of equations.
    $$a + b = c$$
    $$c + d = e$$
    $$a + e = f$$
    $$f + g = h$$
    $$h - e = 7$$
    $$b + d + f = 30$$
    $$a = 4$$

Enrichment Questions 7
Principles of Mathematics 10 Exercise and Homework Book

1. **Communication** The first diagram shows two 1-cm cubes, with one stacked on top of the other. If the lower cube sits on a table, the area of the exposed faces is 9 cm^2. The second diagram shows four cubes, and the area of the exposed faces is 14 cm^2. The third diagram shows six cubes, and so on.
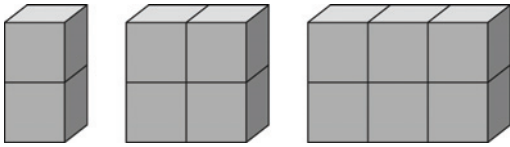
   Write a full solution to the following, showing your mathematical model and your reasoning.
   a) What is the total area of the exposed faces for a figure made from 36 cubes?
   b) If the total area of the exposed faces of a figure is 129 cm^2, how many cubes make up the figure?

2. **Breakfast cereal** About how many boxes of breakfast cereal are sold each year in Canada?

3. **Measurement** The length, width, and height of a rectangular prism are whole numbers of centimetres. Three faces of the prism have areas of 144 cm^2, 72 cm^2, and 32 cm^2. What are the dimensions of the prism?

4. **Toothpicks** About how many flat toothpicks would be needed to cover the floor of your school gym?

5. **Number puzzle** Copy the diagram. Place one of the digits from one to six in each square to make the multiplication true.

6. **Statistics** If you list the digits used to write the numbers from 1 to 100, what is
   a) the median digit?
   b) the mode digit?

7. **Congruence** Copy the diagram. Show two ways of dividing the square along grid lines into four congruent parts, so that each part contains exactly one X.
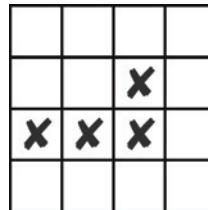
8. **Winning team** Three sportscasters, Aaron, Sandra, and Francois, predicted the winners of the same four hockey games on a Saturday night. Aaron said that Vancouver, Toronto, Edmonton, and Chicago would win. Sandra chose Montréal, Edmonton, Boston, and Toronto. Francois said that Calgary, Vancouver, Edmonton, and Montréal would win. No one chose Detroit to win. Which teams played each other?

1. **Congruent shapes** The shape is to be divided into six congruent parts by cutting along the grid lines. What shapes can the congruent parts have?
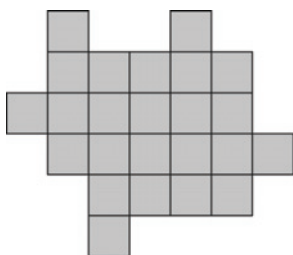
2. **Lunch meeting** Tia, Jane, Fran, and Marta are friends who meet every Friday for lunch. Their occupations are teacher, lawyer, carpenter, and police officer. Each woman has a pet—a dog, a cat, a parrot, or a turtle. Copy and complete the table. Use the clues to match the woman with her occupation and the pet she owns.
   • Tia owns the turtle.
   • Fran and the carpenter play baseball.
   • The dog owner and the teacher do not play baseball.
   • Tia is not the teacher or the police officer.
   • Marta sat across from the parrot owner and the dog owner at lunch.
   • The lawyer does not play baseball.

	tea	law	car	pol	dog	cat	par	tur
Tia								
Jane								
Fran								
Marta								
dog								
cat								
par								
tur								

3. **Communication** Naomi is in Paris, France, on business. She needs to arrange a conference call with two colleagues. One is at head office in Vancouver. The other is in Sydney, Australia. For what time of day, Paris time, should Naomi arrange the call? Explain.

4. **School reunion** Five friends—three women and two men—met at a school reunion. The men were Smith and Wong. The women were Bevan, Lee, and Kostash. Their occupations were biologist, farmer, accountant, writer, and baker. Each one lived in a different city: London, England; Vancouver; Paris, France; Toronto; and Melbourne, Australia. Use the information to determine the occupation and city of residence for each person.
   • Mr. Smith is not the baker.
   • The five friends are Ms. Bevan, Mr. Wong, the woman who lives in Paris, the man who lives in Vancouver, and the biologist who lives in Melbourne.
   • The accountant and Ms. Lee live outside Canada but not in Melbourne.
   • Ms. Bevan does not live in London and is not the woman writer.

5. **Education**
   a) What is the projected increase in the number of children aged 5 to 14 in Canada from the year 2021 to the year 2041?
   b) Estimate the number of new schools needed to accommodate the increase.
   c) Estimate the number of additional teachers needed.

Enrichment Questions 9
Principles of Mathematics 10 Exercise and Homework Book

1. **Sequence**
   a) Draw the next three squares in the sequence.

   b) Describe the pattern in words.
   c) Draw the 75th square.
   d) Draw the 153rd square.

2. **Seating arrangement** Four friends—Alexi, Kala, Lisa, and Jamal—are sitting at a round table. The person wearing the red shirt, who is not Alexi or Kala, is sitting between Lisa and the person wearing the blue shirt. The person wearing the green shirt is sitting between Kala and the person wearing the yellow shirt. What colour shirt is each person wearing?

3. **Communication** Estimate the total number of CDs owned by high school students in your province. Explain and justify your answer.

4. **Number puzzle** Each letter in the box represents a different number. The sums of four columns and four rows are given. Find the missing sums.

5. **Dominoes**
   a) How many dominoes are there in a double-six set of dominoes?
   b) How many spots are there on a double-six set of dominoes?

6. **Renewable energy**
   a) What percent of Canadian energy comes from renewable sources, such as solar and wind power?
   b) What is the projected percent increase in the use of renewable energy over the next 25 years?
   c) What country produces the most wind energy? What percent of this country's wind energy production is Canada's wind energy production?

7. **National debt** If Canada's current national debt were divided equally among all Canadians, what would be each person's share?

8. **Numbers in words** Suppose you start to write the whole numbers in words, starting at one. Remember that 101 is written "one hundred one." In what number will
   a) the letter "a" appear for the first time?
   b) the letter "b" appear for the first time?

9. The numbers 1 to 6 are arranged so that the difference between a pair of numbers appears between and below the pair of numbers. Use the same pattern to make a triangle with the numbers from 1 to 10. The 5 and the 7 have been placed for you.
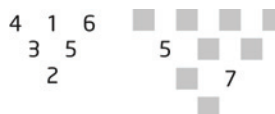
10. **Buildings** About what percent of the land area in your city or town is covered by buildings?

Enrichment Questions 10
Principles of Mathematics 10 Exercise and Homework Book

1. **Fractions** Find the product.

$$\left(1-\frac{1}{2}\right)\left(1-\frac{1}{3}\right)\left(1-\frac{1}{4}\right)\cdots\left(1-\frac{1}{57}\right)$$

2. **Exact change** At one stall at the Bargain Flea Market, every item costs a dollar or less, including tax. If you have three quarters, two dimes, and five pennies, how many different prices could you pay with exact change?

3. **Congruence** The diagram shows one way to cut the figure into four congruent pieces using straight lines. Find three other ways.
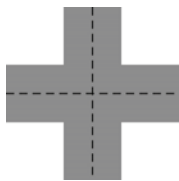
4. **Area of Canada**
   a) About how many times could you handwrite the following sentence on sheets of paper with a total area equal to the area of Canada?
   Canada is the world's second-largest country, after Russia.
   b) About how many years would it take you to write the sentence this many times?

5. **Communication** One year, about 45 000 cyclists took part in the 71-km Tour de I'lle de Montréal. If all the bicycles had been placed end to end, would they have stretched the entire length of the tour? Explain your reasoning and state your assumptions.

6. **Bowling** After the preliminary games in a bowling tournament, bowler A is ranked first, B is second, C is third, and D is fourth. These four bowlers have a playoff. In the first playoff game, D bowls against C. The loser gets the fourth-place prize, and the winner bowls against B in the second game. The loser of the second game gets the third-place prize, and the winner bowls against A in the final game. The loser of the final game gets the second-place prize. In how many different orders can A, B, C, and D finish the playoff?

7. **Canada**
   a) What percent of the world's population lives in Canada?
   b) What percent of the world's energy consumption is used by Canadians?

8. **Communication** Which is the sunniest province in Canada? Explain.

9. **Radio** About how many recordings are played by all the radio stations in Ontario in a day?

10. **Whole numbers** Find the two whole numbers less than 100 that satisfy the following conditions.
    • Dividing by 2 gives a remainder of 1.
    • Dividing by 3 gives a remainder of 1.
    • Dividing by 4 gives a remainder of 1.
    • Dividing by 5 gives a remainder of 0.