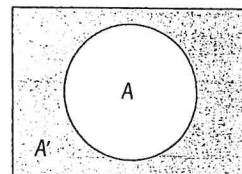


## Consolidate and Debrief

### Key Concepts

- You can calculate the probability of an event using  $P = \frac{n(A)}{n(S)}$ , where  $n(A)$  is the number of successful outcomes and  $n(S)$  is the number of outcomes in the sample space.
- If the trials are dependent, you can use permutations in the calculations.
- To use the indirect method, subtract the probability of the complement from 1.

$$P(A) = 1 - P(A')$$



$$P(A) = 1 - P(A')$$

### Reflect

- A tour guide bet her group of 27 tourists that at least two people have the same birthday. Should they accept the wager? Explain.
- Describe the clues you should look for to identify that a probability problem involves permutations. Include an example.
- How is  ${}_{12}P_3$  different from  ${}_{12}P_1 \times 3$ ? Use examples to help distinguish between the two.

### Practise

Choose the best answer for #3 and #4.

- Three cards are drawn from a deck without replacement. What is the probability that they will be a king, a queen, and a jack, in that order?
- Abby, Chantral, Dougie, Kajan, Minh, and Zara are all in a race and are considered to be equally fast. What is the probability that Abby and Chantral will be the first two finishers?
- Five names are selected at random from a list of 25 names. What is the probability that they will be in alphabetical order?
 

A $\frac{1}{{}_{25}P_5}$	B $\frac{5!}{{}_{25}P_5}$
C $\frac{1}{25^5}$	D $\frac{5}{25!}$

- A standard die is rolled four times. What is the probability that it shows a number divisible by three all four times?

- |                  |                  |
|------------------|------------------|
| A $\frac{1}{3}$  | B $\frac{1}{6}$  |
| C $\frac{1}{81}$ | D $\frac{1}{12}$ |

### Apply

- There are 15 numbered balls on a pool table. What are the odds against them falling in order from 1 to 15? Remember, odds against is the ratio  $P(A') : P(A)$ .
- Communication** A charity lottery uses a random number generator to choose three different days from the calendar. These are days on which grand prizes will be awarded.
  - What is the probability that all three days fall in the month of April?
  - Explain the method you used.



7. In the game of backgammon, when you roll doubles with two dice you can double the total on the dice.
- What is the probability of rolling doubles?
  - What is the probability of rolling doubles on two consecutive rolls?
  - Which has a greater probability: rolling consecutive doubles, or rolling consecutive sums of 7 on two rolls of the dice?

8. What is the probability that a family has all boys, in a family of
- 3 children?
  - 4 children?
  - 5 children?
  - $n$  children?

9. A four-letter word jumble is being formed from the letters in the word LOGARITHM.
- What is the probability it spells MATH?
  - What is the probability it includes the letters M, A, T, and H?
  - What is the probability it includes the letter M?

10. **Application** One card is dealt from a standard deck to each of seven players.
- What is the probability that the cards are dealt in ascending order?
  - What is the probability that none of the cards are of the same denomination?

11. What is the probability that two or more people in a party with 20 people will have the same birthday?

12. **Thinking** How many students are needed in a class for the probability of the "birthday problem" in Example 4 on page 92 to reach 0.5?

13. Your MP3 player is set to random and will play 10 of your favourite songs. What is the probability that
- the songs are played in your order of preference?
  - your two favourite songs are first and second?

14. Five people each choose a card from a standard deck. They replace the card after making their choice.

- What are the odds against at least two people choosing the same card?
- What are the odds against at least two people choosing the same denomination?

#### Processes

#### Selecting Tools and Computational Strategies

How does the tool you selected help you understand the birthday problem?

15. To simulate the results of the birthday problem in Example 4 on page 92, use either a spreadsheet or a graphing calculator to generate 30 random integers between 1 and 365. Repeat this 10 times and determine the number of classes in which at least two people share the same birthday.

- In a spreadsheet, enter **=randbetween(1,365)** in cell A1. Fill down to cell A30. To identify the most frequent number, or mode, in cell A31, enter **=mode(A1:A30)**.
- Using a graphing calculator, press **STAT** then select **1:Edit**. Place the cursor in the heading for list **L1**. Press **MATH** then select **PRB** and **5:randInt(1,365,30)**. Press **ENTER**. Sort the data by pressing **STAT**, then **2:SortA(L1)** and **ENTER**. Press **STAT**, then **1:Edit**. Scroll down to see which numbers repeat.

16. a) Find the probability of cracking a combination lock on a safe if five different numbers are used from
- 1 to 35
  - 1 to 40
  - 1 to 45
- b) **Communication** Compare the results and explain the differences.



## Achievement Check

17. On a TV game show, the contestant is asked to pick one of three doors. Behind each door are two large boxes to choose from. The grand prize is in one of the boxes behind Door 1. There are good prizes in one box behind Door 2 and one box behind Door 3. The other boxes all contain gag prizes.
- Make a tree diagram showing the possible outcomes.
  - Assign a probability to each branch in the tree diagram.
  - What is the probability of winning the grand prize?
  - What is the probability of winning a good prize?
  - What is the probability of winning a gag prize?
  - What is the sum of all the probabilities? Explain the result.

Which of the following scenarios could be modelled using the "birthday problem"? Solve it using the appropriate techniques.

- The probability that at least two people receive hearts when each of six people are dealt five cards.
  - The probability that at least two people roll double sixes, from a group of 10 people.
  - The probability that at least two people, from a group of 25 people, have the same birthday as you.
19. **Thinking** Which is more likely?
- Throwing a sum of 7, or not throwing a sum of 7, on six consecutive rolls of a pair of dice.
  - Five different digits being arranged in descending order, or three different letters being arranged in alphabetical order.
  - At least two out of 20 friends having the same birthday, or at least two out of five friends having the same birth month.

## Extend

20. A lottery ticket contains five numbers chosen from the numbers 1 to 40. The winning ticket is the one that matches all five numbers in the correct order. The second prize winner matches four of the five numbers in the correct order. What is the probability of winning the first or second prize?
21. **Open Question** Create your own probability example that has  $\frac{1}{{}_{15}P_7}$  as its solution. Provide a rationale.
22. A computer screen is divided into a 16 by 9 grid with grid points defined by ordered pairs, using whole numbers, from (0, 0) to (16, 9). A segment is drawn joining two randomly chosen points.
- What is the probability the segment is horizontal?
  - What is the probability the segment is on one of the screen's diagonals?
23. A game involves making a 3 by 3 grid with nine cards from a standard deck. You win if three cards in a row (horizontally, vertically, or diagonally) are the same denomination or are consecutive (in any order).
- What is the probability that there is exactly one winning set of the same denomination?
  - What is the probability that there is exactly one winning set of consecutive cards?
24. In the card game, Six in a Row, six cards are dealt in a row. Points are given for the number of consecutive cards. What is the probability that the six cards are
- consecutive and in order (e.g. 4, 5, 6, 7, 8, 9)?
  - consecutive, but in any order?

