

# 1 Positive integers

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# 1.1 Overview

## Why learn this?

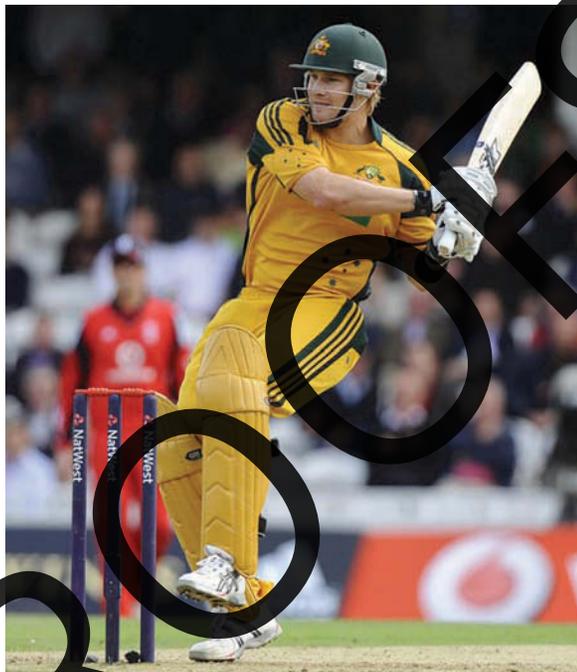
Positive integers are whole numbers. We use positive integers every day. Addition, subtraction, multiplication and division of positive integers are the building blocks of Mathematics.

When you count the number of runs you make in a game of cricket, you are using integers. When you add your runs to the runs your teammates scored, the total number of runs will be a positive integer. This result is found by the addition of integers.

Many daily activities depend on knowing how to answer simple questions like, ‘When you went for that walk, how far did you go?’ or ‘How many people live in your house?’

Every day we see integers displayed on screens — for example when we look at the weather forecast or check our unread messages. We normally don’t even think about integers — they are just the numbers we see all around us.

Understanding integers and their addition, subtraction, multiplication and division is important for everyday life and work. Many jobs, including hospitality, banking, construction, design, engineering, nursing, teaching, finance and medicine all require an understanding of the use of integers.



## Where to get help

Go to your learnON title at [www.jacplus.com.au](http://www.jacplus.com.au) to access the following digital resources. The Online Resources Summary at the end of this topic provides a full list of what’s available to help you learn the concepts covered in this topic.



## Exercise 1.1 Pre-test

Complete this pre-test in your learnON title at [www.jacplus.com.au](http://www.jacplus.com.au) and receive **automatic marks**, **immediate corrective feedback** and **fully worked solutions**.

- MC** Choose the largest of the following numbers.  
A. 5656      B. 5665      C. 5566      D. 5556      E. 5666
- State how many three-digit numbers you can make from the digits 6, 9 and 1 if you are allowed to repeat digits.
- Calculate the following additions.
  - $1366 + 948 + 97$
  - $654 + 937 + 23 + 68\,941$
  - $3085 + 38 + 20\,389 + 3000 + 235$
- Calculate the following subtractions.
  - $987 - 365$
  - $9432 - 2175$
  - $3001 - 1739$
- Calculate the following using a mental strategy.  
 $2 \times 8 \times 6 \times 5$
- Evaluate the following.  
 $3 \overline{)1248}$
- A large chicken farm sorts its eggs into cartons of 12 eggs. If they have 3852 eggs to sort, calculate the number of complete cartons that can be sorted.
- A landscape gardener charges an initial fee of \$165, plus \$52 per hour. Determine how much the landscape gardener will charge for a job that takes 35 hours if a customer has taken advantage of a special offer of \$120 off the total.
- If an order was made for 25 boxes of Fanta and each box contains 24 cans, use factors to calculate the total amount of cans.
- Round 32 895 to the first digit.
- Calculate the following.
  - $48 \div 4$
  - $168 \div 8$
  - $625 \div 25$
- Complete each statement by placing  $<$ ,  $>$  or  $=$  in the empty box so that the statement is true.
  - $2 \times 41 \square 8 \times 2$
  - $16 \div 2 \square 8$
  - $16 \times 2 \square 32 \div 8$
- Evaluate the following.
  - $7 \times 6 \div 3 \div 7$
  - $3 \times 8 \div 6 + 4$
  - $7 + [66 - (5 \times 5)] \times 3$
- Evaluate the following using long division.
  - $2752 \div 16$
  - $7548 \div 17$
  - $4935 \div 21$
- Aziz takes 3 minutes to complete one lap of a running course, while Jani takes 4 minutes to complete one lap. Not counting the start of the race, determine when Aziz will next be running beside Jani.

# 1.2 Place value

## LEARNING INTENTION

At the end of this subtopic you should be able to:

- understand that the value of each digit in a number depends on its position or place value.

### 1.2.1 Place value

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- Numbers are made up of the digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.
- The position of a digit in a number gives a different value to the digit. The table below shows the value of the digit 6 in some different numbers.

Number	Name of number	Value of the digit 6
16	Sixteen	6
3562	Three thousand, five hundred and sixty-two	60
18634	Eighteen thousand, six hundred and thirty-four	600

- Each position in a number has its own **place value**. The number 59376 can be represented in a place-value table as shown.

Ten thousands	Thousands	Hundreds	Tens	Ones
5	9	3	7	6

### WORKED EXAMPLE 1 Expanded form

Write 59376 in expanded form.

#### THINK

- 59376 is the same as 5 ten thousands, 9 thousands, 3 hundreds, 7 tens and 6 ones.

#### WRITE

Ten thousands	Thousands	Hundreds	Tens	Ones
5	9	3	7	6

- Multiply each of the digits by its place value.

- Perform each of the multiplications to show how the expanded form is written.

$$59376 = 5 \times 10\,000 + 9 \times 1000 + 3 \times 100 + 7 \times 10 + 6 \times 1$$

$$= 50\,000 + 9000 + 300 + 70 + 6$$

### Place-holding zeros

- On 6 November 2020, at 10:15 am, the Australian Bureau of Statistics' population clock estimated Australia's population to be 25 718 205. In a place-value table, this number appears as follows.

Ten millions	Millions	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
2	5	7	1	8	2	0	5

- The zero (0) in the place-value table means that there are no tens. The zero must be written to hold the place value, otherwise, the number would be written as 2 571 825 and would no longer have the same value.

## Reading numbers

- To make numbers easier to read and name, they are written in groups of three digits with a space between each group. The only exception to this rule is that four-digit numbers are usually written as a group of four digits.

Number	Name of number
4357	Four thousand, three hundred and fifty-seven
12 345	Twelve thousand, three hundred and forty-five
102 345	One hundred and two thousand, three hundred and forty-five
123 456 789	One hundred and twenty-three million, four hundred and fifty-six thousand, seven hundred and eighty-nine



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## 1.2.2 Ordering and comparing numbers

- Numbers in **ascending order** are placed from smallest to largest, starting on the left. The numbers, 1, 25, 192, 908 and 1115 are in ascending order.
- Numbers in **descending order** are placed from largest to smallest, starting on the left. The numbers 8532, 934, 105, 53 and 5 are in descending order.
- Numbers are ordered according to their place values. For whole numbers, the number with the most digits is the greatest in value because the first digit will have the highest place value.
- If two numbers have the same number of digits, then the digits with the highest place value are compared. If they are equal, the next highest place values are compared, and so on.

1 25 192 908 1115

8532 934 105 53 5

### WORKED EXAMPLE 2 Ordering numbers

Write the following numbers in descending order.  
858, 58, 85, 8588, 5888, 855

#### THINK

- Write the numbers with the most digits.
- There are two numbers with 4 digits. The number with the higher digit in the thousands column is larger. The other number is placed second.
- Compare the two numbers with 3 digits. Both have the same hundreds and tens values, so compare the value of the units.
- Compare the two 2-digit numbers.
- Write the answer.

#### WRITE

8588 and 5888

8588, 5888

858, 855

85, 58

8588, 5888, 858, 855, 85, 58

- The  $<$  symbol means **is less than**. The number sentence  $3 < 5$  is read from left to right like a normal sentence. It is read as ‘three is less than five’.
- The  $>$  symbol means **is greater than**. The number sentence  $5 > 3$  is also read from left to right. It is read as ‘five is greater than three’.
- When comparing two numbers using the symbols  $<$  and  $>$ , think of a crocodile’s mouth. To work out the right symbol to place between two numbers so the number sentence is correct, just remember that the crocodile always wants to eat the bigger number.



### WORKED EXAMPLE 3 Writing number sentences

Copy and complete the following number sentences by placing the  $<$  or  $>$  symbol in each box.

a.  $52 \square 160$

b.  $8764 \square 4720$

#### THINK

a. 1. Examine the two numbers and determine which number is larger.

2. Recall that the symbols  $<$  and  $>$  are like a crocodile’s mouth.

To work out the correct symbol to insert between 52 and 160, remember that the crocodile always wants to eat the larger number.

3. The correct number sentence should read ‘52 is less than 160’.

Write the correct statement.

b. 1. Examine the two numbers and determine which number is larger.

2. Recall that the symbols  $<$  and  $>$  are like a crocodile’s mouth.

To determine the correct symbol to be inserted between 8764 and 4720, remember that the crocodile always wants to eat the larger number.

3. The correct number sentence should read ‘8764 is greater than 4720’.

Write the correct statement.

#### WRITE

a. 160 is larger than 52.

The crocodile opens its mouth to eat the larger number.

$$52 < 160$$

$$52 < 160$$

b. 8764 is larger than 4720.

The crocodile opens its mouth to eat the larger number.

$$8764 > 4720$$

$$8764 > 4720$$

### Resources



#### eWorkbook

Topic 1 Workbook (worksheets, code puzzle and project) (ewbk-1902)



#### Digital documents

SkillSHEET Place value (doc-6409)

SkillSHEET Ascending and descending order (doc-6410)



#### Interactivities

Individual pathway interactivity: Place value (int-4311)

Place value (int-3921)

## Individual pathways

**PRACTISE**

1, 4, 7, 9, 10, 13, 16, 17, 19, 22, 25

**CONSOLIDATE**

2, 5, 8, 11, 14, 18, 20, 23, 26

**MASTER**

3, 6, 12, 15, 21, 24, 27

To answer questions online and to receive **immediate corrective feedback** and **fully worked solutions** for all questions, go to your learnON title at [www.jacplus.com.au](http://www.jacplus.com.au).

## Fluency

- WE1** Write the following numbers in expanded form.

a. 925                      b. 28 469                      c. 800 002                      d. 1 080 100
- Write the following numbers in words.

a. 765                      b. 9105                      c. 90 450                      d. 100 230
- Write each of the following as a numeral.

a. Four hundred and ninety-five  
 b. Two thousand, six hundred and seventy  
 c. One hundred and nine thousand, six hundred and five
- Using words, write the value of the 4 in the distance to Yarracanna.



- Using words, write the value of the 2 in the distance to Esperance.



- Using words, write the value of the 0 in the distance to Katherine.



7. Using words, write the value of the 3 in the distance to Coober Pedy.



8. Using words, write the value of the 5 in the distance to Alice Springs.



### Understanding

9. **MC** Select the largest of the following numbers.  
A. 4884      B. 4488      C. 4848      D. 4844      E. 4888
10. **MC** Select the smallest of the following numbers.  
A. 4884      B. 4488      C. 4848      D. 4844      E. 4888
11. **WE2** Write the following numbers in descending order.  
8569, 742, 48987, 28, 647
12. Rearrange the following numbers so that they are in descending order.  
47890, 58625, 72167, 12947, 32320
13. Organise the following numbers into descending order.  
6477, 7647, 7476, 4776, 8747
14. Change the order of the following numbers to put them in descending order.  
8088, 8800, 8080, 8808, 8008, 8880
15. Write the following numbers in ascending order.  
58, 9743, 68247, 1258647
16. Rearrange the following numbers so that they are in ascending order.  
78645, 58610, 60000, 34108, 84364
17. Organise the following numbers into ascending order.  
9201, 2910, 1902, 9021, 2019, 1290
18. Change the order of the following numbers so that they are in ascending order.  
211, 221, 212, 1112, 222, 111

19. **WE3** Copy and complete the following number sentences by placing the < or > symbol in each box.
- a.  $345 \square 567$                       b.  $89 \square 98$                       c.  $234\,596 \square 23\,459$                       d.  $7765 \square 7756$
20. We can use the abbreviation K to represent \$1000. For example, \$50 000 can be written as \$50K. Using this rule, determine what amounts each of the following represent.
- a. \$6K                                      b. \$340K                                      c. \$58K
21. Write the following using K as an abbreviation, as shown in **Question 20**.
- a. \$430 000                                      b. \$7000                                      c. \$800 000

### Reasoning

22. Determine the largest five-digit number you can write if each digit must be different and no digit may be prime. Show your working.
23. A new mobile phone company is investigating the habits of phone users. From the following sample of phone calls, determine the most common length of call. Start by rounding each call time to the nearest half-minute (30 seconds).

132 s	10 s	43 s	71 s	243 s	52 s
142 s	332 s	6 s	38 s	63 s	32 s
132 s	32 s	43 s	52 s	352 s	101 s
124 s	28 s	153 s	10 s	243 s	64 s

24. Astronomers and other scientists use scientific notation when working with very large or very small numbers. For example, the 'astronomical unit' (AU) is the average distance of the Earth from the Sun; it is equal to 150 million km or  $1.5 \times 10^{13}$  cm. Explain why scientists use scientific notation.



### Problem solving

25. Determine how many two-digit numbers you can make using the digits 1 and 2 if:
- a. you are not allowed to repeat any digits
- b. you can repeat the digits.
26. Determine how many three-digit numbers you can make using the digits 1, 2 and 3 if:
- a. you are not allowed to repeat any digits
- b. you can repeat the digits.

Explain whether there is a relationship between the initial number of digits and the number of arrangements when:

- c. repetition is not allowed
- d. repetition is allowed.
27. Without actually counting to one million, determine a way of estimating the time it would take to count out loud from 0 to 1 000 000.

## 1.3 Strategies for adding and subtracting positive integers

### LEARNING INTENTION

At the end of this subtopic you should be able to:

- add and subtract positive integers using mental strategies.

### 1.3.1 Mental strategies for addition

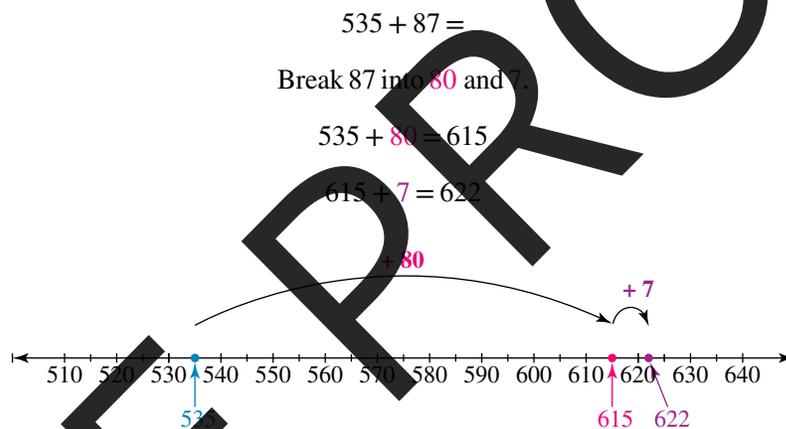
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- Mental strategies for addition are different ways to add up large numbers or integers in your head without a calculator.
- There are lots of different methods that can help you add 2- and 3-digit numbers in your head.

#### Jump strategy for addition

- The jump strategy for addition involves breaking the number being added into smaller parts.

For example:



#### Split strategy for addition

- The split strategy for addition involves splitting both numbers being added into their expanded forms and then adding the parts that have the same place value.

For example:

$$165 + 432 =$$

Split 165 into 1 hundred, 6 tens and 5 ones:  $165 = 100 + 60 + 5$

Split 432 into 4 hundreds, 3 tens and 2 ones:  $432 = 400 + 30 + 2$

$$\begin{aligned} 165 + 432 &= 100 + 60 + 5 + 400 + 30 + 2 \\ &= 100 + 400 + 60 + 30 + 5 + 2 \\ &= 500 + 90 + 7 \\ &= 597 \end{aligned}$$

## WORKED EXAMPLE 4 Using mental strategies to add numbers

- Calculate  $514 + 88$  using the jump strategy.
- Calculate  $759 + 412$  using the split strategy.

### THINK

1. Write the question.
  2. Break 88 into 80 plus 8.
  3. Add 80 to 514 to get 594.
  4. Add 8 to 594 to get 602.
  5. Write the answer.
1. Write the question.
  2. Split each number up by writing it in expanded form.
  3. Add the numbers with the same place value together.
  4. Write the answer.

### WRITE

$$514 + 88$$

$$88 = 80 + 8$$

$$514 + 80 = 594$$

$$594 + 8 = 602$$

$$514 + 88 = 602$$

$$759 + 412$$

$$759 = 700 + 50 + 9$$

$$412 = 400 + 10 + 2$$

$$700 + 400 + 50 + 10 + 9 + 2 = 1100 + 60 + 11 = 1171$$

$$759 + 412 = 1171$$

### Compensation strategy for addition

- The compensation strategy for addition involves making one of the numbers being added larger by rounding up to the nearest ten or hundred, completing the addition, and then subtracting the added amount.

For example:

$$243 + 78 =$$

1. Round 78 up to 80.

$$243 + 80 = 323$$

2. Now subtract 2, since 78 was rounded up to 80 by adding 2.

$$323 - 2 = 321$$

### Rearrange strategy for addition

- The rearrange strategy for addition involves rearranging the numbers being added to form numbers that add up to multiples of 10.

For example:

$$16 + 17 + 14 =$$

Swap the order and add 16 and 14 first, since this will result in a multiple of 10.

$$16 + 14 + 17 =$$

$$30 + 17 = 47$$

## WORKED EXAMPLE 5 Using mental strategies to add numbers

- Calculate  $576 + 86$  using the compensation strategy.
- Calculate  $38 + 13 + 22$  using the rearrange strategy.

### THINK

1. Write the question.
  2. Round 86 up to the nearest 10.
  3. Add 576 to the rounded-up number (90).
  4. Subtract 4, since 86 was rounded up to 90 by adding 4.
  5. Write the answer.
1. Write the question.
  2. Rearrange the numbers so that a multiple of 10 can be formed.  $38 + 22 = 60$ , so add these numbers first.
  3. Add 13 to 60.
  4. Write the answer.

### WRITE

$$\begin{aligned}576 + 86 \\86 \text{ becomes } 90 \text{ when rounded up by adding } 4. \\576 + 90 = 666 \\666 - 4 = 662 \\576 + 86 = 662\end{aligned}$$
$$\begin{aligned}38 + 13 + 22 \\= 38 + 22 + 13 \\= 60 + 13 \\= 73 \\38 + 13 + 22 = 73\end{aligned}$$

## WORKED EXAMPLE 6 Using mental strategies to add numbers

Calculate  $713 + 143$  using an appropriate mental strategy.

### THINK

1. Write the question.
2. Select a strategy. Since the numbers are both large numbers, it may be easiest to split them up.
3. Use the strategy to add numbers.
  - Write each number in expanded form.
  - Add numbers with the same place values.
  - Complete the final addition.
4. Write the answer.

### WRITE

$$\begin{aligned}713 + 143 \\ \text{Split strategy} \\713 = 700 + 10 + 3 \\143 = 100 + 40 + 3 \\700 + 100 + 10 + 40 + 3 + 3 \\= 800 + 50 + 6 \\= 856 \\713 + 143 = 856\end{aligned}$$

## 1.3.2 Mental strategies for subtraction

- Mental strategies for subtraction are different ways to subtract numbers without doing lots of working.
- There are lots of different methods that can help you subtract two- and three-digit numbers in your head.

### Jump strategy for subtraction

- The jump strategy for subtraction is like the jump strategy for addition, but you jump backward instead of forward.
- The number being subtracted is broken into smaller parts and then each part is subtracted one by one.

For example:

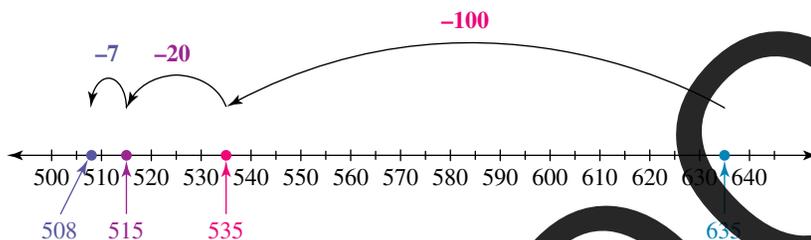
$$635 - 127 =$$

Break 127 into 100, 20 and 7.

$$635 - 100 = 535$$

$$535 - 20 = 515$$

$$515 - 7 = 508$$



### Adding up to find the difference

- Sometimes, even though you are subtracting, it can be helpful to use addition when trying to subtract numbers mentally.
- Start with the smaller number and add to that number in parts until you get to the larger number.

For example:

$$672 - 613 =$$

$$613 + 7 = 620$$

$$620 + 50 = 670$$

$$670 + 2 = 672$$

The numbers added are 7, 50 and 2, which give a total of 59.

Therefore  $672 - 613 = 59$ .

### WORKED EXAMPLE 7 Using mental strategies to subtract numbers

Calculate the following.

a.  $854 - 84$  using the jump strategy.

**THINK**

1. Write the question.
2. Break 84 into 80 plus 4.
3. Subtract 80 from 854 to get 774.
4. Subtract 4 from 774 to get 770.
5. Write the answer.

b.  $436 - 381$  using the adding strategy.

2. Starting at the smaller number, determine what needs to be added to get to the larger number.
3. Add up all the parts.
4. Write the answer.

**WRITE**

$$854 - 84$$

$$84 = 80 + 4$$

$$854 - 80 = 774$$

$$774 - 4 = 770$$

$$854 - 84 = 770$$

$$436 - 381$$

$$381 + 9 = 390$$

$$390 + 40 = 430$$

$$430 + 6 = 436$$

$$9 + 40 + 6 = 55$$

$$436 - 381 = 55$$

## Compensation strategy for subtraction

- The compensation strategy for subtraction is like the compensation strategy for addition, except that you will round up the number being subtracted to the nearest ten or hundred and then add the amount used to do the rounding up.

For example:

$$94 - 49 =$$

Round up 49 to 50 by adding 1.

$$94 - 50 = 44$$

Add 1 to the answer, since 49 was rounded up to 50 by adding 1.

$$44 + 1 = 45$$

$$94 - 49 = 45$$

### WORKED EXAMPLE 8 Using the compensation strategy to subtract numbers

Calculate  $174 - 38$  using the compensation strategy.

#### THINK

- Write the question.
- Round 38 up to the nearest 10 by adding 2.
- Subtract 40 from 174.
- Add 2 since, 38 was rounded up to 40 by adding 2.
- Write the answer.

#### WRITE

$$\begin{aligned} 174 - 38 \\ 38 \text{ becomes } 40. \\ 174 - 40 = 134 \\ 134 + 2 = 136 \\ 174 - 38 = 136 \end{aligned}$$

### Checking subtraction by adding

Remember, a subtraction can always be checked by adding the two smaller numbers to see if they add up to the larger number.

### DISCUSSION

What techniques have you used to mentally add numbers? What shortcuts have you used?

### Resources

-  **eWorkbook** Topic 1 Workbook (worksheets, code puzzle and project) (ewbk-1902)
-  **Digital document** SkillsSHEET Adding and subtracting whole numbers less than 20 (doc-6411)
-  **Interactivity** Individual pathway interactivity: Strategies for adding and subtracting positive integers (int-8731)

## Exercise 1.3 Strategies for adding and subtracting positive integers

### Individual pathways

**PRACTISE**

1, 2, 5, 7, 12, 13, 16

**CONSOLIDATE**

3, 6, 8, 11, 14, 17

**MASTER**

4, 9, 10, 15, 18

To answer questions online and to receive **immediate corrective feedback** and **fully worked solutions** for all questions, go to your learnON title at [www.jacplus.com.au](http://www.jacplus.com.au).

### Fluency

- WE4a** Use the jump strategy to calculate the following.
  - $143 + 85$
  - $1537 + 266$
- WE4b** Use the split strategy to calculate the following.
  - $645 + 261$
  - $370 + 78$
- WE5a** Use the compensation strategy to calculate the following.
  - $471 + 89$
  - $74 + 28$
- WE5b** Use the rearrange strategy to calculate the following.
  - $27 + 36 + 23$
  - $14 + 34 + 16$

### Understanding

- State whether the following statement is true or false. Show your working.  
 $346 + 451$  calculated using the split strategy becomes  $300 + 400 + 40 + 50 + 6 + 1$ .
- MC**  $56 + 12 + 14$  is equal to:  
A. 60      B. 82      C. 70      D. 92      E. 72
- WE6** Calculate  $421 + 54 + 372$  using an appropriate mental strategy.
- WE7a** Use the jump strategy to calculate the following.
  - $88 - 43$
  - $674 - 323$
- WE7b** Add up the difference to calculate the following.
  - $351 - 287$
  - $79 - 46$
- WE8** Use the compensation strategy to calculate the following.
  - $65 - 48$
  - $956 - 729$

- Calculate  $953 - 675$  using an appropriate mental strategy.
- Fill in the gaps for the following sentences.
  - All the numbers in the 5-times table end in \_\_\_\_\_ or \_\_\_\_\_.
  - The numbers in the \_\_\_\_\_-times tables all end in 0.

### Reasoning

- A student calculates  $145 + 671 - 472$ . They give their answer as 344. State whether you agree with their answer. Explain your response.

14. A student has shown the following working on a test.

$$641 + 357 = 600 + 10 + 4 + 300 + 70 + 5 = 989$$

- Determine where the student made an error.
  - Determine the correct answer.
15. Twenty children were playing in the playground. Eight of the children left for home, then six more children came to the playground. Determine how many children are in the playground now. Show your working.

### Problem solving

16. There are 763 students at a senior school campus. Of these, 213 students are currently completing exams. Calculate how many students are not completing exams.
17. Harriet has \$243 in savings. She adds \$93 to her savings account. The next day she spends \$175 from her account. Determine how much is left in her savings account.
18. The sum of two numbers is 19 and their difference is 7. Evaluate the two numbers.

## 1.4 Algorithms for adding and subtracting positive integers

### LEARNING INTENTION

At the end of this subtopic you should be able to:

- add and subtract positive integers using algorithms.



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### 1.4.1 Addition of positive integers using algorithms

- To add numbers or positive integers, write them in columns according to place value and then add them, starting at the ones column.
- The **sum** is the result obtained when numbers are added together.

### WORKED EXAMPLE 9 Adding integers in columns

Arrange these numbers in columns, then add them.

$$1462 + 78 + 316$$

#### THINK

- Set out the numbers in columns according to place value.
- Add the digits in the ones column in your head ( $2 + 8 + 6 = 16$ ). Write the 6 in the ones column of your answer and carry the 1 to the tens column, as shown in the plum colour.
- Add the digits in the tens column ( $1 + 6 + 7 + 1 = 15$ ). Write the 5 in the tens column of your answer and carry the 1 to the hundreds column, as shown in pink.

#### WRITE

	Thousands	Hundreds	Tens	Ones
	1	<sup>1</sup> 4	<sup>1</sup> 6	2
			7	8
+		3	1	6
	<u>1</u>	<u>8</u>	<u>5</u>	<u>6</u>

- Add the digits in the hundreds column ( $1 + 4 + 3 = 8$ ). Write 8 in the hundreds column of your answer, as shown in pink. There is nothing to carry.
- There is only a 1 in the thousands column. Write 1 in the thousands column of your answer.
- State the answer.

The sum of 1462, 78 and 316 is 1856.

### WORKED EXAMPLE 10 Adding by making a multiple of 10

Perform the addition  $27 + 19 + 141 + 73$  by finding suitable pairs of numbers to make multiples of 50.

#### THINK

- Write the question.
- Look for pairs of numbers that can be added to make a multiple of 10. Reorder the sum, pairing these numbers.
- Add the number pairs.
- Complete the addition.

#### WRITE

$$\begin{aligned} 27 + 19 + 141 + 73 \\ &= (27 + 73) + (141 + 19) \\ &= 100 + 160 \\ &= 260 \end{aligned}$$



eles-3648

## 1.4.2 Commutative and associative laws for addition

- The **Commutative Law for addition** means that you can add numbers in any order. For example,  $3 + 4$  gives the same result as  $4 + 3$ .
- The **Associative Law for addition**, simply stated, means that the order in which additions are calculated is not important and does not change the result. For example,  $2 + 3 + 7$  could be calculated as  $5 + 7 = 12$  or  $2 + 10 = 12$ .

This is a very useful property when performing mental calculations.

### ACTIVITY: There's something about Gauss

In the late 1780s, a German teacher gave his class the task of adding the numbers from 1 to 100. One student came up with the correct answer in less than a minute. That student, Johann Carl Friedrich Gauss, used grouping in pairs to work out the sum. He paired the smallest number with the largest number, then the second smallest with the second largest, and so on. Gauss went on to become one of the world's most famous mathematicians.

Try the technique that Gauss used with the numbers from 1 to 10, then 1 to 20, then 1 to 50 and finally 1 to 100. Did you notice any patterns?





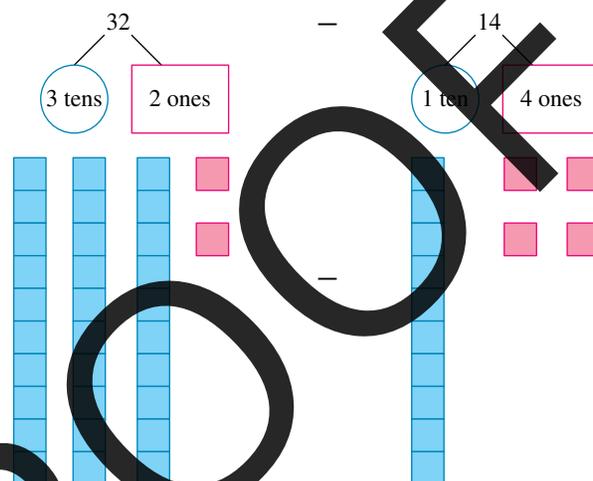
## Subtraction of positive integers with borrowing

- The most common method of subtraction is to use borrowing, which is called the **decomposition method**.
- It's called 'decomposition' because the larger number is decomposed, or taken apart.
- A visual representation of the decomposition method is shown here to help you understand how it works.

## Visual representation of subtracting using decomposition

Evaluate  $32 - 14$ .

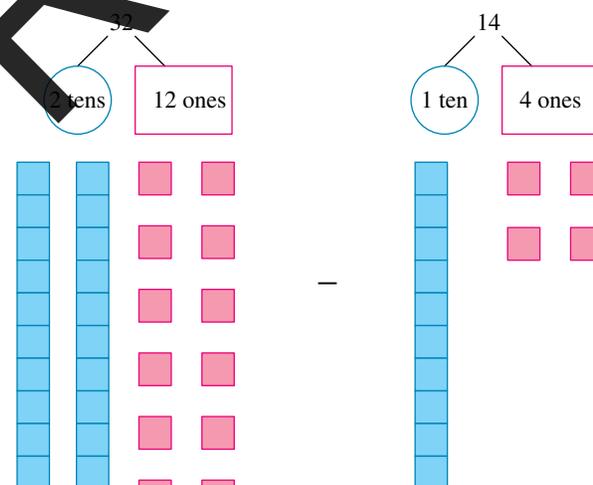
1. Decompose each number by breaking it up into place value parts (**tens** and **ones** in this case).



2. Since we can't take 4 ones from 2 ones, we instead borrow a block of 10 and split them into ones.

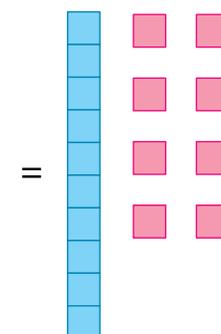
Borrowing step:

3. Rewrite 32 as 2 tens and 12 ones.  
*Note:* Effectively we have borrowed a ten from the tens column and given it to the ones column so that we can work out the subtraction.



4. We can now complete the subtraction.

- Subtracting the ones first gives:  
 $12 - 4 = 8$  ones
- Subtracting the tens next gives:  
 $2 - 1 = 1$  ten
- This gives us 1 ten and 8 ones left over after the subtraction.
- This is the same as 18 individual blocks.



5. State the answer.

$$32 - 14 = 18$$

## Algorithmic approach to subtraction using decomposition

The subtraction  $32 - 14$  can be solved more formally using the following algorithm (set of steps).

1. Set out the difference in columns according to place value.
2. Because 4 can't be subtracted from 2, take one 10 from the tens column of the larger number and add it to the ones column of the same number. So 2 becomes 12, and the 3 tens become 2 tens.
3. Subtract 4 units from 12 units ( $12 - 4 = 8$ ).
4. Subtract 1 ten from the remaining 2 tens ( $2 - 1 = 1$ ).
5. Write the answer.

$$\begin{array}{r} 32 \\ - 14 \\ \hline \end{array}$$

$$\begin{array}{r} \overset{2}{\cancel{3}} \overset{1}{2} \\ - 14 \\ \hline 18 \end{array}$$

$$32 - 14 = 18$$

### WORKED EXAMPLE 12 Subtracting numbers using decomposition

Subtract the following:

a.  $6892 - 467$

b.  $3000 - 467$

THINK

1. Since 7 cannot be subtracted from 2, take one ten from the tens column of the larger number and add it to the units column of the same number. The 2 becomes 12 and the 9 tens become 8 tens.
  2. Subtract the 7 units from the 12 units ( $12 - 7 = 5$ ).
  3. Subtract 6 tens from the 8 remaining tens ( $8 - 6 = 2$ ).
  4. Subtract 4 hundreds from the 8 hundreds ( $8 - 4 = 4$ ).
  5. Subtract 0 thousands from the 6 thousands ( $6 - 0 = 6$ ).
  6. State the answer.
1. Since 7 cannot be taken from 0, 0 needs to become 10.
  2. We cannot take 10 from the tens column because it is also 0. The first column that we can take anything from is the thousands, so 3000 is decomposed to 2 thousands, 9 hundreds, 9 tens and 10 units.
  3. Subtract the units ( $10 - 7 = 3$ ).
  4. Subtract the tens ( $9 - 6 = 3$ ).
  5. Subtract the hundreds ( $9 - 4 = 5$ ).
  6. Subtract the thousands ( $2 - 0 = 2$ ).
  7. State the answer.

WRITE

$$\begin{array}{r} 6892 \\ - 467 \\ \hline 6425 \end{array}$$

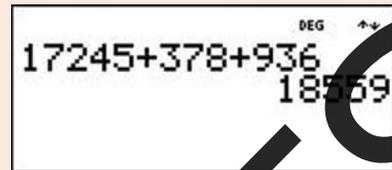
$$6892 - 467 = 6425$$

$$\begin{array}{r} \overset{2}{\cancel{3}} \overset{9}{0} \overset{9}{0} \overset{1}{0} \\ - 467 \\ \hline 2533 \end{array}$$

$$3000 - 467 = 2533$$

## Digital technology

Scientific calculators can evaluate sums of two or more numbers.



Scientific calculators can evaluate differences between two numbers.



## on Resources



**eWorkbook** Topic 1 Workbook (worksheets, code puzzle and project) (ewbk-1902)



**Interactivities** Individual pathway interactivity: Algorithms for adding and subtracting positive integers (int-8732)

Addition of positive integers (int-3922)

Subtraction of positive integers (int-3923)

## Exercise 1.4 Algorithms for adding and subtracting positive integers

learnon

### Individual pathways

#### PRACTISE

1, 2, 6, 9, 12, 13, 18, 22, 25

#### CONSOLIDATE

3, 5, 7, 14, 15, 17, 19, 23, 26

#### MASTER

4, 8, 10, 11, 16, 20, 21, 24, 27, 28

To answer questions online and to receive **immediate corrective feedback** and **fully worked solutions** for all questions, go to your learnON title at [www.jacplus.com.au](http://www.jacplus.com.au).

### Fluency

1. Answer these questions by doing the working in your head.

a.  $7 + 8$

b.  $20 + 17$

c.  $195 + 15$

d.  $227 + 13$

e.  $1000 + 730$

2. Answer these questions by doing the working in your head.

a.  $17\,000 + 1220$

b.  $125\,000 + 50\,000$

c.  $2 + 8 + 1 + 9$

d.  $6 + 8 + 9 + 3 + 2 + 4 + 1 + 7$

e.  $12 + 5 + 3 + 7 + 15 + 8$

3. Add the following numbers, setting them out in columns as shown. Check your answers using a calculator.

a. 
$$\begin{array}{r} 34 \\ + 65 \\ \hline \end{array}$$

b. 
$$\begin{array}{r} 68\,069 \\ 317 \\ 8 \\ + 4254 \\ \hline \end{array}$$

c. 
$$\begin{array}{r} 399 \\ 1489 \\ 2798 \\ + 8943 \\ \hline \end{array}$$

4. **WE9** Arrange the following numbers in columns, then add them.

- a.  $137 + 841$
- b.  $149 + 562 + 55$
- c.  $376 + 948 + 11$
- d.  $8 + 12\,972 + 59 + 1423$
- e.  $1700\,245 + 378 + 930$

Check your answers with a calculator.



5. **WE10** Mentally perform each of the following additions by pairing suitable numbers together.

- a.  $56 + 87 + 24 + 13$
- b.  $74 + 189 + 6 + 11$
- c.  $98 + 247 + 305 + 3 + 95 + 42$
- d.  $180 + 364 + 59 + 141 + 47 + 20 + 16$

6. Answer the following questions without using a calculator.

- a.  $11 - 5$
- b.  $53 - 30$
- c.  $100 - 95$
- d.  $150 - 25$
- e.  $1100 - 200$

7. Work out the following without using a calculator.

- a.  $1700 - 1000$
- b.  $100 - 20 - 10$
- c.  $1000 - 50 - 300 - 150$
- d.  $24 - 3 - 16$
- e.  $54 - 28$

8. Calculate the following.

- a.  $10 + 8 - 5 + 2 - 11$
- b.  $40 + 15 - 35$
- c.  $120 - 40 - 25$
- d.  $15 + 45 + 25 - 85$
- e.  $100 - 70 + 45$
- f.  $1000 - 400 + 250 + 150 + 150$

9. **WE11&12** Work out the following subtractions.

- a.  $167 - 132$
- b.  $47\,836 - 12\,713$
- c.  $642\,803 - 58\,204$

### Understanding

10. Solve the following subtractions.

- a.  $664 - 397$
- b.  $12\,900 - 8487$
- c.  $69\,000 - 3561$
- d.  $2683 - 49$

Check your answers using a calculator.

11. Work out the following subtractions.

- a.  $70\,400 - 1003$
- b.  $27\,321 - 25\,768$
- c.  $812\,741 - 462\,923$
- d.  $23\,718\,482 - 4\,629\,738$

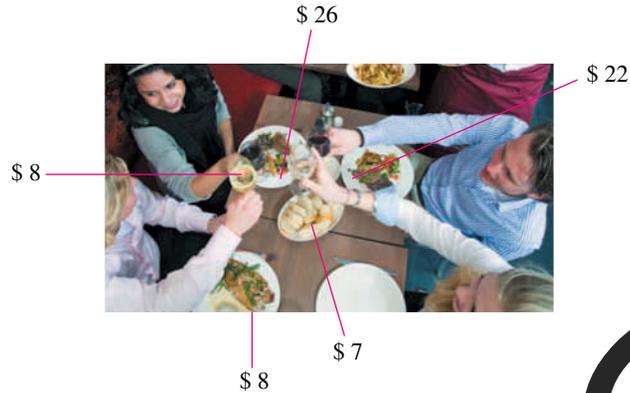
Check your answers using a calculator.

12. Hella was performing in a ballet and needed to buy a tutu, ballet shoes and white tights. Based on the prices shown in the photograph, calculate how much she spent in total on her costume.



13. A print dictionary is split into two volumes. There are 1544 pages in the A–K volume and 1488 pages in the L–Z volume. Calculate how many pages the dictionary has in total.

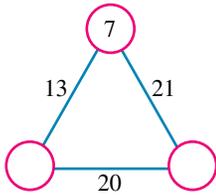
14. Nathan has taken his sister and her friends to lunch for her birthday. Determine what the total cost of the items shown will be.



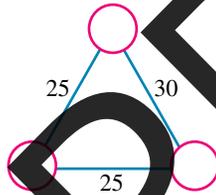
15. Of all the world's rivers, the Amazon in South America and the Nile in Africa are the two longest. The Amazon is 6437 kilometres in length and the Nile is 233 kilometres longer than the Amazon. Calculate the length of the Nile.

16. An **arithmagon** is a triangular figure in which the two numbers at the end of each line add to the number along the line, like in the example shown. Solve each of these arithmagons.

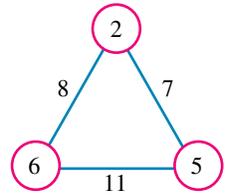
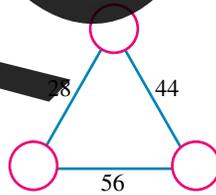
a.



b.

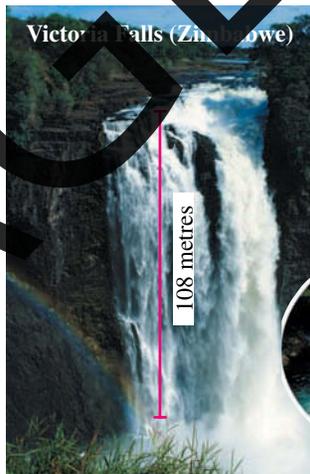


c.



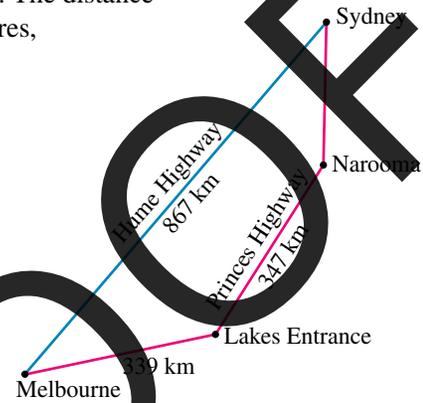
17. The following photographs show three of the highest waterfalls in the world. Determine how much higher:

- Victoria Falls is than Iguazu Falls
- Iguazu Falls is than Niagara Falls
- Victoria Falls is than Niagara Falls



18. Prithvi received a box of 36 chocolates. They ate 3 on Monday, 11 on Tuesday and gave 7 away on Wednesday. Calculate how many they had left.

19. A crowd of 24 083 attended an NRL match between Canterbury-Bankstown Bulldogs and St George Illawarra Dragons. If 14 492 people supported the Bulldogs and the rest supported the Dragons, calculate how many supporters the Dragons had.
20. A school bus left Laurel High School with 31 students aboard. Thirteen of these passengers disembarked at Hardy Railway Station. The bus collected 24 more students at Hardy High School and a further 11 students disembarked at Laurel Swimming Pool. Calculate how many students were still on the bus.
21. Shu-Ling and Ty were driving from Melbourne to Sydney for a holiday. The distance between Melbourne and Sydney via the Hume Highway is 867 kilometres, but they chose the more scenic Princes Highway even though the distance is 1039 kilometres. They drove to Lakes Entrance on the first day (339 kilometres), a further 347 kilometres to Narooma on the second day, and arrived in Sydney on the third day.
- Calculate how much further it is from Melbourne to Sydney via the Princes Highway than via the Hume Highway.
  - Determine how far Shu-Ling and Ty travelled on the third day.



### Reasoning

22. Fill in the missing numbers. The \* can represent any digit.

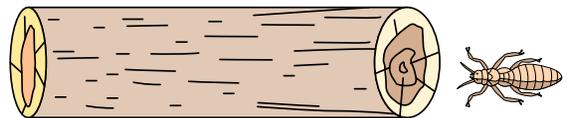
a. 
$$\begin{array}{r} 6 * 8 * 2 * \\ - 4 8 8 4 1 7 \\ \hline * 4 9 9 * 4 \end{array}$$

b. 
$$\begin{array}{r} 3 * 9 * \\ - 6 * 5 \\ \hline * 0 7 \end{array}$$

23. In less than 10 seconds, without using a calculator, calculate the answer to  $6\,849\,317 - 999\,999$ . Explain how you reached your answer.
24. A beetle has fallen into a hole that is 15 metres deep. It is able to climb a distance of 3 metres during the day, but at night the beetle is tired and must rest. However, during the night it slides back 1 metre. How many days will it take the beetle to reach the top of the hole to freedom? Explain your answer.

### Problem solving

25. Five termites start munching through a log.  
 Pixie is 19 mm ahead of Bitsie.  
 Trixie is 5 mm ahead of Mixie.  
 Mixie is twice as far ahead as Itsie.  
 Itsie is 10 mm behind Bitsie.  
 Mixie has eaten through 52 mm.  
 Determine which termite has eaten the most. Show your working.



26. In a class of 22 students, each attends swimming practice or lifesaving, or both. If 16 students attend swimming practice and 9 attend lifesaving, work out how many attend both.
27. Zama works in a restaurant where people work from Monday to Friday, on weekends only, or from Monday to Sunday. There are 15 employees at the restaurant. If 13 employees work every Monday and 14 employees work every Sunday, evaluate how many employees do not work from Monday to Sunday.



28. There are 20 chocolate bars on the table all containing only fruit, only nuts, or fruit and nuts together. If 12 chocolate bars contain nuts and 14 chocolate bars contain fruit, evaluate the number of chocolate bars that contain both fruit and nuts.

# 1.5 Multiplying positive integers

## LEARNING INTENTION

At the end of this subtopic you should be able to:

- multiply positive integers using mental strategies and algorithms.



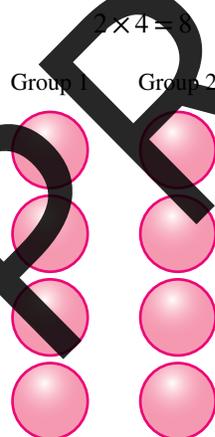
eles-3650

## 1.5.1 Multiplying positive integers

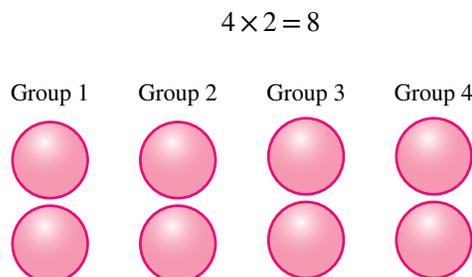
- **Multiplication** is a short way of performing repeated addition of the same number. For example,  $3 + 3 + 3 + 3 + 3$  represents 5 groups of 3 and can be written as  $5 \times 3$ .
- The **product** is the answer you get when numbers are multiplied. For example, the product of 5 and 3 is 15 because  $5 \times 3 = 15$ .
- Multiplication is commutative because the order in which numbers are multiplied is not important. For example,  $3 \times 8 = 8 \times 3$ .

### Multiplying using diagrams

- The following diagram shows 2 groups of balls with 4 balls in each group. There are 8 balls in total. This can be written as a multiplication.



- Instead, what if we looked at the picture as 4 groups of balls with 2 balls in each group? Would we get the same answer? Count the balls and see. There are still 8 balls in total.



### Multiplying two numbers

When two numbers are multiplied, the order does not matter; the answer will be the same.

### WORKED EXAMPLE 13 Using a diagram to multiply numbers

a. Draw a diagram to show  $2 \times 6$ .

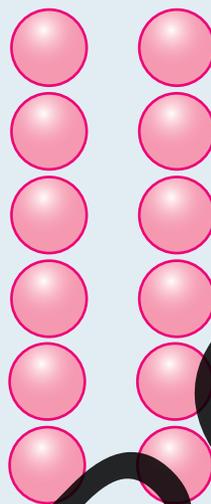
b. State what  $2 \times 6$  is equal to.

#### THINK

a. Draw a diagram with 2 groups of 6.

#### WRITE/DRAW

Group 1      Group 2



b. Count how many circles there are altogether. There are 12 circles.

c. Write the answer.

$$2 \times 6 = 12$$

- To multiply small numbers, we learn the times tables. We can also use diagrams.
- To multiply larger numbers, we need to use other methods. These methods are discussed later in this topic.

### Multiplying using expanded form

- In this method of multiplication the larger number being multiplied is broken up into expanded form first, then each component is multiplied by the smaller number.

For example, here is how the expanded form can be used to calculate  $215 \times 4$ .

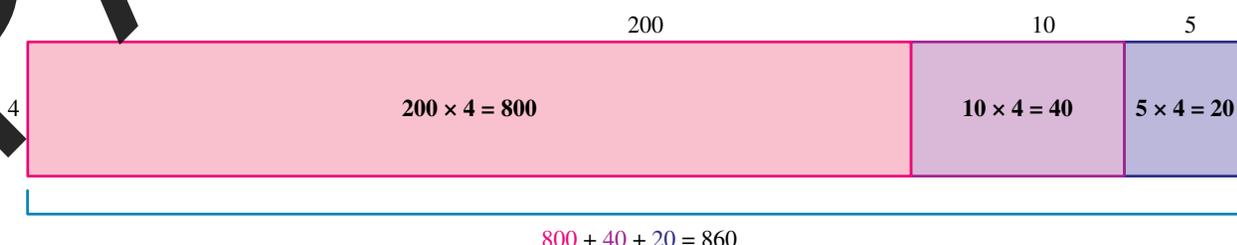
The expanded form of  $215 = 200 + 10 + 5$

$$\begin{aligned} 215 \times 4 &= (200 \times 4) + (10 \times 4) + (5 \times 4) \\ &= 800 + 40 + 20 \\ &= 860 \end{aligned}$$

### Multiplying using the area model

- The area model of multiplication involves using the expanded form of the larger number and constructing rectangles for each component, arranged according to place value.

This diagram shows how to calculate  $215 \times 4$  using an area model. (*Note:* This graph is not drawn to scale.)



## 1.5.2 The short multiplication algorithm

- The short multiplication algorithm can be used when multiplying a large number by a single digit number.
- Start by lining up the numbers in columns, with one number under the other number. Place the larger number on top.
- Next, multiply each place value in the larger number by the smaller number, starting with the units column.
- Write the answer to each multiplication underneath the smaller number in the appropriate column.
- If an answer has two place values, carry the larger place value to the next column on the left and add it to the result of the next multiplication.

$$\begin{array}{r} 2 \\ 215 \\ \times 4 \\ \hline 860 \end{array}$$

1.  $5 \times 4 = 20$
2. Write the 0 in the units column and carry the 2 over to the tens column.
3. Perform the next multiplication and add the carried number to the result.  
 $1 \times 4 = 4$ ;  $4 + 2 = 6$
4. Write the 6 in the tens column.
5.  $2 \times 4 = 8$
6. Write the 8 in the hundreds column.

### WORKED EXAMPLE 14 Multiplying using short multiplication

Calculate  $1456 \times 5$ .

**THINK**

1. Write the numbers in columns according to place value with the larger number on top.
2. Multiply the units by 5 ( $5 \times 6 = 30$ ). Write down the 0 and carry the 3 to the tens column.
3. Multiply the tens by 5 and add the carried number ( $5 \times 5 = 25$ ;  $25 + 3 = 28$ ). Write the 8 in the tens column and carry the 2 to the hundreds column.
4. Multiply the hundreds by 5 and add the carried number ( $5 \times 4 = 20$ ;  $20 + 2 = 22$ ).. Write the last 2 in the hundreds column and carry the other 2 to the thousands column.
5. Multiply the thousands by 5 and add the carried number ( $5 \times 1 = 5$ ;  $5 + 2 = 7$ ). Write 7 in the thousands column of the answer.
6. Write the answer.

**WRITE**

$$\begin{array}{r} 1456 \\ \times 5 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 2124356 \\ \times 5 \\ \hline 7280 \end{array}$$

$$1456 \times 5 = 7280$$

eles-3652 **1.5.3 The long multiplication algorithm**

- The long multiplication algorithm is used to multiply numbers that both have more than one digit. The process is the same as that for short multiplication, but it is repeated for each additional digit.
- When multiplying two numbers that both have more than one digit, a 0 is added in the second row.

**WORKED EXAMPLE 15** Multiplying whole numbers

Evaluate the following.

- a.  $547 \times 6$   
 b.  $35 \times 62$

**THINK**

a. 1. Set up the multiplication in columns, with the smaller number on the bottom.

2. Multiply each digit in 547 by 6.
- $7 \times 6 = 42$ . Write 2 and carry 4.
  - $4 \times 6 + 4 = 28$ . Write 8 and carry 2.
  - $5 \times 6 + 2 = 32$ . Write 32.

3. Write the answer.

b. 1. Set up the multiplication in columns.

2. Multiply 35 by 2.
- $5 \times 2 = 10$ . Write 0 and carry 1.
  - $3 \times 2 + 1 = 7$ .  $6 + 1 = 7$ . Write 7.

3. Add a 0 to the second row because you are multiplying by a number in the tens column.

4. Multiply 35 by 6.
- $5 \times 6 = 30$ . Write 0 and carry 3.
  - $3 \times 6 + 3 = 21$ . Write 21.

5. Add 70 and 2100 to get the answer.

6. Write the answer.

**WRITE**

$$\begin{array}{r} 547 \\ \times 6 \\ \hline 3282 \end{array}$$

$547 \times 6 = 3282$

$$\begin{array}{r} 35 \\ \times 62 \\ \hline \end{array}$$

$$\begin{array}{r} 135 \\ \times 62 \\ \hline 70 \end{array}$$

$$\begin{array}{r} 335 \\ \times 62 \\ \hline 70 \\ 210 \end{array}$$

$$\begin{array}{r} 335 \\ \times 62 \\ \hline 70 \\ +2100 \\ \hline 2170 \end{array}$$

$35 \times 62 = 2170$

## WORKED EXAMPLE 16 Multiplying using long multiplication

Calculate  $1456 \times 132$  using long multiplication.

### THINK

1. Set the product up in columns according to place value, writing the larger number on top.
2. Multiply the larger number by the units digit in the smaller number using short multiplication ( $1456 \times 2 = 2912$ ). Write the answer directly below the problem.
3. Place a zero in the units column, as shown in pink, when multiplying the larger number by the tens digit of the smaller number ( $1456 \times 3 = 4368$ ). This is because you are really working out  $1456 \times 30 = 43\,680$ . Write the answer directly below the previous answer.
4. Place zeros in the units and tens columns, as shown in pink, when multiplying the larger number by the hundreds digit of the smaller number ( $1456 \times 1 = 1456$ ). This is because you are really working out  $1456 \times 100 = 145\,600$ . Write the answer directly below the previous answer.
5. Add the numbers in each column of the three rows to determine the answer.
6. Write the answer.

### WRITE

$$\begin{array}{r} 1456 \\ \times 132 \\ \hline \end{array}$$

$$\begin{array}{r} 1456 \\ \times 132 \\ \hline 2912 \end{array}$$

$$\begin{array}{r} 1456 \\ \times 132 \\ \hline 2912 \\ 43680 \end{array}$$

$$\begin{array}{r} 1456 \\ \times 132 \\ \hline 2912 \\ 43680 \\ +145600 \\ \hline 192192 \end{array}$$

$$1456 \times 132 = 192\,192$$

- The **Distributive Law** applies only to multiplication. It states that  $a(b + c) = ab + ac$ . The Distributive Law helps with mental calculation because it means, for example, that  $8 \times 13$  can be thought of as:

$$\begin{aligned} 8 \times 13 &= 8 \times (3 + 10) \\ &= 8 \times 3 + 8 \times 10 \\ &= 24 + 80 \\ &= 104 \end{aligned}$$

### Digital Technology

Scientific calculators can evaluate the multiplication of large numbers.



## 1.5.4 Mental strategies for multiplication

- In many cases it is not practical to use pen and paper (or even a calculator) to perform multiplication.
- There are mental strategies that can make multiplication easier.
- Multiplication is associative — this means smaller numbers can be paired up for multiplication.

$$\begin{aligned} \text{For example, } 2 \times 17 \times 5 &= 17 \times (2 \times 5) \\ &= 17 \times 10 \\ &= 170 \end{aligned}$$

This calculation has been simplified by finding the pair of numbers that multiply to equal 10.

### WORKED EXAMPLE 17 Using mental strategies for multiplication

Use mental strategies to calculate  $4 \times 23 \times 25$ .

#### THINK

1. Write the question.
2. Look for a number pair that makes a simpler multiplication and rearrange.  $4 \times 25 = 100$ , and multiplying by 100 is simpler than multiplying by either 4 or 25.
3. Mentally calculate  $4 \times 25$ .
4. Mentally calculate the final answer.

#### WRITE

$$\begin{aligned} &4 \times 23 \times 25 \\ &= 23 \times (4 \times 25) \\ &= 23 \times 100 \\ &= 2300 \end{aligned}$$

### WORKED EXAMPLE 18 Using mental strategies for multiplication

Use a mental strategy to calculate  $34 \times 200$ .

#### THINK

1. Write the question.
2. Write 200 as  $2 \times 100$ .
3. Mentally calculate  $34 \times 2$ .
4. Mentally calculate  $68 \times 100$ .

#### WRITE

$$\begin{aligned} &34 \times 200 \\ &= 34 \times 2 \times 100 \\ &= 68 \times 100 \\ &= 6800 \end{aligned}$$

#### Multiplying multiples of 10 or 100

If both numbers are **multiples** of 10, 100 and so on, ignore the zeros, multiply the remaining numbers, then add the total number of zeros to the answer.

For example,  $900 \times 6000 = 5400\,000$ .

- Consider the multiplication  $9 \times 58$ . This multiplication can be regarded as  $10 \times 58 - 1 \times 58$ . Using this way of writing the multiplication, the answer can be mentally calculated by multiplying 58 by 10 and then subtracting 58 from the answer. This can be thought of as the ‘multiply by 10’ strategy.

### WORKED EXAMPLE 19 Using mental strategies for multiplication

Use a mental strategy to calculate  $77 \times 9$ .

#### THINK

1. Write the question.
2. Use the strategy of ‘multiply by 10’.
3. Calculate  $77 \times 10$  and then subtract 77.

#### WRITE

$$\begin{aligned} &77 \times 9 \\ &= 77 \times 10 - 77 \times 1 \\ &= 770 - 77 \\ &= 693 \end{aligned}$$

-  **eWorkbook** Topic 1 Workbook (worksheets, code puzzle and project) (ewbk-1902)
-  **Digital documents** SkillSHEET Times tables (doc-6412)  
SkillSHEET Multiplying whole numbers (doc-6413)
-  **Interactivities** Individual pathway interactivity: Multiplying positive integers (int-4313)  
Multiplying positive integers (int-3958)  
Mental strategies for multiplication (int-3925)

## Exercise 1.5 Multiplying positive integers

### Individual pathways

#### ■ PRACTISE

1, 2, 6, 8, 11, 13, 16, 17, 22, 23,  
24, 27, 30, 33

#### ■ CONSOLIDATE

3, 4, 9, 12, 14, 18, 19, 25, 26,  
31, 34

#### ■ MASTER

5, 7, 10, 15, 20, 21, 28, 29, 32,  
35, 36

To answer questions online and to receive **immediate corrective feedback** and **fully worked solutions** for all questions, go to your learnON title at [www.jacplus.com.au](http://www.jacplus.com.au).

### Fluency

1. **WE13** Represent each of the following as a diagram and then use the diagram to calculate the product.
  - a.  $8 \times 3$
  - b.  $6 \times 9$
  - c.  $12 \times 5$
  - d.  $13 \times 2$
  - e.  $15 \times 3$
2. Calculate the product of each of the following without using a calculator.
  - a.  $25 \times 4$
  - b.  $45 \times 2$
  - c.  $16 \times 2$
  - d.  $21 \times 3$
  - e.  $54 \times 2$
3. Calculate the product of each of the following without using a calculator.
  - a.  $25 \times 3$
  - b.  $3 \times 4 \times 6$
  - c.  $3 \times 3 \times 3$
  - d.  $5 \times 6 \times 3$
  - e.  $8 \times 5 \times 2$
4. Calculate  $267 \times 3$  by rewriting the larger number in expanded form.
5. Use an area model to:
  - a. show  $523 \times 4$
  - b. calculate  $523 \times 4$ .
6. **WE14** Calculate the following using short multiplication.
  - a.  $16 \times 8$
  - b.  $137 \times 9$
  - c.  $857 \times 3$
  - d.  $4920 \times 5$
7. Calculate the following using short multiplication.
  - a.  $7888 \times 8$
  - b.  $2015 \times 8$
  - c.  $10\,597 \times 6$
  - d.  $41\,060 \times 12$
 Check your answers using a calculator.
8. **WE15** Calculate the following using long multiplication.
  - a.  $52 \times 44$
  - b.  $97 \times 31$
  - c.  $59 \times 28$
9. Calculate the following using long multiplication.
  - a.  $16 \times 57$
  - b.  $850 \times 76$
  - c.  $407 \times 53$
10. Calculate the following using long multiplication.
  - a.  $80\,055 \times 27$
  - b.  $57\,835 \times 476$
  - c.  $8027 \times 215$
 Check your answers using a calculator.

11. **WE17** Use mental strategies to calculate the following.  
 a.  $2 \times 8 \times 5$       b.  $4 \times 19 \times 25$       c.  $50 \times 45 \times 2$       d.  $4 \times 67 \times 250$
12. **WE18** Use mental strategies to calculate the following.  
 a.  $45 \times 20$       b.  $62 \times 50$       c.  $84 \times 200$       d.  $86 \times 2000$
13. Calculate each of the following.  
 a.  $200 \times 40$       b.  $600 \times 800$       c.  $1100 \times 5000$       d.  $900\,000 \times 7000$
14. Calculate each of the following.  
 a.  $90 \times 80$       b.  $800 \times 7000$       c.  $9000 \times 6000$       d.  $12\,000 \times 1100$
15. **WE19** Use mental strategies to calculate each of the following.  
 a.  $34 \times 9$       b.  $628 \times 9$       c.  $75 \times 99$       d.  $26 \times 8$
16. a. Calculate  $56 \times 100$ .  
 b. Calculate  $56 \times 10$ .  
 c. Use your answers to parts **a** and **b** to calculate the answer to  $56 \times 90$ .
17. Use the method demonstrated in question **16** to calculate each of the following.  
 a.  $48 \times 90$       b.  $125 \times 90$       c.  $32 \times 900$
18. a. Calculate  $25 \times 6$ .  
 b. Multiply your answer to part **a** by 2.  
 c. Now calculate  $25 \times 12$ .
19. Use one of the methods demonstrated in this subtopic to mentally calculate the value of each of the following.  
 a.  $15 \times 12$       b.  $70 \times 12$       c.  $40 \times 16$       d.  $34 \times 20$
20. Answer the following questions.  
 a. Calculate the value of  $9 \times 10$ .  
 b. Calculate the value of  $9 \times 3$ .  
 c. Calculate the value of  $9 \times 13$ .
21. Use one of the methods demonstrated in this subtopic to mentally calculate the value of each of the following.  
 a.  $25 \times 13$       b.  $24 \times 13$

### Understanding

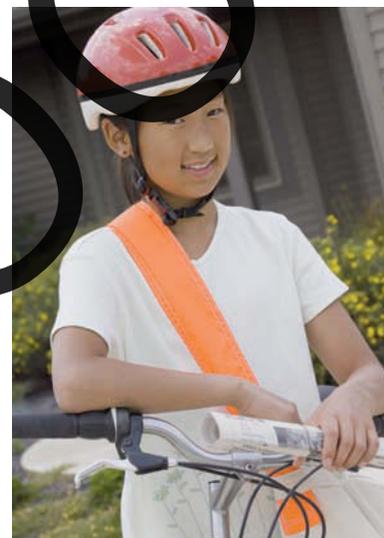
22. A school has eight Year 7 classes with 26 students in each class. Calculate how many students there are in Year 7 in total.
23. A shop owner sells 84 bananas each day. Calculate how many bananas are sold in 2 weeks.
24. Ezra wants to make a telephone call to her friend Aasuka, who lives in San Francisco. The call will cost her \$3 per minute. If Ezra speaks to Aasuka for 24 minutes:  
 a. calculate what the call will cost  
 b. calculate what Ezra would pay if she made this call every month for 2 years.



25. Santilla is buying some generators. The generators cost \$12 000 each. She needs 11 of them. Calculate how much they will cost her in total.
26. Julie was saving money to buy a digital camera. She was able to save \$75 each month.
- Calculate how much she saved over 9 months.
  - Calculate how much she saved over 16 months.
  - If Julie continues to save money at the same rate, calculate how much she will save over a period of 3 years.



27. A car can travel 14 kilometres using 1 litre of fuel. Calculate how far it could travel with 35 litres of fuel.
28. In 1995 a team of British soldiers in Hamelin, Germany, constructed a bridge in the fastest time ever. The bridge spanned an 8-metre gap and took the soldiers 8 minutes and 44 seconds to build. Determine how many seconds in total it took to build the bridge.
29. Narissa does a paper round each morning before school. She travels 2 kilometres each morning on her bicycle, delivers 80 papers and is paid \$35. She does her round each weekday.
- Calculate how far she travels in 1 week.
  - Determine how much she gets paid in 1 week.
  - Calculate how far she travels in 12 weeks.
  - Calculate how much she would be paid over 52 weeks.
  - Calculate how many papers she would deliver in 1 week.
  - Determine how many papers she would deliver in 52 weeks.



### Reasoning

30. Jake says the product of 42 and 35 is 1428. His friend Ben worked out the answer to be 1470. State who is correct, Jake or Ben. Explain your answer.
31. Explain whether the mathematical statement  $23 \times 4 > 20 \times 7$  is true.
32. Imagine a simplified form of a car numberplate that consists of one letter followed by one number, from A0 up to Z9. Determine how many numberplates could be issued under this system. Remember that all numberplates issued have to be different.



### Problem solving

33. Evaluate the product of 4, 16 and 9 using expanded form.
34. Consider numbers with two identical digits multiplied by 99. Determine:

$$11 \times 99, 22 \times 99, 33 \times 99$$

Can you see a pattern? Explain it.

Without using a calculator or long multiplication, write down the answers to the following.

- |                   |                   |                   |
|-------------------|-------------------|-------------------|
| a. $44 \times 99$ | b. $55 \times 99$ | c. $66 \times 99$ |
| d. $77 \times 99$ | e. $88 \times 99$ | f. $99 \times 99$ |

- 35. Theo eats one of the strawberries in a basket, then he and his two friends split them evenly. If Theo's friends get 15 strawberries each, determine how many there were in the basket to begin with.
- 36. The product of two consecutive numbers is 1190. Evaluate the two numbers and their sum.



## 1.6 Dividing positive integers

### LEARNING INTENTION

At the end of this subtopic you should be able to:

- divide positive integers using mental strategies and the short division algorithm

### 1.6.1 Dividing positive integers

eles-3653

- **Division** is the process of sharing (or dividing) a number into equal parts. If 10 is divided into five parts, you can write this as  $10 \div 5 = 2$ .
- Division is the opposite (or inverse) of multiplication. To evaluate  $56 \div 8$ , you could ask the question, 'By which number do I multiply 8 to get 56?'  $8 \times 7 = 56$ , so the answer is 7.
- The commutative law does not apply to division. This means the order in which you divide numbers is important. For example,  $10 \div 5$  is not the same as  $5 \div 10$ .
- A division can be written in a variety of ways, as shown.

$$10 \div 5 = 2$$

$$\begin{array}{r} 2 \\ \hline 5 \overline{)10} \end{array}$$

$$\frac{10}{5} = 2$$

The vinculum represents the division symbol.

- Consider a box of chocolates that is going to be shared between a group of friends. There are 20 chocolates in total and 4 people sharing the box. How can the chocolates be divided evenly between the 4 friends? 20 chocolates divided by 4 people means they will get 5 chocolates each. We can write this mathematically as:  
 $20 \div 4 = 5$



### Checking division by multiplying

A division can always be checked by multiplying.

If  $20 \div 4 = 5$ , then  $4 \times 5 = 20$ .

## Dividing using expanded form

- One way to divide numbers is to first break the dividend (the number being divided) into expanded form and then divide each part by the divisor (the number of parts that the dividend is being divided into).

For example, calculate  $636 \div 6$ .

1. Write the dividend (636) in expanded form.  $636 = 600 + 30 + 6$
2. Divide each part by the divisor (6).
3. Add the results.

$$600 \div 6 = 100$$

$$30 \div 6 = 5$$

$$6 \div 6 = 1$$

$$\text{so } 636 \div 6 = 100 + 5 + 1 = 106$$

## 1.6.2 The short division algorithm

eles-3654

- Another way to divide numbers is to use an algorithm known as short division.
- Here is an example demonstration of how to use this algorithm.

$$6 \overline{)636}$$

$$6 \overline{)636} \begin{array}{r} 1 \\ \hline \end{array}$$

Divide 6 into 6.  $6 \div 6 = 1$ .  
Write 1 on top.

$$6 \overline{)636} \begin{array}{r} 10 \\ \hline \end{array}$$

Divide 6 into 3.  
6 cannot divide into 3.  
Therefore 0 is placed on top.  
3 is carried over to the next digit (6).

$$6 \overline{)636} \begin{array}{r} 106 \\ \hline \end{array}$$

When 3 is carried over to 6,  
the new number formed is 36.  
Divide 6 into 36.  $36 \div 6 = 6$ .  
Write 6 on top.

- Sometimes there is a number left over after numbers have been divided. This number is called a **remainder**. The letter *r* is used to show that a number is a remainder.  
A box of 9 chocolates needs to be shared evenly between 2 people. Because 9 cannot be divided exactly into 2 groups, each person will get 4 chocolates, with 1 chocolate left over.



$$9 \div 2 = 4 \text{ remainder } 1$$

or

$$9 \div 2 = 4 \text{ r } 1$$

## WORKED EXAMPLE 20 Dividing using short division

Evaluate the following.

a.  $834 \div 2$

**THINK**

- a. 1. Write the equation as a short division.
2. Divide each digit by 2.
  - $8 \div 2 = 4$ . Write 4 on top.
  - $3 \div 2 = 1 \text{ r } 1$ . Write 1 on top and carry the remainder of 1 to the next digit. The next digit becomes 14.
  - $14 \div 2 = 7$ . Write 7 on top.
3. Write the answer.

b.  $466 \div 3$

**WRITE**

$$\begin{array}{r} 2 \overline{)834} \\ \underline{417} \phantom{0} \\ 417 \phantom{0} \\ \underline{417} \phantom{0} \\ 0 \phantom{0} \end{array}$$

$$834 \div 2 = 417$$

- b. 1. Write the equation as a short division.
2. Divide each digit by 3.
  - $4 \div 3 = 1 \text{ r } 1$ . Write 1 on top and carry the remainder of 1 to the next digit. The next digit becomes 16.
  - $16 \div 3 = 5 \text{ r } 1$ . Write 5 on top and carry the remainder of 1 over to the next digit. The next digit becomes 16.
  - $16 \div 3 = 5 \text{ r } 1$ . Write 5 r 1 on top.
3. Write the answer.

$$\begin{array}{r} 3 \overline{)466} \\ \underline{3} \phantom{00} \\ 16 \phantom{0} \\ \underline{15} \phantom{0} \\ 16 \phantom{0} \\ \underline{15} \phantom{0} \\ 1 \phantom{0} \end{array}$$

$$466 \div 3 = 155 \text{ r } 1$$

## WORKED EXAMPLE 21 Dividing using short division

Calculate  $89\,656 \div 8$  using short division.

**THINK**

1. Write the equation as a short division.
2. Divide 8 into the first digit and carry the remainder to the next digit. 8 divides into 8 once. Write 1 above the 8 as shown. There is no remainder.
3. Divide 8 into the second digit and carry the remainder to the next digit. 8 divides into 9 once, with 1 left over. Write 1 above the 9 and carry 1 to the hundreds column.
4. Divide 8 into the third digit and carry the remainder to the next digit. 8 divides into 16 twice, with no remainder. Write 2 above the 6.
5. Divide 8 into the fourth digit and carry the remainder to the next digit. 8 doesn't divide into 5. Write 0 above the 5. Carry 5 to the next digit.
6. Divide 8 into 56. 8 divides into 56 seven times. Write 7 above the 6. There is no remainder.
7. Write the answer.

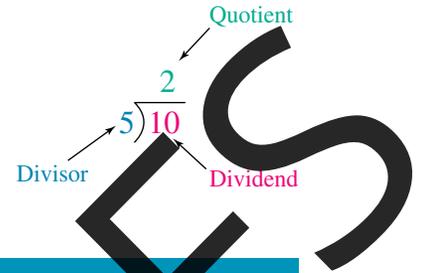
**WRITE**

$$\begin{array}{r} 8 \overline{)89656} \\ \underline{8} \phantom{0000} \\ 19 \phantom{000} \\ \underline{16} \phantom{000} \\ 36 \phantom{00} \\ \underline{32} \phantom{00} \\ 45 \phantom{0} \\ \underline{40} \phantom{0} \\ 56 \\ \underline{56} \\ 0 \end{array}$$

$$89\,656 \div 8 = 11\,207$$

## 1.6.3 Dividing numbers that are multiples of 10

- When we are dividing numbers that are multiples of 10, an equivalent number of zeros can be cancelled from both the **dividend (numerator)** and the **divisor (denominator)**.
- The dividend is the quantity to be divided.
- The divisor is the number by which the dividend is to be divided.
- The **quotient** is the answer obtained when one number is divided by another number.



### WORKED EXAMPLE 22 Dividing numbers that are multiples of 10

Calculate  $48\,000 \div 600$ . Note that both numbers are multiples of 10.

#### THINK

1. Write the question.
2. Write the question as a fraction.
3. Cancel as many zeros as possible, crossing off the same number of zeros in both numerator and denominator.
4. Perform the division.
5. Write the answer.

#### WRITE

$$48\,000 \div 600$$

$$= \frac{48\,000}{600}$$

$$= \frac{480}{6}$$

$$6 \overline{)480}$$

$$48\,000 \div 600 = 80$$

*Note:* The principle of associativity is not true for division. This means that, for example,  $(80 \div 8) \div 2$  is not equivalent to  $80 \div (8 \div 2)$ . This is shown by the following.

$$(80 \div 8) \div 2 = 10 \div 2 = 5$$

$$80 \div (8 \div 2) = 80 \div 4 = 20$$

#### Digital technology

Scientific calculators can evaluate the division of large numbers.



#### ACTIVITY: Magic division

1. a. Choose a digit from 2 to 9. Write it 6 times to form a 6-digit number. For example, if you choose 4 your 6-digit number will be 444 444.
  - b. Divide your 6-digit number by 33.
  - c. Divide your result from part b by 37.
  - d. Divide your result from part c by 91.
  - e. What do you notice about your result from part d?
2. Repeat question 1 with a different 6-digit number and explain how the 'magic division' works.

-  **eWorkbook** Topic 1 Workbook (worksheets, code puzzle and project) (ewbk-1902)
-  **Digital document** SkillsHEET Dividing whole numbers (doc-6414)
-  **Interactivities** Individual pathway interactivity: Dividing positive integers (int-8733)  
Dividing numbers that are multiples of 10 (int-3926)

## Exercise 1.6 Dividing positive integers

learnON

### Individual pathways

**PRACTISE**  
1, 6, 8, 12, 15, 18

**CONSOLIDATE**  
2, 4, 7, 9, 13, 14, 16, 19

**MASTER**  
3, 5, 10, 11, 17, 20

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### Fluency

1. Calculate these divisions without using a calculator. There should be no remainder.
 

a. $24 \div 6$	b. $36 \div 9$	c. $96 \div 12$
d. $56 \div 7$	e. $26 \div 2$	f. $45 \div 15$
2. Calculate these divisions without using a calculator. There should be no remainder.
 

a. $27 \div 3 \div 3$	b. $96 \div 8 \div 6$	c. $48 \div 12 \div 2$
d. $56 \div 7 \div 4$	e. $100 \div 2 \div 10$	f. $90 \div 3 \div 2$

Check your answers using multiplication.
3. Perform the following calculations, which involve a combination of multiplication and division. Remember to work from left to right.
 

a. $4 \times 5 \div 2$	b. $80 \div 10 \times 7$	c. $144 \div 12 \times 7$
d. $120 \div 10 \times 5$	e. $121 \div 11 \times 4$	
4. **WE20** Calculate the following using short division.
 

a. $3 \overline{)1455}$	b. $7 \overline{)43456}$	c. $11 \overline{)30371}$	d. $8 \overline{)640360}$
-------------------------	--------------------------	---------------------------	---------------------------
5. **WE21** Calculate the following using short division.
 

a. $3 \overline{)255194}$	b. $6 \overline{)516285}$	c. $7 \overline{)6328520}$	d. $8 \overline{)480594}$
---------------------------	---------------------------	----------------------------	---------------------------

Check your answers using a calculator.
6. Divide the following numbers, which are multiples of 10.
 

a. $4200 \div 6$	b. $210 \div 30$	c. $720\,000 \div 800$
------------------	------------------	------------------------
7. Divide the following numbers, which are multiples of 10.
 

a. $4\,000\,000 \div 8000$	b. $600\,000 \div 120$	c. $480\,000 \div 600$
----------------------------	------------------------	------------------------
8. Calculate  $144 \div 2$  by breaking 144 up into expanded form.
9. Calculate  $642 \div 3$  by breaking 642 up into expanded form.
10. Calculate  $4256 \div 8$  by breaking 4256 up into expanded form.

## Understanding

11. Kelly works part time at the local pet shop. Last year she earned \$2496.
  - a. Calculate how much Kelly earned each month.
  - b. Calculate how much Kelly earned each week.
12. At the milk processing plant, the engineer asked Farid how many cows he had to milk each day. Farid said he milked 192 cows, because he had 1674 litres of milk at the end of each day and each cow produced 9 litres. Determine whether Farid really milks 192 cows each day. If not, calculate how many cows he does milk.
13. When Juan caters for a celebration like a wedding, he confirms the arrangements with the client by filling out a form. Juan has been called to answer the phone, so it has been left to you to fill in the missing details. Copy and complete this planning form.



Celebration type	Wedding
Number of guests	152
Number of people per table	8
Number of tables required	
Number of courses for each guest	4
Total number of courses to be served	
Number of courses each waiter can serve	80
Number of waiters required	
Charge per guest	\$55
Total charge for catering	

14. Janet is a land developer. She has bought 10 450 square metres of land. She intends to subdivide the land into 11 separate blocks.
  - a. Calculate how many square metres each block will be.
  - b. If she sells each block for \$72 250, determine how much she will receive for the subdivided land.

## Reasoning

15. Kayla divides 243 by 9 and works out the answer to be 27. Her friend Tristan calculates the answer to be 26. State whether either Kayla or Tristan calculated the correct answer.
16. Explain whether this statement is true:  $1148 \div 4 = 282$ . Justify your answer by breaking 1148 up into expanded form.

17. Some people like to keep mice as pets. Female mice give birth to about six litters of babies per year, with about six babies in each litter.
- If you own a female mouse, how many pet mice will you have at the end of one year if none of the female's babies have any litters of their own? Explain how you reached your answer.
  - Explain how many female mice you had at the start of the year if, at the end of the year, you had 111 mice and none of your females' babies had any litters of their own. Show your working.



### Problem solving

18. Danh has booked a beach house for a week over the summer period for a group of 12 friends. The house costs \$1344 for the week. If all 12 people stayed for 7 nights, determine how much each person will pay per night.



19. A total of 62 people have been invited to a dinner party. Each table can seat 8 people. Determine how many tables are needed.



20. List the first four whole numbers that will have a remainder of 2 when you divide by 8. Describe the pattern and explain how you found these numbers.

## 1.7 Rounding and estimating

### LEARNING INTENTION

At the end of this subtopic you should be able to:

- provide an estimate to a problem by rounding to the first digit.



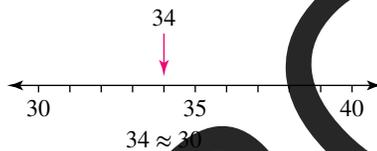
### 1.7.1 Rounding integers

eles-3656

- Numbers or integers can be rounded to different degrees of accuracy.

#### Rounding to the nearest 10

- To round to the nearest 10, think about which multiple of 10 the number is closest to. For example, if 34 is rounded to the nearest 10, the result is 30 because 34 is closer to 30 than it is to 40.



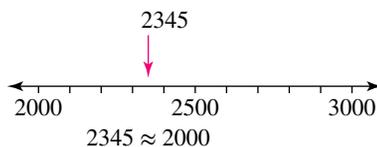
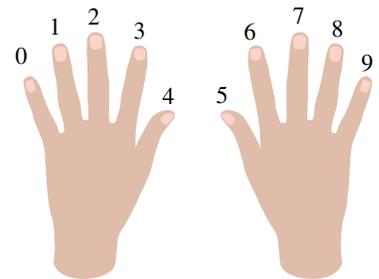
(Note: The symbol  $\approx$  means 'is approximately equal to'.)

#### Rounding to the nearest 100

- To round to the nearest 100, think about which multiple of 100 the number is closest to. For example, if 177 is rounded to the nearest 100, the result is 200 because 177 is closer to 200 than it is to 100.

#### Rounding to the first (or leading) digit

- To round to the first (or leading) digit, use the following guidelines:
  - Consider the digit after the leading one (i.e. the second digit).
  - If the second digit is 0, 1, 2, 3 or 4, the first digit stays the same and all the following digits are replaced with zeros.
  - If the second digit is 5, 6, 7, 8 or 9, the first digit is raised by 1 (rounded up) and all the following digits are replaced with zeros.
- For example, if 2345 is rounded to the first digit, the result is 2000 because 2345 is closer to 2000 than it is to 3000.



### WORKED EXAMPLE 23 Rounding to the first digit

Round the following numbers to the first (or leading) digit.

a. 2371

b. 872

#### THINK

- a. Since the second digit (3) is less than 5, leave the leading digit unchanged and replace all other digits with zeros.
- b. Since the second digit (7) is greater than 5, add 1 to the leading digit and replace all other digits with zeros.

#### WRITE

a.  $2371 \approx 2000$

b.  $872 \approx 900$

## 1.7.2 Estimation

eles-3657

- An estimate is not the same as a guess, because an estimate is based on information.
- When you do not need to know an exact amount, an estimate or approximation is enough.
- To estimate the answer to a mathematical problem, round the numbers to the first digit and find an approximate answer.
- Estimations can be made when multiplying, dividing, adding or subtracting. They can also be used when there is more than one operation in the same question.

### WORKED EXAMPLE 24 Estimating by rounding to the first digit

Estimate  $48\,921 \times 823$  by rounding to the first digit.

#### THINK

1. Write the question.
2. Round each part of the question to the first digit.
3. Multiply and write the answer.

#### WRITE

$$48\,921 \times 823$$

$$= 50\,000 \times 800$$

$$= 40\,000\,000$$

### DISCUSSION

Is the estimated answer to the multiplication in Worked example 24 higher or lower than the actual answer? Justify your response.

### Resources

-  **eWorkbook** Topic 1 Workbook (worksheets, code puzzle and project) (ewbk-1902)
-  **Digital document** SkillsHEET Rounding to the first (leading) digit (doc-6418)
-  **Interactivities** Individual pathway interactivity: Estimation (int-4318)  
Rounding (int-3932)

## Exercise 1.7 Rounding and estimating

### Individual pathways

**PRACTISE**

1, 4, 5, 6, 15, 18

**CONSOLIDATE**

2, 7, 8, 13, 14, 16, 19

**MASTER**

3, 9, 10, 11, 12, 17, 20

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### Fluency

1. **WE23** Round each of the following to the first (or leading) digit.

a. 6

b. 45

c. 1368

d. 12 145

e. 168 879

f. 4 985 452

2. **WE24** Estimate  $67\,451 \times 432$  by rounding to the first digit.

3. Copy and complete the following table by rounding the numbers to the first digit. The first row has been completed as an example.

- In the 'Estimate' column, round each number to the first digit.
- In the 'Estimated answer' column, calculate the answer.
- In the 'Prediction' column, guess whether the actual answer will be higher or lower than your estimate.
- Use a calculator to work out the actual answer and record it in the 'Calculation' column to determine whether it is higher or lower than your estimate.

		Estimate	Estimated answer	Prediction	Calculation
Example	$4129 \div 246$	$4000 \div 200$	20	Lower	16.784 553, so lower
a.	$487 + 962$				
b.	$33\,041 + 82\,629$				
c.	$184\,029 + 723\,419$				
d.	$93\,261 + 37\,381$				
e.	$321 - 194$				
f.	$468\,011 - 171\,962$				
g.	$36 \times 198$				
h.	$623 \times 12\,671$				
i.	$29\,486 \times 39$				
j.	$31\,690 \div 963$				
k.	$63\,003 \div 2590$				
	$69\,241 \div 1297$				

4. **MC** Select which of the following is the best estimate of  $4372 + 2587$ .

A. 1000

B. 5527

C. 6000

D. 7000

E. 7459

5. **MC** Choose which of the following is the best estimate of  $672 \times 54$ .

A. 30 000

B. 35 000

C. 36 000

D. 40 000

E. 42 000

6. **MC** Select which of the following is the best estimate of  $67\,843 \div 365$ .

A. 150

B. 175

C. 200

D. 230

E. 250

## Understanding

7. Estimate the answers to each of the following by rounding to the first digit.

- a.  $5961 + 1768$                       b.  $48\,022 \div 538$                       c.  $9701 \times 37$   
d.  $98\,631 + 608\,897$                       e.  $6501 + 3790$

8. Estimate the answers to each of the following by rounding to the first digit.

- a.  $11\,890 - 3642$                       b.  $112\,000 \times 83$                       c.  $66\,501 \div 738$   
d.  $392 \times 113\,486$                       e.  $12\,476 \div 24$

Questions 9 to 12 relate to the following information.

Su-Lin was using her calculator to answer some mathematical questions, but she got a different answer each time she performed the same calculation. Using your estimation skills, predict which of Su-Lin's answers is most likely to be correct.

9. **MC**  $217 \times 489$

- A. 706                      B. 106 113                      C. 13 203                      D. 19 313                      E. 105 203

10. **MC**  $89\,344 \div 256$

- A. 39                      B. 1595                      C. 89 088                      D. 349                      E. 485

11. **MC**  $78 \times 6703$

- A. 522 834                      B. 52 260                      C. 6781                      D. 56 732 501                      E. 51 624

12. **MC**  $53\,669 \div 451$

- A. 10                      B. 1076                      C. 53 218                      D. 119                      E. 183

13. Kody is selling tickets for his school's theatre production of *South Pacific*. So far he has sold 439 tickets for Thursday night's performance, 529 for Friday's and 587 for Saturday's. The costs of the tickets are \$9.80 for adults and \$4.90 for students.

- a. Round the figures to the first digit to estimate the number of tickets Kody has sold so far.  
b. If approximately half the tickets sold were adult tickets and the other half were student tickets, estimate how much money has been received so far by rounding the cost of the tickets to the first digit.

14. For the following calculations:

- i. estimate the answer by rounding to the first digit  
ii. calculate the answer using a written method.

Check your answers using a calculator.

- a.  $6650 - 1310$                       b.  $36 \times 223$                       c.  $18\,251 \div 391$

## Reasoning

15. Ava wants to buy three items that cost \$5.58, \$15.92 and \$7.22. Estimate the total cost of the three items by rounding each number to the nearest whole number, and then adding.

16. Estimate the number of graduating students shown in the photograph. (Do not count all of the students in the photograph.) If the hall where they are graduating holds 12 times this number, estimate the total capacity of the hall.

Show your working and write a sentence explaining how you solved this problem.



17. At Kooboora Secondary College there are 127 students in Year 7, 152 students in Year 8 and 319 students in Years 9 and 10. Estimate the total number of students in Years 7–10.

### Problem solving

18. Describe a situation in everyday life where it is *not* appropriate to estimate values.
19. Shari bought a car five years ago for \$21 798. The car's value has decreased to one-third of its initial value. Determine the approximate value of the car today.
20. During the intermission of the school production of *South Pacific*, Jia is planning to run a stall selling hamburgers to raise money for the school. She has priced the items she needs and made a list in order to estimate her expenses.
- By rounding the item price to the first digit, use the following table to estimate how much each item will cost Jia for the quantity she requires.
  - Estimate what Jia's total shopping bill will be.
  - If Jia sells 300 hamburgers over the 3 nights for \$2 each, determine how much money she will receive for the hamburgers.
  - Determine approximately how much money Jia will raise through selling hamburgers over the 3 nights.



Item	Item price	Quantity required	Estimated cost
Bread rolls	\$2.90/dozen	25 packets of 12	
Hamburgers	\$2.40/dozen	25 packets of 12	
Tomato sauce	\$1.80/litre	2 litres	
Margarine	\$2.20/tub	2 tubs	
Onions	\$1.85/kilogram	2 kilograms	
Tomatoes	\$3.50/kilogram	2 kilograms	
Lettuce	\$1.10 each	5 lettuces	

## 1.8 Order of operations

### LEARNING INTENTION

At the end of this subtopic you should be able to:

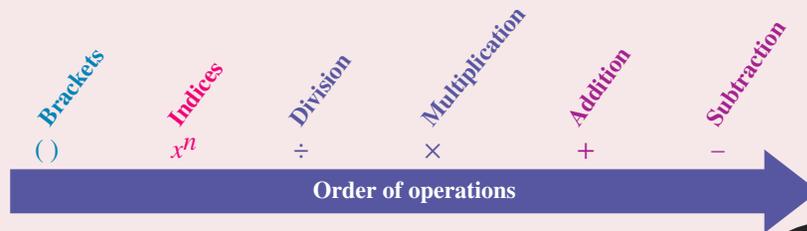
- understand how the order of operations is to be applied
- apply the order of operations to solve problems.

### 1.8.1 BIDMAS

- There are rules in mathematics that ensure everyone has the same understanding of mathematical operations. These rules are known as the **order of operations**.
- The acronym **BIDMAS** (**B**rackets, **I**ndices or roots, **D**ivision and **M**ultiplication, **A**ddition and **S**ubtraction) can be used to remember the correct order of operations.

## BIDMAS

BIDMAS helps us to remember the correct order in which we perform the various operations, working from left to right.



### WORKED EXAMPLE 25 Applying the order of operations

Calculate  $6 + 12 \div 4$ .

#### THINK

1. Write the question.
2. Follow BIDMAS.
  - Brackets: there are none.
  - Indices or roots: there are none.
  - Division and multiplication: there is one division.
  - Addition and subtraction: there is one addition.
3. Apply BIDMAS by working out the division before the addition.
4. Calculate the answer.

#### WRITE

$$\begin{aligned}6 + 12 \div 4 \\6 + 12 \div 4 \\= 6 + 3 \\= 9\end{aligned}$$

### WORKED EXAMPLE 26 Applying the order of operations

Calculate the following.

a.  $12 \div 2 + 4 \times (4 + 6)$

#### THINK

- a. 1. Write the question.
2. Apply BIDMAS. Remove the brackets by working out the addition inside.
3. Perform the division and multiplication next, doing whichever occurs first as you work from left to right. Work out  $12 \div 2$  first, then work out  $4 \times 10$ .
4. Complete the addition last and calculate the answer.

- b. 1. Write the question.
2. Remove the innermost brackets first by working out the subtraction inside them.
3. Remove the next pair of brackets by working out the multiplication inside them.
4. Remove the final pair of brackets by working out the addition inside them.
5. Perform the division last and calculate the answer.

b.  $80 \div [((11 - 2) \times 2) + 2]$

#### WRITE

$$\begin{aligned}\text{a. } 12 \div 2 + 4 \times (4 + 6) \\= 12 \div 2 + 4 \times 10 \\= 12 \div 2 + 4 \times 10 \\= 6 + 40 \\= 46 \\80 \div [((11 - 2) \times 2) + 2] \\= 80 \div [(9 \times 2) + 2] \\= 80 \div [18 + 2] \\= 80 \div 20 \\= 4\end{aligned}$$

### ACTIVITY: Order of operations

Using the expressions from Worked example 26, investigate whether the order of operations is applied on different devices such as your mobile phone or a computer. Do you have to do anything different to ensure that the order of operations is followed?

### WORKED EXAMPLE 27 Inserting brackets to make a statement true

Insert one set of brackets in the appropriate place to make the following statement true.

$$3 \times 10 - 8 \div 2 + 4 = 7$$

#### THINK

1. Write the left-hand side of the equation.
2. Place one set of brackets around the first two values.
3. Perform the multiplication inside the bracket.
4. Perform the division.
5. Perform the subtraction and addition working from left to right.

*Note:* Since this is not the answer, the above process must be repeated.

6. Place one set of brackets around the second and third values.
7. Perform the subtraction inside the bracket.
8. Perform the multiplication and division working from left to right.
9. Perform the addition last and calculate the answer.
10. Write the answer.

#### WRITE

$$\begin{aligned} 3 \times 10 - 8 \div 2 + 4 \\ = (3 \times 10) - 8 \div 2 + 4 \\ = 30 - 8 \div 2 + 4 \\ = 30 - 4 + 4 \\ = 26 + 4 \end{aligned}$$

*Since this is not equal to 7 we must place the brackets in a different position.*

$$\begin{aligned} 3 \times 10 - 8 \div 2 + 4 \\ = 3 \times (10 - 8) \div 2 + 4 \\ = 3 \times 2 \div 2 + 4 \\ = 6 \div 2 + 4 \\ = 3 + 4 \\ = 7 \\ 3 \times (10 - 8) \div 2 + 4 = 7 \end{aligned}$$

### WORKED EXAMPLE 28 Using the order of operations

Calculate  $58 - (2 \times 8 + 3^2)$  using the order of operations.

#### THINK

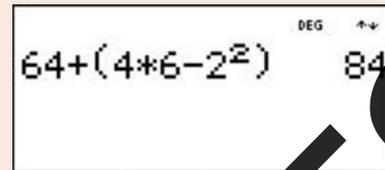
1. Write the question.
2. Apply BIDMAS.
  - Remove the brackets first.
    - Calculate the indices inside the brackets.
    - Work out the multiplication inside the brackets.
    - Do the addition inside the brackets.
  - Do the subtraction.
3. Write the answer.

#### WRITE

$$\begin{aligned} 58 - (2 \times 8 + 3^2) \\ = 58 - (2 \times 8 + 9) \\ = 58 - (16 + 9) \\ = 58 - (25) \\ = 33 \end{aligned}$$

## Digital technology

Scientific calculators can evaluate the expression using the order of operations.



## DISCUSSION

Use a calculator to work out the answer to Worked example 28. Do you think it is easier or harder to perform the calculation using a calculator? What do you think the advantages and disadvantages are of using a calculator compared to calculating using mental strategies?

## Resources

- eWorkbook** Topic 1 Workbook (worksheets, code puzzle and project) (wbk-1902)
- Digital document** SkillSHEET Order of operations I (doc-6415)
- Video eLesson** BIDMAS (eles-2425)
- Interactivities** Individual pathway interactivity: Order of operations (int-4315)  
Order of operations (int-3707)

## Exercise 1.8 Order of operations

learnON

### Individual pathways

#### PRACTISE

1, 2, 6, 9, 14, 17, 20, 21

#### CONSOLIDATE

3, 7, 10, 12, 13, 16, 18, 22, 23

#### MASTER

4, 5, 8, 11, 15, 19, 24, 25

To answer questions online and to receive **immediate corrective feedback** and **fully worked solutions** for all questions, go to your learnON title at [www.jacplus.com.au](http://www.jacplus.com.au).

### Fluency

1. **WE25 & 26** Follow the order of operations rules and calculate each of the following.

a.  $3 + 4 \div 2$

b.  $8 + 1 \times 1$

c.  $24 \div (12 - 4)$

d.  $15 \times (17 - 15)$

e.  $11 + 6 \times 8$

2. Follow the order of operations rules and calculate each of the following.

a.  $30 - 45 \div 9$

b.  $56 \div (7 + 1)$

c.  $12 \times (20 - 12)$

d.  $(7 + 5) - (10 + 2)$

3. Follow the order of operations rules and calculate each of the following.

a.  $3 \times 4 + 23 - 10 - 5 \times 2$

b.  $42 \div 7 \times 8 - 8 \times 3$

c.  $10 + 40 \div 5 + 14$

d.  $81 \div 9 + 108 \div 12$

e.  $16 + 12 \div 2 \times 10$

f.  $(18 - 15) \div 3 \times 27$

4. Follow the order of operations rules and calculate each of the following.

- a.  $4 + (6 + 3 \times 9) - 11$
- b.  $52 \div 13 + 75 \div 25$
- c.  $88 \div (24 - 13) \times 12$
- d.  $(4 + 5) \times (20 - 14) \div 2$
- e.  $\{[(16 + 4) \div 4] - 2\} \times 6$
- f.  $60 \div \{[(12 - 3) \times 2] + 2\}$

### Understanding

5. **WE27** Insert one set of brackets in the appropriate place to make these statements true.

- a.  $12 - 8 \div 4 = 1$
- b.  $4 + 8 \times 5 - 4 \times 5 = 40$
- c.  $3 \times 10 - 2 \div 4 + 4 = 10$
- d.  $12 \times 4 + 2 - 12 = 60$
- e.  $10 \div 5 + 5 \times 9 \times 9 = 81$
- f.  $18 - 3 \times 3 \div 5 = 9$

6. Calculate the following, using the order of operations.

- a.  $6 + 3 \times 4$
- b.  $18 - 12 \div 3$
- c.  $2 - 4 - 6$
- d.  $17 - 3 + 8$

7. Calculate the following, using the order of operations.

- a.  $6 \times 3 \div 9$
- b.  $72 \div 8 \times 3$
- c.  $7 - (3 + 4)$
- d.  $(6 + 3) \div 9$

8. Calculate the following, using the order of operations.

- a.  $3 \times 2 - 3 \times 1$
- b.  $6 \times 5 - 2 \times 6$
- c.  $4 \times (9 + 4)$
- d.  $(8 + 3) \times 7$

9. **WE28** Evaluate each of the following.

- a.  $4 + 7 \times 3 - 2$
- b.  $6 - 4 + (4)^2$
- c.  $(2)^3 - 3 \times 2$
- d.  $3 + (8 - 2) + 6$

10. Evaluate each of the following.

- a.  $8 \div 2 + (2)^2$
- b.  $4 \times 8 - [2 + (3)^2]$
- c.  $(7 + 5) + 24 \div 6$
- d.  $30 \div (5 - 2) - 10$

11. Evaluate each of the following.

- a.  $54 \div 6 + 8 \times 9 \div 4$
- b.  $(9 + 6) \div 5 - 8 \times 0$
- c.  $7 + 7 \div 7 \times 7 + 7$
- d.  $9 \times 5 - (3 + 2) - 48 \div 6$

12. **MC**  $20 - 6 \times 3 + 28 \div 7$  is equal to:

- A. 46
- B. 16
- C. 6
- D. 4
- E. 2

13. **MC** Choose which of the following is the correct order of the two signs that can replace \* in the equation  $7 * 2 * 4 - 3 = 12$ .

- A. -, +
- B. +, ×
- C. =, ÷
- D. ÷, ×
- E. ×, ÷

14. **MC** Select which of the following the expression  $6 - 2 \times 5 + 10 \div 2$  is equal to.

- A. 25
- B. 40
- C. 30
- D. 1
- E. 3

15. Insert brackets (if necessary) to make each statement true.

- a.  $6 + 2 \times 4 - 3 \times 2 = 10$
- b.  $6 + 2 \times 4 - 3 \times 2 = 26$
- c.  $6 + 2 \times 4 - 3 \times 2 = 16$
- d.  $6 + 2 \times 4 - 3 \times 2 = 8$

16. Model each situation with integers, then calculate the result.

- a. Jemma starts out with \$274 in the bank. She makes 2 withdrawals of \$68 each, then 3 deposits of \$50 each. Calculate how much money Jemma now has in the bank.
- b. If 200 boxes of apples were each 3 short of the stated number of 40 apples, calculate the overall shortfall in the number of apples.
- c. A person with a mass of 108 kg wants to reduce his mass to 84 kg in 3 months. Determine what average mass reduction is needed per month.

## Reasoning

17. Discuss a real-life situation in which performing calculations in the wrong order could cause problems.
18. Keenan and Amona discovered that they had different answers to the same question, which was to calculate  $6 + 6 \div 3$ . Keenan thought the answer was 8. Amona thought the answer was 4. State who was correct, Keenan or Amona. Explain your response.
19. I have a pile of pebbles. Arranging them in piles of 7 leaves 1 extra pebble, and arranging them in piles of 5 leaves 3 extra pebbles. If there are more than 10 pebbles in my pile, determine the smallest number of pebbles possible for my pile to have in it. Show your working.



## Problem solving

20. The student lockers at Jacaranda College are to be numbered consecutively from 1 to 800 using plastic digits. Each digit costs 10c. Calculate the total cost of all the digits.
21. Xanthe bakes and sells cupcakes. A customer ordered 3 lemon cupcakes at \$4.25 each, 3 chocolate cupcakes at \$4.75 each and 2 original cupcakes at \$3.75 each.
- Write an expression to help Xanthe calculate the amount the customer has to pay.
  - Use this expression to calculate the amount that the customer has to pay.
22. Local time in Sydney is 3 hours ahead of Singapore time, which is 5 hours behind Auckland (NZ) time. Auckland is 11 hours ahead of Berlin (Germany) time. Determine the time difference between:
- Sydney and Berlin
  - Singapore and Berlin



23. Minh was asked to buy enough ice creams for everyone in his class. There are 31 people in the class. At the supermarket, ice creams come in packets of 3 or packets of 5. Minh is told that the cost of one ice cream is the same from either packet. Determine how many packets (or what combination of packets) Minh should buy.

24. Use the digits 1, 2, 3 and 4 and the operators +, −, × and ÷ to construct equations that result in the numbers 1 to 5 (the numbers 2 and 4 are already done for you). You must use each digit in each expression, and you may not use the digits more than once. You may combine the digits to form larger numbers (such as 21). You may also use brackets to make sure the operations are done in the correct order.

$$\begin{aligned}1 &= \\2 &= 4 - 3 + 2 - 1 \\3 &= \\4 &= 4 - 2 + 3 - 1 \\5 &= \end{aligned}$$

25. Use the digits 1, 2, 3 and 4 and the operators +, −, × and ÷ to construct equations that result in the numbers 5 to 10 (the numbers 7 and 10 have already been done for you). You must use each digit in each expression and you may not use the digits more than once. You may combine the digits to form larger numbers (such as 21). You may also use brackets to make sure the operations are done in the correct order.

$$\begin{aligned}5 &= \\6 &= \\7 &= 24 \div 3 - 1 \\8 &= \\9 &= \\10 &= 1 + 2 + 3 + 4\end{aligned}$$

PAGE PROOFS

# 1.9 Review

## 1.9.1 Topic summary

**Place value**

The position of a digit in a number gives a different value to the digit.  
For example, the place value of each digit in the number 613 452 is:

Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
6	1	3	4	5	2

• The number 613 452 is read as 'six hundred and thirteen thousand, four hundred and fifty-two'.

**Rounding and estimating**

To round to the first digit, use the following guidelines:

- If the second digit is 0, 1, 2, 3 or 4, the first digit stays the same and all the following digits are replaced with zeros.
- If the second digit is 5, 6, 7, 8 or 9, the first digit is increased by 1 (rounded up) and all the following digits are replaced with zeros.

### POSITIVE INTEGERS

**Positive integers**

Positive integers are whole numbers including 0 without decimals or fractions.

- The integers 1, 2, 3, ... are called positive integers.
- 0 is neither positive nor negative....

**Addition of positive integers**

Some mental strategies and algorithms used to add up numbers without a calculator are:

- jump strategy
- split strategy
- compensation strategy
- rearrange strategy
- algorithm to add positive integers.

e.g.  $462 + 78 + 316$

$$\begin{array}{r} 14 \quad 16 \quad 2 \\ \phantom{14} \quad 7 \quad 8 \\ 3 \quad 1 \quad 6 \\ \hline 8 \quad 5 \quad 6 \end{array}$$

**Subtraction of positive integers**

Some mental strategies and algorithms used to subtract numbers without a calculator are:

- jump strategy
- adding up to find the difference
- compensation strategy
- algorithm to subtract positive integers.

e.g.  $892 - 467$

$$\begin{array}{r} 8^8 \quad 9^1 \quad 2 \\ 4 \quad 6 \quad 7 \\ \hline 4 \quad 2 \quad 5 \end{array}$$

**Multiplication of positive integers**

- A short way of performing repeated addition of the same number
- Expanded form, area model, short and long multiplication algorithms are used to multiply.

e.g.

Long multiplication

$$\begin{array}{r} 1456 \\ \times 132 \\ \hline 2912 \\ 43680 \\ \hline 192192 \end{array}$$

Short multiplication

$$\begin{array}{r} 1^2 456 \\ \times 5 \\ \hline 7280 \end{array}$$

**Division of positive integers**

- The process of sharing or dividing a number into equal parts.
- Expanded form and short division algorithm are used to divide.

e.g.

$$\begin{array}{r} 417 \\ 2 \overline{)834} \end{array}$$


**Order of operations**

- The order of operations is a set of rules we must follow so that we all have a common understanding of mathematical operations.
- The set order in which we calculate problems is:
  1. **Brackets** ( ) or [ ]
  2. **Indices or roots**  $a^x$  or  $\sqrt[x]{a}$
  3. **Division and Multiplication** (working left to right) ÷ or ×
  4. **Addition and Subtraction** (working left to right) + or -
- The acronym **BIDMAS** can be used to remember the correct order of operations.

## 1.9.2 Success criteria

Tick the column to indicate that you have completed the subtopic and how well you think you have understood it using the traffic light system.

(**Green:** I understand; **Yellow:** I can do it with help; **Red:** I do not understand)

Subtopic	Success criteria			
1.2	I understand that the value of each digit in a number depends on its position or place value.			
1.3	I can add and subtract positive integers using mental strategies.			
1.4	I can add and subtract positive integers using algorithms.			
1.5	I can multiply positive integers using mental strategies and algorithms.			
1.6	I can divide positive integers using mental strategies and the short division algorithm.			
1.7	I can provide an estimate to a problem by rounding to the first digit.			
1.8	I understand how the order of operations is to be applied.			
	I can apply the order of operations to solve problems.			

## 1.9.3 Project

### Ancient number systems

All ancient civilisations developed methods to count and use numbers. The methods they used to represent numbers did not involve the ten digits 1, 2, 3, 4, 5, 6, 7, 8, 9 and 0 that we use today. Instead they involved different systems like letters, other symbols, pebbles, tying knots in ropes, or cutting notches in sticks. As the need to use and represent larger numbers became more and more important, many old systems fell out of use.

### Egyptian numbers

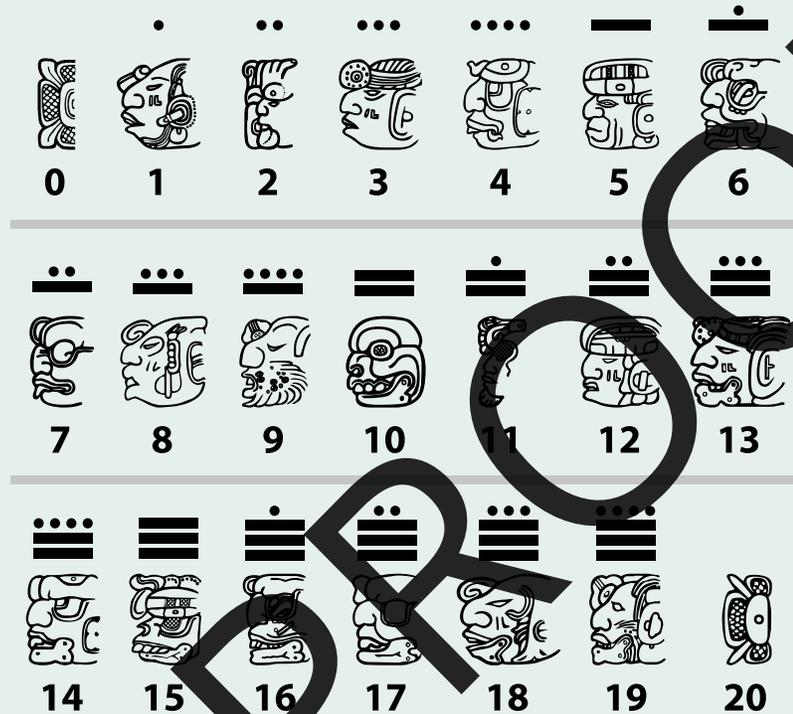
The ancient Egyptians were one of the oldest known civilisations to have a recorded number system. In about 5000 BCE, Egyptians used a system of symbols called hieroglyphs. An example of hieroglyphs can be seen in the photograph.





10. Search online to find out about number systems used by other ancient civilisations. Try to find out what symbols were used to represent numbers and how those symbols were used in calculations. Discuss any advantages of these systems and suggest why the system may have fallen out of use. Present your findings on a separate sheet of paper.

### Maya Numbers



#### Resources

- eWorkbook** Topic 1 Workbook (worksheets, code puzzle and project) (ewbk-1902)
- Interactivities** Crossword (int-2586)  
Sudoku puzzle (int-3153)

### Exercise 1.9 Review questions

learnon

To answer questions online and to receive **immediate corrective feedback** and **fully worked solutions** for all questions, go to your learnON title at [www.jacplus.com.au](http://www.jacplus.com.au).

#### Fluency

- State the place value of the digit shown in pink in each of the following.
 

a. 74 037	b. 541 910	c. 1 904 000	d. 290
-----------	------------	--------------	--------
- Write each of the following numbers in expanded form.
 

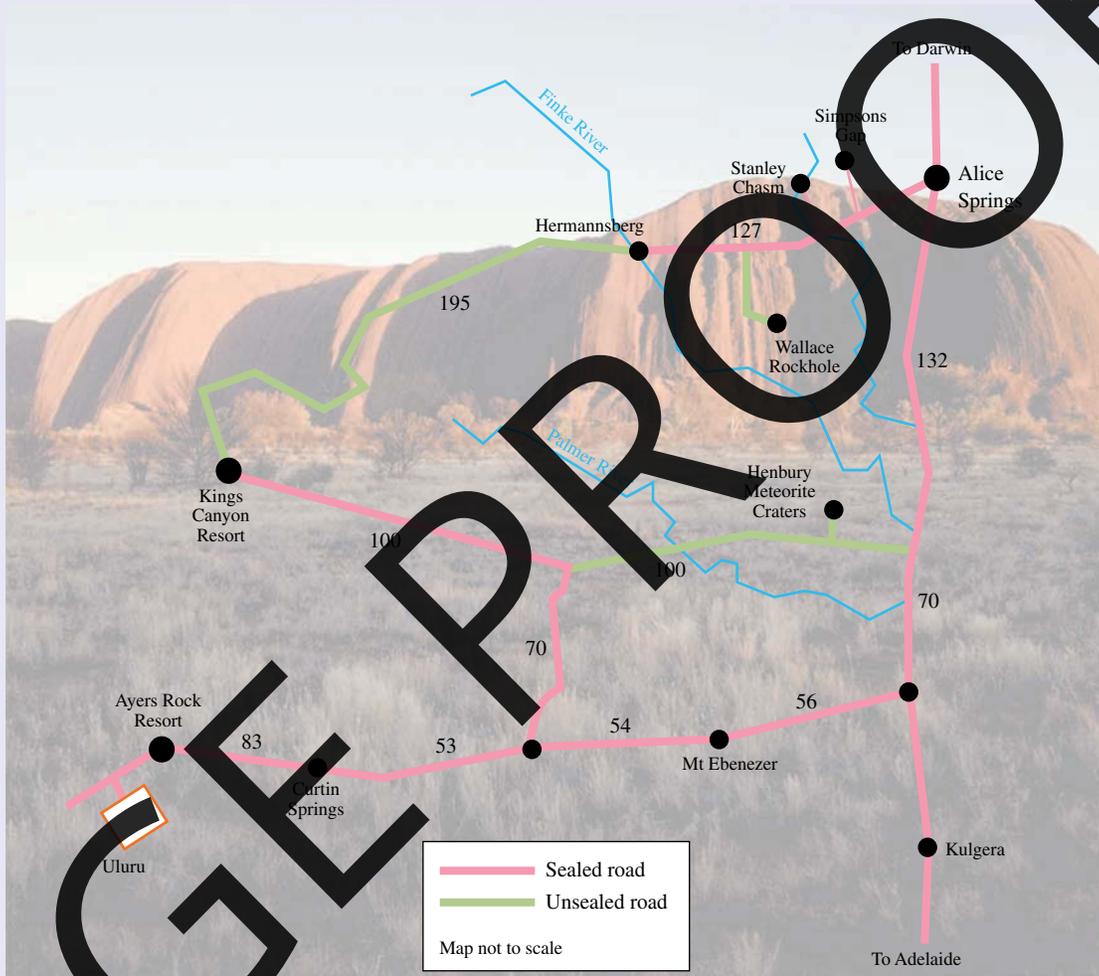
a. 392	b. 4109	c. 42 001	d. 120 000
--------	---------	-----------	------------
- List the numbers 394, 349, 943, 934, 3994, 3499 in ascending order.

4. List the numbers 1011, 101, 110, 1100, 1101 in descending order.
5. Calculate the sum of these numbers.
- |                       |                               |
|-----------------------|-------------------------------|
| a. $43 + 84$          | b. $139 + 3048$               |
| c. $3488 + 91 + 4062$ | d. $3486208 + 38645 + 692803$ |
6. Calculate each of the following.
- |                       |                       |
|-----------------------|-----------------------|
| a. $20 - 12 + 8 - 14$ | b. $35 + 15 + 5 - 20$ |
| c. $300 - 170 + 20$   | d. $18 + 10 - 3 - 11$ |
7. Calculate the difference between the following numbers.
- |                      |                   |
|----------------------|-------------------|
| a. $688 - 273$       | b. $400 - 183$    |
| c. $68348 - 8026$    | d. $46234 - 8476$ |
| e. $286005 - 193048$ |                   |
8. Use mental strategies to multiply each of the following.
- |                           |                            |                   |
|---------------------------|----------------------------|-------------------|
| a. $2 \times 15 \times 5$ | b. $4 \times 84 \times 25$ | c. $62 \times 20$ |
| d. $67 \times 9$          | e. $31 \times 19$          |                   |
9. Evaluate the following multiplications using a diagram.
- |                 |                 |                 |
|-----------------|-----------------|-----------------|
| a. $3 \times 6$ | b. $5 \times 4$ | c. $2 \times 7$ |
|-----------------|-----------------|-----------------|
10. Calculate the following using expanded form.
- |                  |                   |                   |
|------------------|-------------------|-------------------|
| a. $24 \times 4$ | b. $134 \times 8$ | c. $642 \times 5$ |
|------------------|-------------------|-------------------|
11. Calculate the following using an area model.
- |                   |                   |                   |
|-------------------|-------------------|-------------------|
| a. $236 \times 6$ | b. $347 \times 4$ | c. $675 \times 5$ |
|-------------------|-------------------|-------------------|
12. Calculate the following using the short multiplication algorithm.
- |                    |  |  |
|--------------------|--|--|
| a. $128 \times 9$  |  |  |
| b. $762 \times 3$  |  |  |
| c. $3840 \times 5$ |  |  |
13. Calculate the following using the long multiplication algorithm.
- |                   |                    |                       |
|-------------------|--------------------|-----------------------|
| a. $64 \times 72$ | b. $542 \times 57$ | c. $50426 \times 364$ |
|-------------------|--------------------|-----------------------|
14. Calculate each of the following using expanded form.
- |                 |                  |                   |
|-----------------|------------------|-------------------|
| a. $645 \div 5$ | b. $1040 \div 4$ | c. $15063 \div 3$ |
|-----------------|------------------|-------------------|
15. Calculate each of the following.
- |                         |                               |                          |
|-------------------------|-------------------------------|--------------------------|
| a. $6 \times 4 \div 3$  | b. $4 \times 9 \div 12$       | c. $49 \div 7 \times 12$ |
| d. $81 \div 9 \times 5$ | e. $6 \times 3 \div 9 \div 2$ |                          |
16. Divide the following multiples of 10.
- |                     |                    |                    |
|---------------------|--------------------|--------------------|
| a. $84000 \div 120$ | b. $4900 \div 700$ | c. $12300 \div 30$ |
|---------------------|--------------------|--------------------|
17. Evaluate the following using short division.
- |                   |                    |                  |
|-------------------|--------------------|------------------|
| a. $4704 \div 3$  | b. $6867 \div 7$   | c. $3762 \div 7$ |
| d. $5702 \div 17$ | e. $11852 \div 13$ |                  |



## Problem solving

29. Uluru is a sacred Aboriginal site. The following map shows some roads between Uluru and Alice Springs. The distances (in kilometres) along particular sections of road are indicated.
- Calculate how far Kings Canyon Resort is from Ayers Rock Resort near Uluru.
  - Determine the shortest distance by road from Kings Canyon Resort to Alice Springs.
  - If you are travelling in a hire car in this part of Australia, you must travel only on sealed roads. Work out the distance you need to travel if you are driving in a hire car from Kings Canyon Resort to Alice Springs.



30. In summer, an ice cream factory operates 16 hours a day and makes 28 ice creams an hour.
- Calculate how many ice creams are made each day.
  - If the factory operates 7 days a week, determine how many ice creams are made in one week.
  - If there are 32 staff who run the machines over a week, calculate how many ice creams each person would make.



31. When you add two even positive integers, the answer is even. The sum of an even and an odd positive integer is an odd integer. Two odd positive integers add to give an even integer. Determine what happens if you perform multiplication on these types of integers. Give examples to support your answers. Write a general statement to summarise what would happen if you multiplied more than two positive integers.
32. Complete the following subtraction by adding the missing digits to the boxes.

$$\begin{array}{r}
 82 \square 0 \\
 - 3 \square 8 \square \\
 \hline
 \square 5 5 9
 \end{array}$$

33. A lolly factory machine dispenses 760 lollies into 8 jars. Assuming that an equal number of lollies is dispensed into each jar, evaluate how many lollies there are in each jar.
34. Julie sells 8 bottles of soft drink for \$3 each and 12 bottles of water for \$2 each.
- Write a calculation that will find the total value of Julie's sales.
  - Calculate the total value of Julie's sales.
35. Dara estimates the crowd at a football match to be 20 000 people. If Dara's estimate is correct to the nearest 1000 people, evaluate the greatest number of people that could possibly be at the match.



36. a. Complete the addition table below.

+	6		3
	11	15	
12			
	15		

b. Complete the multiplication table below.

×	4		6
	12	24	18
5			
	8		

37. Minimum and maximum temperatures are recorded at many locations around the world.
- In Melbourne the temperature often changes rapidly during the day. On one very hot day the temperature reached  $42^{\circ}\text{C}$ . A cool change arrived during the afternoon and the temperature dropped by  $18^{\circ}\text{C}$ . Determine the temperature after the cool change.
  - In Alaska the weather often changes suddenly as storms sweep across the frozen plains. On one day, the temperature was  $3^{\circ}\text{C}$ , but a storm caused the temperature to drop by  $24^{\circ}\text{C}$ . Determine the temperature during the storm.

38. You have 30 questions to answer on a multiple choice test. Each correct answer scores one mark (+1). Each incorrect answer loses two marks (−2). Any unmarked questions will be counted as incorrect. Evaluate the lowest number of questions that you can answer correctly and still obtain a score greater than 0. Determine how many marks you would earn. Explain your reasoning.

	+		×		=	32
+		×		+		
	−		+		=	7
×		÷		÷		
	−		−		=	4
=		=		=		
29		10		15		

39. Place the digits 1–9 (with no repeats) in the grid shown so that the equations reading across and down are true.

40. The following table lists a business's profit over the past four years. Evaluate which two consecutive years had the greatest difference. Show your working.

Year	2016	2017	2018	2019
Profit/loss	1020	2620	3808	8222



To test your understanding and knowledge of this topic, go to your learnON title at [www.jacplus.com.au](http://www.jacplus.com.au) and complete the **post-test**.

Below is a full list of **rich resources** available online for this topic. These resources are designed to bring ideas to life, to promote deep and lasting learning and to support the different learning needs of each individual.

## eWorkbook

Download the workbook for this topic, which includes worksheets, a code puzzle and a project (ewbk-1902)

## Solutions

Download a copy of the fully worked solutions to every question in this topic (sol-0690)

## Digital documents

- 1.2 SkillsHEET Place value (doc-6409)
- SkillsHEET Ascending and descending order (doc-6410)
- 1.3 SkillsHEET Adding and subtracting whole numbers less than 20 (doc-6411)
- 1.5 SkillsHEET Times tables (doc-6412)
- SkillsHEET Multiplying whole numbers (doc-6413)
- 1.6 SkillsHEET Dividing whole numbers (doc-6414)
- 1.7 SkillsHEET Rounding to the first (leading) digit (doc-6418)
- 1.8 SkillsHEET Order of operations I (doc-6415)

## Video eLessons

- 1.2 Place value (eles-3643)
- Ordering and comparing numbers (eles-3644)
- 1.3 Mental strategies for addition (eles-3645)
- Mental strategies for subtraction (eles-3646)
- 1.4 Addition of positive integers using algorithms (eles-3647)
- Commutative and associative laws for addition (eles-3648)
- Subtraction of positive integers using algorithms (eles-3649)
- 1.5 Multiplying positive integers (eles-3650)
- The short multiplication algorithm (eles-3651)
- The long multiplication algorithm (eles-3652)
- Mental strategies for multiplication (eles-4838)
- 1.6 Dividing positive integers (eles-3653)
- The short division algorithm (eles-3654)
- Dividing numbers that are multiples of 10 (eles-3655)
- 1.7 Rounding integers (eles-3656)
- Estimation (eles-3657)
- 1.8 BIDMAS I (eles-3658)
- BIDMAS II (eles-2425)

## Interactivities

- 1.2 Individual pathway interactivity: Place value (int-4311)
- Place value (int-3921)
- 1.3 Individual pathway interactivity: Strategies for adding and subtracting positive integers (int-8731)
- 1.4 Individual pathway interactivity: Algorithms for adding and subtracting positive integers (int-8732)
- Addition of positive integers (int-3922)
- Subtraction of positive integers (int-3924)

- 1.5 Individual pathway interactivity: Multiplying positive integers (int-4313)
- Multiplying positive integers (int-3955)
- Mental strategies for multiplication (int-3925)
- 1.6 Individual pathway interactivity: Long division (int-4316)
- Dividing positive integers (int-8733)
- Dividing numbers that are multiples of 10 (int-3926)
- 1.7 Individual pathway interactivity: Estimation (int-4318)
- Rounding (int-3932)
- 1.8 Individual pathway interactivity: Order of operations (int-4315)
- Order of operations (int-3707)
- 1.9 Crossword (int-2586)
- Sudoku puzzle (int-3163)

## Teacher resources

There are many resources available exclusively for teachers online.

To access these online resources, log on to [www.jacplus.com.au](http://www.jacplus.com.au).

# Answers

## Topic 1 Positive integers

### Exercise 1.1 Pre-test

- E
- 27
- a. 2411      b. 70 555      c. 26 747
- a. 622      b. 7257      c. 1262
- 480
- 416
- 321
- \$1865
- 600
- 30 000
- a. 12      b. 21      c. 25
- a. <      b. =      c. >
- a. 2      b. 8      c. 130
- a. 172      b. 444      c. 235
- 12 minutes after the race has started.

### Exercise 1.2 Place value

- a.  $900 + 20 + 5$   
b.  $20\,000 + 8000 + 400 + 60 + 9$   
c.  $800\,000 + 2$   
d.  $1\,000\,000 + 80\,000 + 100$
- a. Seven hundred and sixty-five  
b. Nine thousand, one hundred and five  
c. Ninety thousand, four hundred and fifty  
d. One hundred thousand, two hundred and thirty-six
- a. 495      b. 2670      c. 109 605
- Forty
- Two hundred
- Zero
- Three hundred
- Fifty
- E
- B
- 48 987, 85 697, 742 647, 28
- 72 167, 58 625, 47 890, 32 320, 12 947
- 7647, 7476, 6747, 6477, 4776
- 8880, 8808, 8800, 8088, 8080, 8008
- 9, 58, 743, 68 247, 1 258 647
- 34 108, 58 610, 60 000, 78 645, 84 364
- 1290, 1902, 2019, 2910, 9021, 9201
- 111, 211, 212, 221, 222, 1112
- a.  $345 < 567$       b.  $89 < 98$       c.  $234\,596 > 23\,459$   
d.  $7765 > 7756$
- a. \$6000      b. \$340 000      c. \$58 000
- a. \$430K      b. \$7K      c. \$800K
- 98 641
- Half a minute (30 s)

24. Astronomers and other scientists work with very small or very large numbers. Scientific notation is a system that makes working with very small or very large numbers easier.

- a. 2  
b. 4
- a. 6  
b. 27  
c. In part a, the number of two-digit numbers is the same as the number of digits. In part b the number of three-digit numbers is double the number of digits because the number can begin with any one of the three digits, and then there are two digits to choose from for the second place and one digit for the third place; this makes six possible numbers.  
d. In part a, the number of two-digit numbers is  $2^2$ . In part b the number of three-digit numbers is  $3^3$ .
- About 11 days at a rate of 1 number per second

### Exercise 1.3 Strategies for adding and subtracting positive integers

- a. 228      b. 1803
- a. 906      b. 448
- a. 560      b. 102
- a. 86      b. 64
- True
- B
- 847
- a. 45      b. 351
- a. 64      b. 33
- a. 17      b. 227
- 278
- a. 5 or 0      b. 10
- Yes. Working shown:  
 $145 + 671$ : Break into 600, 70 and 1  
 $145 + 600 = 745$   
 $745 + 70 = 815$   
 $815 + 1 = 816$   
 $816 - 472$ : Break into 400, 70 and 2  
 $816 - 400 = 416$   
 $416 - 70 = 346$   
 $346 - 2 = 344$
- a. The student has not listed the tens and ones correctly.  
b. 998
- There are 18 children on the playground now.
- 550 students are not completing exams.
- Harriet has \$161 left in her savings account.
- The two numbers are 13 and 6.

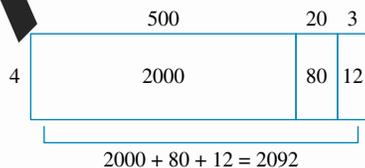
### Exercise 1.4 Algorithms for adding and subtracting positive integers

- a. 15      b. 37      c. 210  
d. 240      e. 1730
- a. 18 220      b. 175 000      c. 20  
d. 40      e. 50

3. a. 99                      b. 72 648                      c. 13 629  
 4. a. 978                      b. 766                      c. 1335  
     d. 14 462                      e. 1 701 553  
 5. a. 180                      b. 280                      c. 790  
     d. 827  
 6. a. 6                      b. 23                      c. 5  
     d. 125                      e. 900  
 7. a. 700                      b. 70                      c. 500  
     d. 5                      e. 26  
 8. a. 4                      b. 20                      c. 55  
     d. 0                      e. 73                      f. 1150  
 9. a. 35                      b. 35 123                      c. 584 599  
 10. a. 267                      b. 4413                      c. 65 439  
     d. 2634  
 11. a. 69 397                      b. 1553                      c. 349 818  
     d. 19 088 744  
 12. \$247  
 13. 3032 pages  
 14. \$71  
 15. 6670 km  
 16. a. 7, 6, 14                      b. 15, 10, 15                      c. 8, 20, 36  
 17. a. 26 m                      b. 26 m                      c. 52 m  
 18. 15  
 19. 9591  
 20. 31  
 21. a. 172 km                      b. 353 km  
 22. a.  $638\,321 - 488\,417 = 149\,904$   
     b.  $3492 - 1685 = 1807$  (other answers possible)  
 23. 5 849 318  
 24. 7 days  
 25. Trixie  
 26. Three students attend both swimming practice and lifesaving.  
 27. Three people do not work Monday to Sunday.  
 28. 6

### Exercise 1.5 Multiplying positive integers

1. a. 24                      b. 54                      c. 60  
     d. 26                      e. 45  
 2. a. 100                      b. 90                      c. 32  
     d. 63                      e. 108  
 3. a. 75                      b. 72                      c. 27  
     d. 90                      e. 80  
 4. 80  
 5. a.



- b. 2092  
 6. a. 128                      b. 1233  
     c. 2571                      d. 24 600

7. a. 63 104                      b. 16 120  
     c. 63 582                      d. 492 720  
 8. a. 2288                      b. 3007                      c. 1652  
 9. a. 912                      b. 64 600                      c. 21 571  
 10. a. 2 161 485                      b. 27 529 460                      c. 1 725 805  
 11. a. 80                      b. 1900  
     c. 4500                      d. 67 000  
 12. a. 900                      b. 3100  
     c. 16 800                      d. 172 000  
 13. a. 8000                      b. 480 000  
     c. 5 500 000                      d. 6 300 000 000  
 14. a. 7200                      b. 5 600 000  
     c. 54 000 000                      d. 13 200 000  
 15. a. 306                      b. 5652  
     c. 7425                      d. 208  
 16. a. 5600                      b. 560                      c. 5040  
 17. a. 4720                      b. 11 250                      c. 28 800  
 18. a. 150                      b. 300                      c. 300  
 19. a. 180                      b. 840                      c. 640                      d. 680  
 20. a. 90                      b. 270                      c. 117  
 21. a. 325                      b. 312  
 22. 205  
 23. 1176  
 24. a. \$72                      b. \$1728  
 25. \$132 000  
 26. a. \$675                      b. \$1200                      c. \$2700  
 27. 490 km  
 28. 524 seconds  
 29. a. 10 km                      b. \$175                      c. 120 km  
     d. \$9100                      e. 400 papers                      f. 20 800 papers  
 30. The correct answer is 1470 so Ben is correct.  
 31.  $92 > 140$  False  
 32. 260  
 33. 576  
 34. 108 921 783 267  
     a. 4356                      b. 5445                      c. 6534  
     d. 7623                      e. 8712                      f. 9801  
 35. 46  
 36. The two numbers are 34 and 35. Their sum is 69.

### Exercise 1.6 Dividing positive integers

1. a. 4                      b. 4                      c. 8  
     d. 8                      e. 13                      f. 3  
 2. a. 3                      b. 2                      c. 2  
     d. 2                      e. 5                      f. 15  
 3. a. 10                      b. 56                      c. 84  
     d. 60                      e. 44  
 4. a. 485                      b. 6208  
     c. 2761                      d. 80 045  
 5. a. 85 064 remainder 2                      b. 86 047 remainder 3  
     c. 904 074 remainder 2                      d. 60 074 remainder 2

6. a. 700      b. 7      c. 900  
 7. a. 500      b. 5000      c. 800  
 8. 72  
 9. 214  
 10. 532  
 11. a. \$208      b. \$48  
 12. 186 cows  
 13. Number of tables required: 19; total number of courses to be served: 608; number of waiters required: 8; total charge for catering: \$8360  
 14. a.  $950 \text{ m}^2$       b. \$794 750  
 15. Kayla:  $243 \div 9 = 27$   

$$\begin{array}{r} 027 \\ 9 \overline{)2463} \end{array}$$
  
 16. The statement is false.  
 17. a. 37      b. 3  
 18. \$16 per night  
 19. There needs to be 8 tables.  
 20. 10, 18, 26. Students should mention that the pattern in the solution differs by the divisor and that it is found by adding the remainder to each of the multiples.

### Exercise 1.7 Rounding and estimating

1. a. 10      b. 50      c. 1000  
 d. 10 000      e. 200 000      f. 5 000 000  
 2. 28 000 000  
 3. Estimation table:

	Estimate	Estimated answer	Actual answer
a.	$500 + 1000$	1500	1449
b.	$30\,000 + 80\,000$	110 000	115 670
c.	$200\,000 + 700\,000$	900 000	907 448
d.	$90\,000 - 40\,000$	50 000	55 880
e.	$300 - 200$	100	127
f.	$500\,000 - 200\,000$	300 000	296 049
g.	$40 \times 200$	8000	7128
h.	$600 \times 10\,000$	6 000 000	7 894 033
i.	$30\,000 \times 40$	1 200 000	1 149 954
j.	$30\,000 \div 1000$	30	32.907 58
k.	$60\,000 \div 3000$	20	24.325 483
l.	$70\,000 \div 1000$	70	53.385 505

4. D  
 5. B  
 6. B  
 7. a. 8000      b. 100      c. 400 000  
 d. 700 000      e. 11 000  
 8. a. 6000      b. 8 000 000      c. 100  
 d. 40 000 000      e. 500

9. B  
 10. D  
 11. A  
 12. D  
 13. a. 1500 tickets      b. \$11 250  
 14. a. i. 6000      ii. 5340  
 b. i. 8000      ii. 8028  
 c. i. 50      ii. 46.677 740  
 15. \$29  
 16.  $\approx 1200$  ( $10 \times 10 \times 12$ ). There are approximately 10 seats in each row and about 10 rows of students, so there are approximately 100 students in the photograph.  
 17. 900 students  
 18. It is important not to estimate calculations by rounding when a very accurate answer is needed.  
 19. \$7270  
 20. a.

Item	Estimated cost
Bread rolls	\$75
Hamburgers	\$50
Tomato sauce	\$4
Margarine	\$4
Onions	\$4
Tomatoes	\$8
Lettuce	\$5

- b. \$150      c. \$600      d. \$450

### Exercise 1.8 Order of operations

1. a. 5      b. 9      c. 3  
 d. 30      e. 59  
 2. a. 25      b. 7      c. 96  
 d. 0  
 3. a. 15      b. 24      c. 32  
 d. 18      e. 76      f. 27  
 4. a. 7      b. 12      c. 96  
 d. 27      e. 18      f. 3  
 5. a.  $(12 - 8) \div 4 = 1$   
 b.  $(4 + 8) \times 5 - 4 \times 5 = 40$   
 c.  $3 \times (10 - 2) \div 4 + 4 = 10$   
 d.  $12 \times (4 + 2) - 12 = 60$   
 e.  $10 \div (5 + 5) \times 9 \times 9 = 81$   
 f.  $(18 - 3) \times 3 \div 5 = 9$   
 6. a. 18      b. 14      c. 0      d. 22  
 7. a. 2      b. 27      c. 0      d. 1  
 8. a. 3      b. 18      c. 40      d. 77  
 9. a. 23      b. 18      c. 2      d. 15

10. a. 8      b. 21      c. 16      d. 0  
 11. a. 27      b. 3      c. 21      d. 32  
 12. C  
 13. B  
 14. D  
 15. a.  $6 + 2 \times (4 - 3) \times 2 = 10$   
 b.  $(6 + 2) \times 4 - 3 \times 2 = 26$   
 c.  $6 + (2 \times 4 - 3) \times 2 = 16$   
 d.  $6 + 2 \times 4 - 3 \times 2 = 8$ , no brackets required  
 16. a.  $274 + 2 \times -68 + 3 \times 50 = \$288$   
 b. 600 apples  
 c. 8 kg  
 17. When dealing with money.  
 18. Keenan ( $6 + 6 \div 3 = 6 + 2 = 8$ )  
 19. 43 pebbles  
 20. \$229.20  
 21. a.  $3 \times (4.25 + 4.75) + 2 \times 3.75$   
 b. \$34.50

22. a. Sydney 9h ahead  
 b. Singapore 6h ahead  
 23. Two possible solutions: 2 packets with 3 ice creams and 5 packets with 5 ice creams, or 7 packets with 3 ice creams and 2 packets with 5 ice creams.  
 With further investigation of the number pattern obtained by summing 3s and 5s, it appears that there are combinations of 3 packs and 5 packs that will amount to any quantity of ice creams equal to or larger than 8.  
 24. An example is shown below.  
 $1 = (4 - 3) \div (2 - 1)$   
 $3 = 21 \div (3 + 4)$   
 $5 = 3 + 4 - (2 \times 1)$   
 25. An example is shown below.  
 $5 = 4 + 3 - (2 \times 1)$   
 $6 = 3 \times 4 \div (2 \times 1)$   
 $8 = 4 \times (3 - 2 + 1)$   
 $9 = 4 + 3 + 2 \div 1$

### Project

- 1 530 431
- 
- 
- 
- 
- 
- List any difficulties you encountered.

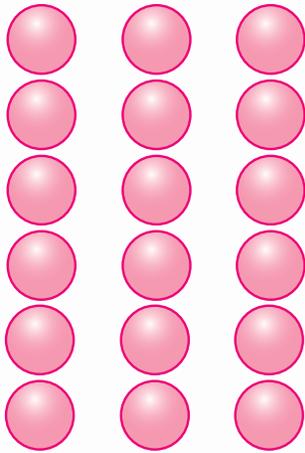
Symbol	Value	Symbol	Value
$\alpha$	1	$\xi$	60
$\beta$	2	$\omicron$	70
$\gamma$	3	$\pi$	80
$\delta$	4	$\varphi$ or $\zeta$	90
$\epsilon$	5	$\rho$	100
$\zeta$ or $F$	6	$\sigma$	200
$\xi$	7	$\tau$	300
$\eta$	8	$\upsilon$	400
$\theta$	9	$\phi$	500
$\iota$	10	$\chi$	600
$\kappa$	20	$\psi$	700
$\lambda$	30	$\omega$	800
$\mu$	40	$\bar{\epsilon}$	900
$\nu$	50		

9. Adding a subscript or superscript *iota* (Greek letter for 10) with the symbols used for 1 to 9 represented the numbers 1000 to 9000.  $M$  was used to represent 10 000. When symbols were placed on top of the  $M$ , this meant that the value of the symbols was multiplied by 10 000. This enabled the ancient Greeks to represent larger numbers.  
 10. Sample response can be found in the worked solutions in the online resources.

### Exercise 1.9 Review questions

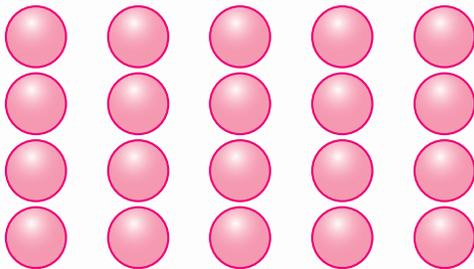
- a. 7      b. 40 000  
 c. 1 000 000      d. 90
- a.  $300 + 90 + 2$       b.  $4000 + 100 + 9$   
 c.  $40\,000 + 2000 + 1$       d.  $100\,000 + 20\,000$
- 349, 394, 934, 943, 3499, 3994
- 1101, 1100, 1011, 110, 101
- a. 127      b. 3187  
 c. 7641      d. 4 217 656
- a. 2      b. 35      c. 150      d. 14
- a. 415      b. 217      c. 60 322  
 d. 37 758      e. 92 957
- a. 150      b. 8400      c. 1240  
 d. 603      e. 589

9. a.  $3 \times 6$



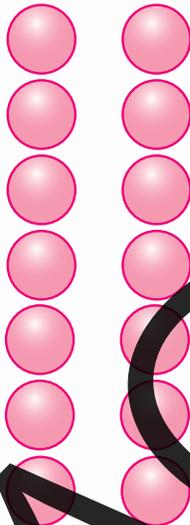
There are 18 balls = 18

b.  $5 \times 4$



There are 20 balls = 20

c.  $2 \times 7$



There are 14 balls = 14

10. a. 96                      b. 1072                      c. 3210  
 11. a. 1416                    b. 1388                      c. 3375  
 12. a. 1152                    b. 2286                      c. 19200  
 13. a. 4608                    b. 30894                    c. 18355064  
 14. a. 129                      b. 260                        c. 5021  
 15. a. 8                        b. 3                            c. 84                        d. 45                        e. 1  
 16. a. 700                      b. 7                            c. 410  
 17. a. 1568                    b. 981                        c. 537r3  
       d. 335r7                    e. 911r9

18. a. 14000                    b. 5000                      c. 50  
       d. 420000                   b. 120000                   f. 210000

19. C

20. a. <                        b. =                            c. >                            d. >  
 21. a. 327                      b. 1090                      c. 789                        d. 216  
 22. a. 127                      b. 81                            c. 711                        d. 278  
 23. a. 28                      b. 24                            c. 10                            d. 8                            e. 11                        f. 27  
 24. a. 12                        b. 30                            c. 5  
       d. 900                        e. 14                            f. 25

25. a. <                        b. =                            c. >                            d. <

26. a. <                        b. <                            c. >                            d. >

27. 23.5

28. a. 5                        b. 38                            c. 6                            d. 5                            e. 70                        f. 29

29. a. 306 km                    b. 322 km                    c. 482 km

30. a. 448                        b. 3136                        c. 98

31. As long as one of the factors in a multiplication is even, the result will be even. Otherwise, the answer will be odd.

32. 8240

$$\begin{array}{r} -3681 \\ 8240 \\ \hline 4559 \end{array}$$

33. 95

34. a.  $8 \times 3 + 12 \times 2$                       b. \$48

35. 20499

36. a.

+	6	10	3
5	11	15	8
12	18	22	15
9	15	19	12

b.

×	4	8	6
3	12	24	18
5	20	40	30
2	8	16	12

37. a.  $24^\circ\text{C}$                       b.  $-21^\circ\text{C}$

38. 21 questions for 3 marks

39.

8	+	4	×	6	=	32
+		×		×		
3	-	5	+	9	=	7
×		÷		÷		
7	-	2	-	1	=	4
=		=		=		
29		10		15		

40. 2019 and 2018