

VCE VM Numeracy Unit 1

Chapter 2 — Number

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Chapter 2 Number — 2A Place value: whole numbers and decimals to two places

About the data in this section. The prices, populations, times and masses here are **made up** (not real): pretend shops and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Theory

Why place value.

Every number you read at work — a pay slip, an order form, a price tag, a scale, a meter — is only useful if you read each digit in the right place. The same digits in different places make different numbers: 703 is not 73, and 33 is not the same pair of 3s twice. Place value is the rule that says what each digit is worth, and it is the reason a number can be written in digits, in words, or split into parts, and still be the same number.

Digits and position.

A **digit** is one of the symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. A **whole number** is a number with no fraction and no decimal part: 0, 1, 2, 3, ... and so on. The **place value** of a digit is the value it carries because of the place it sits in.

The rule behind every place: **each place is worth 10 times the place next to it on the right.** In $33 = 30 + 3$ the left-hand 3 is worth ten times the right-hand 3, purely because of where it sits.

The number 486 213 in a place value chart

columns (places)	Hundred thousands	Ten thousands	Thousands	Hundreds	Tens	Ones
digits	4	8	6	2	1	3
value of each digit	400 000	80 000	6 000	200	10	3

Each column is worth 10 times the column next to it on the right.

Read the chart across: in 486 213 the 4 is worth 400 000, the 8 is worth 80 000, the 6 is worth 6 000, the 2 is worth 200, the 1 is worth 10, and the 3 is worth 3.

Expanded form.

Writing a number as the sum of its digit values is called **expanded form**. The ordinary way of writing the number, all digits in their places, is called **standard form**:

$$486\,213 = 400\,000 + 80\,000 + 6\,000 + 200 + 10 + 3$$

Expanded form: the number as the sum of its digit values

400 000	+	80 000	+	6 000	+	200	+	10	+	3	=	486 213
---------	---	--------	---	-------	---	-----	---	----	---	---	---	---------

Add the parts and you get the number back (standard form).

Expanded form works backwards too. Add the parts and you get the standard form:
 $40\,000 + 9\,000 + 600 + 20 + 8 = 49\,628$.

Whole numbers in words and digits.

To say or write a whole number in words, split it into groups of three digits counting from the right. Say each group as a number, then say the group's name (thousand, and so on). Use “and” before the last part when that part is under 100:

- 486 213 — “four hundred and eighty-six thousand, two hundred and thirteen”
- 2 050 — “two thousand and fifty”
- 50 006 — “fifty thousand and six”

Zeros inside a number are **placeholders**: they hold a place empty so the other digits keep their value. In 703 the 0 holds the tens place, which is what keeps the 7 worth 700. Drop that zero and you get 73 — a different, much smaller number.

Decimals: the point and the places after it.

The **decimal point** separates the whole-number part of a number from the part smaller than 1. The first place to the right of the point is the **tenths** place: one tenth is written 0.1. The second place to the right of the point is the **hundredths** place: one hundredth is written 0.01. In this section we work with decimals of up to two decimal places — tenths and hundredths, and nothing smaller.

The decimal 7.35 in a place value chart

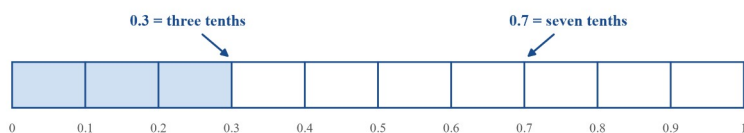
columns	Ones		Tenths	Hundredths
digits	7	.	3	5
value	7	—	0.3	0.05

↑
the decimal point

Left of the point: whole numbers. Right of the point: tenths, then hundredths.

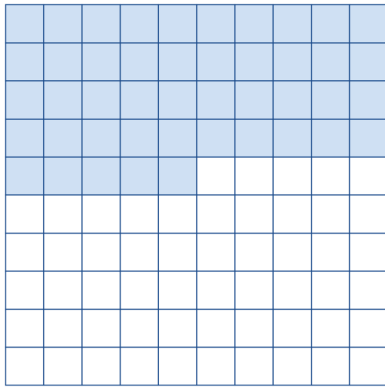
The chart says $7.35 = 7 + 0.3 + 0.05$: seven ones, three tenths and five hundredths.

One whole bar split into 10 equal parts — each part is one tenth (0.1)



Counting along in tenths: 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0

One whole, split into 100 equal parts



45 of the 100 small squares are shaded.

Shaded part = 0.45 = forty-five hundredths

Two habits to keep. Always write a zero in front of the point when the whole-number part is empty — write 0.45, not .45. And remember that a zero at the **end** of a decimal changes nothing: $0.6 = 0.60$. That is not true of whole numbers, where an end zero does change the value: $60 \neq 6$.

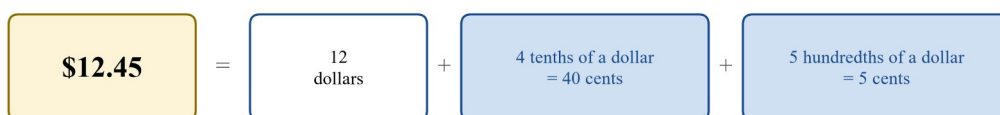
Decimals in words.

There are two accepted ways to say a decimal. You can say “point” and then read the digits after it one at a time: 7.35 is “seven point three five” — never “seven point thirty-five”, because the places after the point are read digit by digit. Or you can name the places: 7.35 is “seven and thirty-five hundredths”. Either way, a zero after the point must be said: 5.07 is “five point zero seven”.

Money and decimals.

Money is the decimal you meet most often. One cent is one hundredth of a dollar, and ten cents are one tenth of a dollar:

Money is a decimal number



1 cent = \$0.01 (one hundredth of a dollar) 10 cents = \$0.10 (one tenth of a dollar)

In words: twelve dollars and forty-five cents.

So \$12.45 is 12 dollars plus 4 tenths of a dollar plus 5 hundredths of a dollar, which is why $\$12.45 = 1245$ cents. Money is always written to two decimal places so the cents place is visible — the same rule used for money in §1D.

Refresher. Multiplying and dividing by 10 and by 100.

Multiplying by 10 moves every digit one place to the **left**; dividing by 10 moves every digit one place to the **right**. Multiplying by 100 moves digits two places left; dividing by 100 moves them two places right. The decimal point stays put — it is the digits that move. Empty places left behind are filled with zeros.

Multiplying by 10 moves every digit one place to the left

	Tens	Ones		Tenths	Hundredths
0.45	0	0	.	4	5
4.5	0	4	.	5	0
45	4	5	.	0	0

÷10 value shrinks: each digit moves one place RIGHT

×10 value grows

The decimal point stays put — the digits move. Faint 0s hold the empty places.

- $3.6 \times 10 = 36$, and $36 \div 10 = 3.6$
- $0.45 \times 10 = 4.5$, and $0.45 \times 100 = 45$
- $4.5 \div 10 = 0.45$, and $45 \div 100 = 0.45$

Renaming with place value.

One value can wear several names. Renaming is how you compare decimals, check a calculator display, and move between dollars and cents:

- $0.45 = 45$ hundredths
- $3.6 = 36$ tenths
- $\$2.40 = 240$ cents
- 85 hundredths $= 0.85$
- 240 cents $= \$2.40$

Comparing and ordering numbers.

Three symbols do the work of comparing. The wide, open end of the symbol always faces the bigger number:

Symbol	Reads as	Example
<	less than	$0.58 < 0.6$
>	greater than	$0.6 > 0.58$
=	equal to	$0.6 = 0.60$

To compare two decimals: line up the decimal points, add end zeros so both numbers have the same number of decimal places, then compare digits from the left and stop at the first difference.

Comparing 0.6 and 0.58

- 1 Give both numbers two decimal places: $0.6 = 0.60$.
- 2 Line up the decimal points, one under the other.
- 3 Compare from the left. Tenths: 6 is bigger than 5 — stop here.

Ones		Tenths	Hundredths	
0	.	6	0	0.60
0	.	5	8	0.58

6 tenths > 5 tenths,
so $0.60 > 0.58$
and $0.6 > 0.58$

0.58 is written with more digits, but 0.6 is the bigger number. Longer does not mean larger.

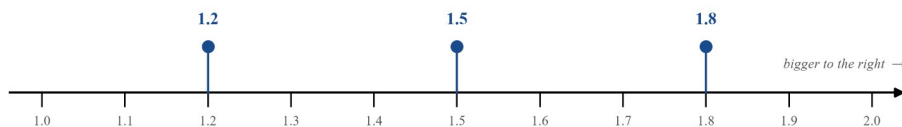
Notice what the figure shows: 0.58 is written with more digits than 0.6, yet 0.6 is the bigger number. **Longer does not mean larger.**

To **order** a set of numbers means to write them from smallest to largest, or from largest to smallest — always say which direction you used.

Number lines.

A **number line** puts numbers in their order, left to right: smaller numbers to the left, bigger numbers to the right. It is a fast check on any ordering you have done with digits.

A number line from 1.0 to 2.0



Each tick on this line is one tenth (0.1) further along. The points 1.2, 1.5 and 1.8 sit in that order from left to right, which is the order from smallest to largest.

Refresher. Adding and subtracting with lined-up places.

When money or decimals are added or subtracted in columns, line up the decimal points one under the other, add end zeros so both numbers have the same number of places, then add or subtract as if they were whole numbers. The point in the answer goes directly under the points above it. For example:

$$\begin{array}{r} 5.00 \\ - 2.40 \\ \hline 2.60 \end{array}$$

so $\$5.00 - \$2.40 = \$2.60$. Lining up the points is what keeps the tenths under the tenths and the hundredths under the hundredths.

Key ideas.

- A digit's value comes from its place; each place is worth 10 times the place to its right.
- Expanded form splits a number into its digit values; standard form puts them back together.
- Right of the decimal point come tenths, then hundredths. In this section, decimals go to two places at most.
- A zero can hold a place empty (703, 5.07); an end zero after the point changes nothing ($0.6 = 0.60$).
- Multiplying by 10 or 100 moves digits left; dividing by 10 or 100 moves them right. The point stays put.
- To compare decimals: line up the points, pad with end zeros, read from the left. Longer does not mean larger.
- Money is a decimal number: 1 c = \$ 0.01, and money is written to two decimal places.

Worked examples

Example 1 — scaffolded

A town's welcome sign gives its population as 58 347. (a) What is the value of the digit 8? (b) Write the population in words. (c) Write the population in expanded form.

Working	Comment
(a) the 8 sits in the thousands place: $8 \times 1\,000 = 8\,000$	Name the place first, then the digit's value.
(b) “fifty-eight thousand, three hundred and forty-seven”	Groups of three from the right: 58 thousand, then 347; “and” before the last part under 100.
(c) $58\,347 = 50\,000 + 8\,000 + 300 + 40 + 7$	One part per digit, each part the digit's value.
check: $50\,000 + 8\,000 + 300 + 40 + 7 = 58\,347$	Adding the parts returns the population, so the expanded form is right.

Example 2 — scaffolded

A shelf label in a shop reads \$8.45. (a) Give the tenths digit and its value, in dollars and in cents. (b) Give the hundredths digit and its value, in dollars and in cents. (c) Write the price in words. (d) Write the price in cents only.

Working	Comment
(a) tenths digit 4: value $\$0.40 = 40\text{ c}$	The first place right of the point.
(b) hundredths digit 5: value $\$0.05 = 5\text{ c}$	The second place right of the point.
(c) “eight dollars and forty-five cents”	Dollars said as a whole number, then the cents said as a number of cents.
(d) $\$8.45 \times 100 = 845\text{ c}$	Multiplying by 100 moves every digit two places left.

Example 3 — unscaffolded

Three swimmers record these times for the same 50 m leg of a relay: 34.56 s, 34.6 s and 34.58 s. Put the times in order from fastest to slowest, and say which time needed a zero added before it could be compared.

In a race the **smallest** time is the fastest, so this is an ordering from smallest to largest. Line up the decimal points and pad to two decimal places: 34.56, 34.60 and 34.58. The 34.6 s time is the one that needed the placeholder zero — $34.6 = 34.60$, the same time written to two places.

Compare from the left. The 34 ones are equal in all three. In the tenths place the digits are 5, 6, 5: the 6 is the biggest, so 34.60 is the slowest. Between the two times with 5 tenths, compare the hundredths: 6 against 8, so 34.56 is smaller than 34.58.

$\therefore$ from fastest to slowest the times are 34.56 s, 34.58 s, 34.6 s; the 34.6 s time needed the placeholder zero (34.60) to be compared with the others.

Example 4 — unscaffolded

A builder's job sheet lists 3.5 m of timber and a tube of glue at \$6.05. (a) Rename the timber length in tenths of a metre. (b) Write the glue price in words, and as a point-number reading. Explain why \$6.05 is not \$6.50. (c) Write the glue price in cents.

(a) 3.5 is 3 ones and 5 tenths, which is 35 tenths altogether: $3.5 \times 10 = 35$. The timber is 35 tenths of a metre.

(b) In money words the price is “six dollars and five cents”; read digit by digit it is “six point zero five”. The zero holds the empty tenths place. Without it the tag would read \$6.50, which is 45 cents more than \$6.05 — a different price.

(c) $\$6.05 \times 100 = 605$, so the glue costs 605 cents.

$\therefore$ the job sheet's 3.5 m of timber is 35 tenths of a metre, and the glue at \$6.05 (“six dollars and five cents”, six point zero five) is 605 c — the zero in the tenths place is what keeps the price at six dollars and five cents.

Practice questions

Scaffolded

Q1. The number is 72 409. (a) Write down the thousands digit. (b) What is the value of the 7? (c) Write the number in words.

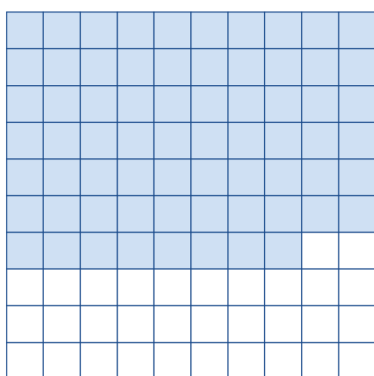
Q2. (a) Write $40\,000 + 9\,000 + 600 + 20 + 8$ in standard form. (b) Write 3 704 in expanded form. (c) What is the value of the 7 in 3 704?

Q3. (a) In 0.62, write down the hundredths digit and its value. (b) Write 5.07 in words, using the point-number reading. (c) In 12.4, write down the tenths digit and its value.

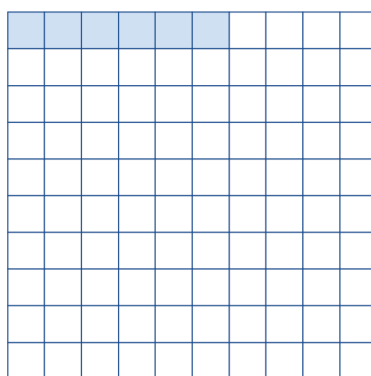
Q4. (a) Write \$ 4.30 in cents. (b) What is the value of the 9 in \$ 12.95, in cents? (c) Write “seven dollars and five cents” in digits.

Q5. Each grid below shows 1 whole split into 100 equal parts.

Each grid shows 1 whole, split into 100 equal parts



Grid A



Grid B

- (a) Write the shaded part of Grid A as a decimal.
- (b) Write the shaded part of Grid B in hundredths, and as a decimal.
- (c) Explain why Grid B shows 0.06 and not 0.6.

Q6. Copy each pair of numbers and put $<$, $>$ or $=$ between them. (a) 4 968 and 5 012 (b) 0.7 and 0.65 (c) 2.5 and 2.50

Un scaffolded

Q7. A road sign reads “thirty-nine thousand and eighty-six”. (a) Write the number in digits. (b) What is the value of the 9? (c) Which digit holds the hundreds place?

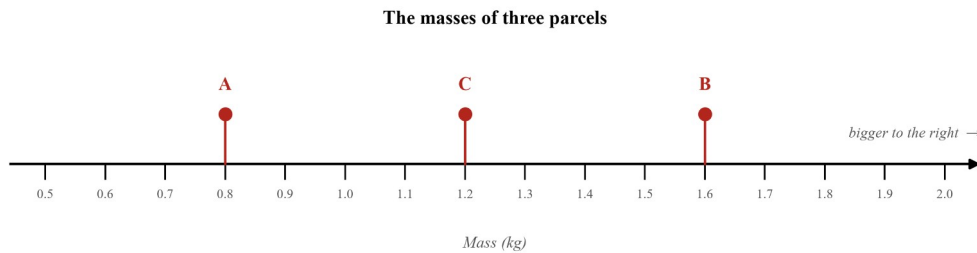
Q8. A bottle label reads “two point zero five litres”. (a) Write the volume in digits with its unit. (b) Say what the zero does, and what the number would be without it. (c) Rename the volume in hundredths of a litre.

Q9. A number is made of 6 ten-thousands, 0 thousands, 2 hundreds, 9 tens and 4 ones. (a) Write the number in standard form. (b) Write the number in words. (c) What is the value of the 6?

Q10. (a) Write 8.32 in expanded form. (b) Write $30 + 0.6 + 0.01$ in standard form. (c) A bag of rice weighs $5 + 0.2 + 0.07$ kilograms. Write its mass in standard form.

Q11. Four athletes run the same 400 m race. Their times are: Tia 41.2 s, Ben 40.85 s, Ayu 41.05 s, Chris 40.9 s. (a) Who ran the fastest time? (b) List the athletes in order from fastest to slowest. (c) Write Chris’s time to two decimal places.

Q12. The number line shows the masses of three parcels, in kilograms.



- Read off the mass of each parcel.
- Which parcel is the heaviest?
- List the parcels in order from lightest to heaviest.

Q13. A parking machine charges \$ 2.40 for an hour. (a) Show that \$ 2.40 = 240 cents, one step per line. (b) Rename \$ 2.40 in tenths of a dollar. (c) You pay with a \$ 5.00 note. How much change do you get?

Q14. A workshop shelf board is 1.35 m long, and the gap it must fit into is 1.4 m wide. After the board is cut, an offcut of 0.9 m is left on the bench. (a) Rename the shelf board's length in hundredths of a metre. (b) Rename the 0.9 m offcut in tenths of a metre, and then in hundredths of a metre. (c) Does the shelf board fit the gap? If it fits, how much longer than the board is the gap?

Q15. A form asks for a number written as "four hundred and five thousand and sixty". (a) Write the number in digits. (b) What is the value of the 5? (c) What is the value of the 4?

Q16. A walker's app records 6.28 km for the day. (a) Write down the tenths digit and its value. (b) Write 6.28 in expanded form. (c) Rename 6.28 km in hundredths of a kilometre.

Q17. Three shops advertise the same drill at \$ 89.9, \$ 89.90 and \$ 89.09. (a) Which two prices are the same amount? Explain how you know. (b) Write those two prices to two decimal places. (c) List the three prices in order from smallest to largest.

Q18. A café receipt lists three items:

Item	Price
loaf of bread	\$2.95
carton of milk	\$3.25
dozen eggs	\$6.05

Made-up data: the item names and every price in this table are made up for this section.

- Write the price of the eggs in words.
- What is the value of the 2 in \$ 3.25, in cents?
- How much more do the eggs cost than the milk?

Answers

Q1. (a) 2. (b) 70 000. (c) “seventy-two thousand, four hundred and nine”. **Q2.** (a) 49 628. (b) $3\,704 = 3\,000 + 700 + 4$. (c) 700. **Q3.** (a) 2, value 0.02. (b) “five point zero seven”. (c) 4, value 0.4. **Q4.** (a) 430 c. (b) 90 c. (c) \$ 7.05. **Q5.** (a) 0.68. (b) 6 hundredths, written 0.06. (c) the 6 sits in the hundredths place and a 0 holds the empty tenths place; six tenths would need 60 of the 100 squares shaded. **Q6.** (a) $4\,968 < 5\,012$. (b) $0.7 > 0.65$. (c) $2.5 = 2.50$. **Q7.** (a) 39 086. (b) 9 000. (c) 0. **Q8.** (a) 2.05 L. (b) the zero holds the tenths place; without it the label would read 2.5 L, a different and larger volume. (c) 205 hundredths of a litre. **Q9.** (a) 60 294. (b) “sixty thousand, two hundred and ninety-four”. (c) 60 000. **Q10.** (a) $8 + 0.3 + 0.02$. (b) 30.61. (c) 5.27 kg. **Q11.** (a) Ben. (b) Ben, Chris, Ayu, Tia. (c) 40.90 s. **Q12.** (a) A 0.8 kg, B 1.6 kg, C 1.2 kg. (b) B. (c) A, C, B. **Q13.** (a) shown in solutions. (b) 24 tenths of a dollar. (c) \$ 2.60. **Q14.** (a) 135 hundredths of a metre. (b) 9 tenths, which is 90 hundredths. (c) yes; the gap is 0.05 m longer than the board. **Q15.** (a) 405 060. (b) 5 000. (c) 400 000. **Q16.** (a) 2, value 0.2 km. (b) $6 + 0.2 + 0.08$. (c) 628 hundredths of a kilometre. **Q17.** (a) \$ 89.9 and \$ 89.90 — an end zero after the point changes nothing. (b) \$ 89.90 each. (c) \$ 89.09, then \$ 89.9 and \$ 89.90 (equal). **Q18.** (a) “six dollars and five cents”. (b) 20 c. (c) \$ 2.80.

Fully-worked solutions

Q1. (a) Counting places from the right — ones, tens, hundreds, thousands — the thousands digit is 2. (b) The 7 sits in the ten-thousands place: $7 \times 10\,000 = 70\,000$. (c) Groups of three from the right give 72 thousand, then 409: “seventy-two thousand, four hundred and nine”.

Q2. (a) $40\,000 + 9\,000 + 600 + 20 + 8 = 49\,628$. (b) $3\,704 = 3\,000 + 700 + 4$ — the tens place is empty, so it contributes no part. (c) The 7 sits in the hundreds place: 700.

Q3. (a) The hundredths digit of 0.62 is 2; its value is $2 \div 100 = 0.02$. (b) “five point zero seven” — the zero is said, because it holds the tenths place. (c) The tenths digit of 12.4 is 4; its value is $4 \div 10 = 0.4$.

Q4. (a) $\$ 4.30 \times 100 = 430$ c. (b) The 9 in \$ 12.95 sits in the tenths place: $\$ 0.90 = 90$ c. (c) Seven dollars and five cents is \$ 7.05 — the zero holds the empty tenths place.

Q5. (a) Grid A has 68 of the 100 squares shaded: 0.68. (b) Grid B has 6 of the 100 squares shaded: 6 hundredths, written 0.06. (c) In 0.06 the 6 sits in the hundredths place, and the 0 holds the empty tenths place. Six tenths is the same as 60 hundredths, so 0.6 would need 60 squares shaded; Grid B has only 6.

Q6. (a) $4\,968 < 5\,012$ — the first difference from the left is the thousands place: 4 against 5. (b) $0.7 > 0.65$ — pad to 0.70 against 0.65; the tenths decide it, 7 against 6. (c) $2.5 = 2.50$ — an end zero after the point changes nothing.

Q7. (a) “thirty-nine thousand and eighty-six” is 39 thousand and 86: 39 086. (b) The 9 sits in the thousands place: 9 000. (c) The hundreds digit is 0 — it holds the place empty so the 9 stays in the thousands.

Q8. (a) 2.05 L. (b) The zero holds the tenths place. Without it the label would read 2.5 L — two and five tenths litres — which is a different, larger volume than 2.05 L. (c) $2.05 \times 100 = 205$, so the volume is 205 hundredths of a litre.

Q9. (a) $60\,000 + 0 + 200 + 90 + 4 = 60\,294$. (b) Groups of three from the right: 60 thousand, then 294: “sixty thousand, two hundred and ninety-four”. (c) The 6 sits in the ten-thousands place: 60 000.

Q10. (a) $8.32 = 8 + 0.3 + 0.02$. (b) $30 + 0.6 + 0.01 = 30.61$. (c) $5 + 0.2 + 0.07 = 5.27$, so the bag weighs 5.27 kg.

Q11. (a) The smallest time is the fastest: Ben, at 40.85 s. (b) Pad every time to two places — 40.85, 40.90, 41.05, 41.20 — then order from smallest: Ben, Chris, Ayu, Tia. (c) 40.9 s = 40.90 s; the end zero changes nothing, it just shows the hundredths place.

Q12. (a) Each tick is one tenth: A is 0.8 kg, B is 1.6 kg, C is 1.2 kg. (b) B is furthest to the right, so B is the heaviest at 1.6 kg. (c) Left to right is lightest to heaviest: A (0.8 kg), C (1.2 kg), B (1.6 kg).

Q13. (a) One step per line:

$$\text{\$ } 1 = 100 \text{ c}$$

$$\text{\$ } 2.40 \times 100 = 240$$

$\therefore \text{\$ } 2.40 = 240$ cents. (b) $\text{\$ } 2.40 \times 10 = 24$, so $\text{\$ } 2.40$ is 24 tenths of a dollar. (c) Line up the points:
 $\text{\$ } 5.00 - \text{\$ } 2.40 = \text{\$ } 2.60$.

Q14. (a) $1.35 \times 100 = 135$, so the board is 135 hundredths of a metre long. (b) $0.9 = 9$ tenths of a metre; renaming again, $0.9 = 90$ hundredths of a metre. (c) Line up the two lengths: 1.40 against 1.35. The tenths decide it (4 against 3), so $1.40 > 1.35$ and the board fits, with $1.40 - 1.35 = 0.05$ m to spare.

Q15. (a) “four hundred and five thousand and sixty” is 405 thousand and 60: 405 060. (b) The 5 sits in the thousands place: 5 000. (c) The 4 sits in the hundred-thousands place: 400 000.

Q16. (a) The tenths digit of 6.28 is 2; its value is 0.2 km. (b) $6.28 = 6 + 0.2 + 0.08$. (c) $6.28 \times 100 = 628$, so the walk is 628 hundredths of a kilometre.

Q17. (a) $\text{\$ } 89.9$ and $\text{\$ } 89.90$ are the same amount: an end zero after the decimal point changes nothing. The third price, $\text{\$ } 89.09$, is different — its 9 sits in the hundredths place, not the tenths. (b) Both write as $\text{\$ } 89.90$ to two decimal places. (c) Smallest to largest: $\text{\$ } 89.09$, then $\text{\$ } 89.9$ and $\text{\$ } 89.90$, which are equal.

Q18. (a) “six dollars and five cents” — read digit by digit it would be “six point zero five”, and either way the zero in the tenths place must not be dropped. (b) The 2 in $\text{\$ } 3.25$ sits in the tenths place: $\text{\$ } 0.20 = 20$ c. (c) Line up the points:
 $\text{\$ } 6.05 - \text{\$ } 3.25 = \text{\$ } 2.80$.

Chapter 2 Number — 2B Multiplication facts, factors and multiples

Theory

About the data in this section. The prices, counts and business names here are **made up** (not real): pretend businesses and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Multiplication is repeated addition. Adding the same number several times is multiplication: $4 + 4 + 4 = 12$ is three lots of 4, written $3 \times 4 = 12$. **Refresher.** The numbers being multiplied are called **factors**, and the answer is called the **product**. Because $3 \times 4 = 12$, we say 3 and 4 are factors of 12, and 12 is a multiple of 3 and a multiple of 4. Those three words — factor, multiple, product — do most of the work in this section.

Even and odd numbers. Refresher. A whole number is **even** if it can be split into two equal whole-number halves; even numbers end in 0, 2, 4, 6 or 8. A number is **odd** if it cannot; odd numbers end in 1, 3, 5, 7 or 9. So 14 is even and 15 is odd, and you can tell without doing any dividing — just look at the last digit.

Skip counting gives multiples. Refresher. Counting on in jumps — 5, 10, 15, 20, ... — is skip counting, and the numbers you say are the multiples of 5. Multiples of 4 up to 20 are 4, 8, 12, 16, 20. Every jump lands on one more multiple, so knowing your skip counting is the same as knowing your multiples.

The multiplication facts grid. Everything in this section grows out of the one-digit facts, 1×1 up to 10×10 . The grid below holds all 100 of them: read across to a row, up to a column, and the cell where they meet is the product.

the multiplication facts grid: row $\times$ column

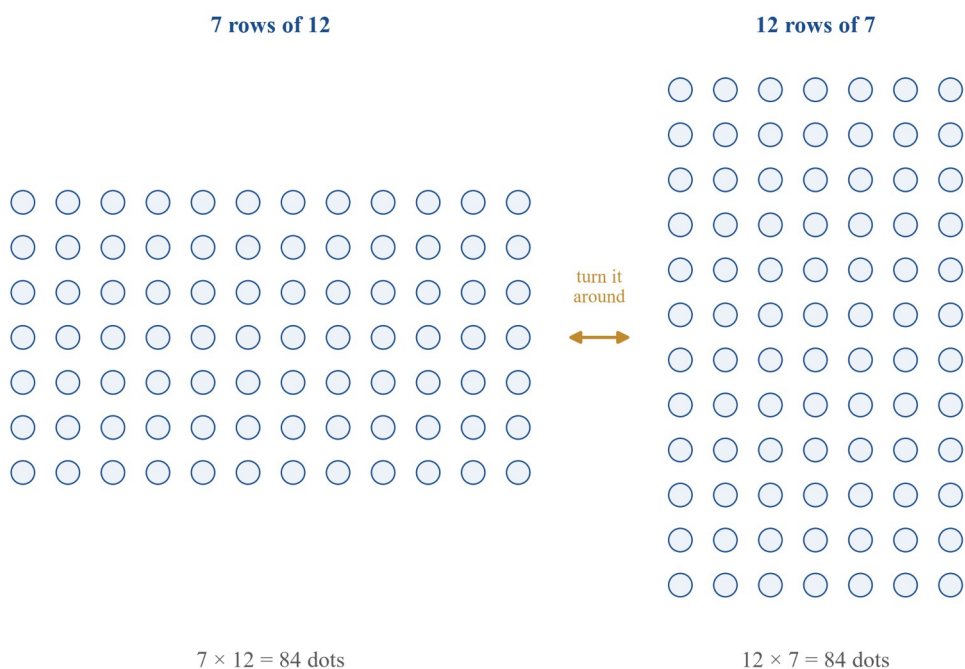
$\times$	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

the shaded row is the 7s and the shaded column is the 4s: $7 \times 4 = 28$ and $4 \times 7 = 28$ — same answer, turned around

The facts grid. The shaded row is the 7s and the shaded column is the 4s; they meet at 28, so $7 \times 4 = 28$ — and turning it around, $4 \times 7 = 28$ as well.

Notice the turn-around in the grid: the answer sitting in row 7, column 4 is the same answer as row 4, column 7. You only have to learn half the grid, because every fact has a turned-around twin.

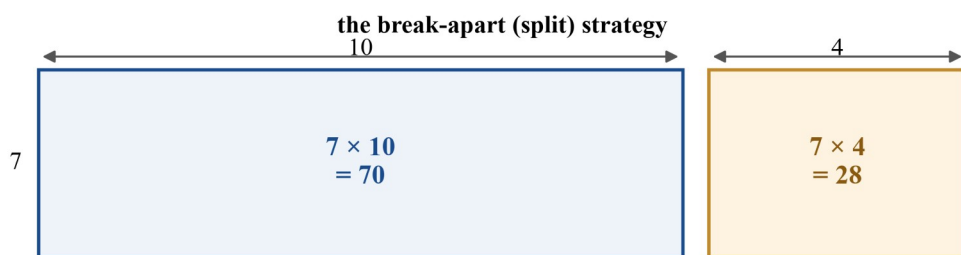
Arrays show the turn-around. A rectangle of dots — an **array** — makes the same point with pictures. Seven rows of twelve dots is the same collection as twelve rows of seven dots; nobody added or removed a dot when the array was turned.



The same 84 dots arranged two ways: $7 \times 12 = 84$ and $12 \times 7 = 84$.

Strategies for the bigger facts. You do not need to memorise the big facts separately — each one hangs off a fact you already know.

- $\times 2$: double the number. $2 \times 14 = 28$.
- $\times 4$: double, then double again. 4×12 : $12 \rightarrow 24 \rightarrow 48$.
- $\times 8$: double three times. 8×7 : $7 \rightarrow 14 \rightarrow 28 \rightarrow 56$.
- $\times 5$: half of $\times 10$. 5×16 : $10 \times 16 = 160$, half of 160 is 80.
- $\times 20$: double, then $\times 10$. 20×13 : $2 \times 13 = 26$, so 260.
- $\times 9$: $\times 10$ then take one lot away. $9 \times 6 = 60 - 6 = 54$.
- **Break apart:** split one factor into 10 and a bit. $7 \times 14 = 7 \times 10 + 7 \times 4 = 70 + 28 = 98$.



14 is broken into 10 and 4, so $7 \times 14 = 70 + 28 = 98$

The break-apart strategy: 14 is split into 10 and 4, so $7 \times 14 = 70 + 28 = 98$.

Multiplying and dividing by 10 and 100. When you multiply a number by 10, every digit moves one place to the left; multiply by 100 and every digit moves two places. Dividing by 10 or 100 moves the digits back to the right.

Refresher. Place value (Section 2A) is why this works: a digit one place to the left is worth ten times as much.

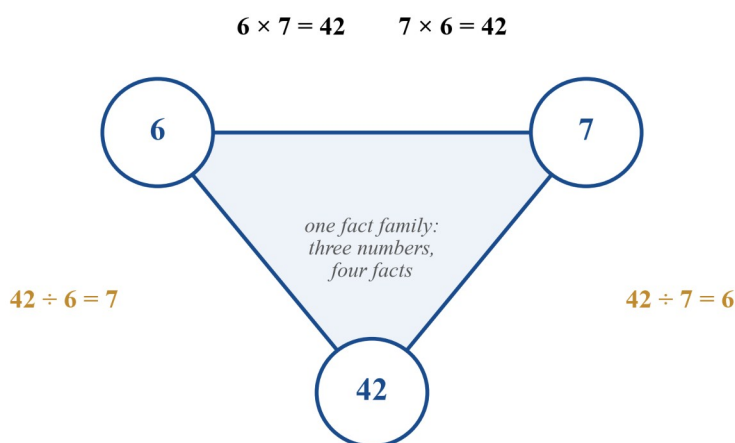
Refresher. Money is just decimals — \$4.75 means 4 dollars and 75 hundredths — so the same digit shift handles money, and you keep the cents in place.

each digit moves one place to the LEFT for every $\times 10$

	hundreds	tens	ones	.	tenths	hundredths	
			4	.	7	5	4.75
$\times 10$		4	7	.	5		47.5
$\times 10$	4	7	5	.			475

Each digit moves one place left for every $\times 10$: \$4.75 $\rightarrow$ \$47.50 $\rightarrow$ \$475.

Fact families. Three numbers that fit one multiplication fact give you four facts altogether — two multiplication and two division. The family 6, 7, 42 gives $6 \times 7 = 42$, $7 \times 6 = 42$, $42 \div 6 = 7$ and $42 \div 7 = 6$. **Refresher.** Division is multiplication in reverse: $42 \div 6$ asks “six times what makes 42?”, and the fact family answers it. So every multiplication fact you know is really two division facts you know as well.



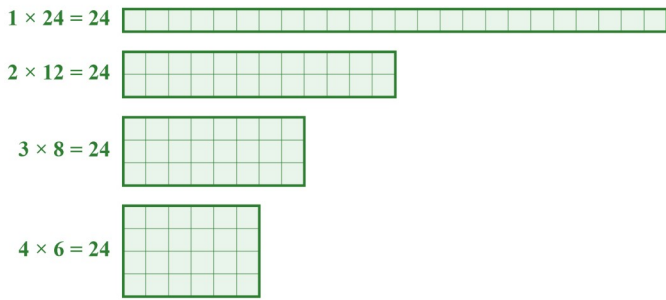
know one multiplication fact and you know two division facts

One fact family: three numbers, four facts. Know $6 \times 7 = 42$ and you also know $42 \div 6 = 7$ and $42 \div 7 = 6$.

Remainders: when it does not divide exactly. Sometimes there is a bit left over. Sharing 47 into groups of 6: $6 \times 7 = 42$, and $47 - 42 = 5$, so $47 \div 6 = 7$ remainder 5. The remainder is always smaller than the group size — if it were not, you could make one more full group. **Refresher.** When the things you are counting come whole — packs, boxes, trips, tents — a leftover usually means you need **one more**: 50 bottles into packs of 8 is 6 packs (48 bottles) with 2 left over, so you must buy 7 packs to take all 50 home.

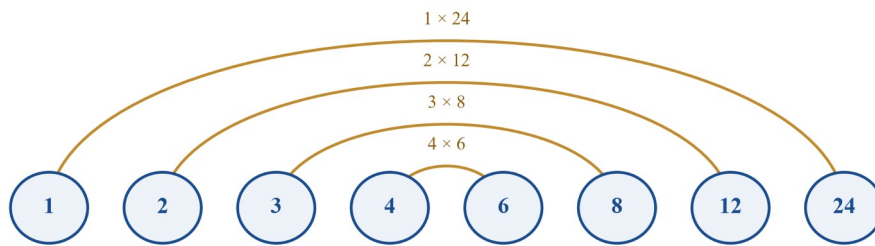
Factors and factor pairs. The factors of a number are the whole numbers that divide it exactly, with nothing left over. Factors come in pairs that multiply to the number: for 24 the pairs are 1×24 , 2×12 , 3×8 and 4×6 , so the factors of 24 are 1, 2, 3, 4, 6, 8, 12, 24. Listing pairs is the reliable way to find every factor without missing any — start at 1 and work up until the pairs meet in the middle.

every rectangle holds 24 squares — the factor pairs of 24



$1 \times 24, 2 \times 12, 3 \times 8, 4 \times 6$

Every rectangle holds exactly 24 squares: the four factor pairs of 24 drawn as arrays.



the factors of 24 in order, with the pairs joined: every pair multiplies to 24

The factors of 24 written in order, with each pair joined by an arc — a factor rainbow. Every pair multiplies to 24.

Prime and composite numbers. A **prime** number has exactly two factors: 1 and itself. A **composite** number has more than two factors. 7 is prime (factors 1, 7); 8 is composite (factors 1, 2, 4, 8). The number 1 is neither — it has only one factor, itself. And 2 is the only even prime, because every other even number has 2 as a factor on top of 1 and itself.

the whole numbers from 1 to 40

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

- prime — only two factors (1 and itself)
- composite — more than two factors
- 1 is neither prime nor composite

The whole numbers from 1 to 40, sorted into prime, composite and the special case of 1.

Four quick tests for multiples. Before dividing, you can often see whether a number is a multiple of 2, 5, 10 or 3 just by looking at its digits.

four quick tests: is this number a multiple of ... ?

2 the last digit is 0, 2, 4, 6 or 8 (that is, the number is even) 38 ends in 8, so 38 is a multiple of 2	5 the last digit is 0 or 5 45 ends in 5, so 45 is a multiple of 5	10 the last digit is 0 130 ends in 0, so 130 is a multiple of 10	3 its digits add to a multiple of 3 27: $2 + 7 = 9$, and 9 is a multiple of 3, so 27 is too
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a number ending in 0 passes three of these tests at once: it is a multiple of 2, of 5 and of 10

Four quick tests. A number ending in 0 passes three of them at once: it is a multiple of 2, of 5 and of 10.

The test for 3 uses the **digit sum** — add the digits and see whether that total is a multiple of 3: for 27, $2 + 7 = 9$, and 9 is a multiple of 3, so 27 is too.

Common multiples and common factors. Two lists of multiples share some numbers: those shared numbers are **common multiples**, and the smallest one is the first place the two skip-counting lines meet. Two lists of factors share numbers too: those are **common factors**, and the largest of them is the biggest group size that fits both numbers exactly.

multiples of 3 and multiples of 4, up to 40

multiples of 3

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

multiples of 4

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40

the ringed numbers 12, 24 and 36 are in BOTH lists — they are common multiples; the first one is 12

Multiples of 3 and multiples of 4 up to 40. The ringed numbers 12, 24 and 36 are in both lists — the common multiples; the first one is 12.

For common factors, list each number's factors and compare. Factors of 12: 1, 2, 3, 4, 6, 12. Factors of 18: 1, 2, 3, 6, 9, 18. The common factors are 1, 2, 3, 6, and the largest common factor is 6.

Choosing the right maths. Most problems in this section are one of five jobs.

The job

How many altogether, in equal groups?

The maths to reach for

multiplication

How many in each group, or how many groups?	division
Does it divide exactly, with nothing left over?	factors and multiples
When do two repeating jobs first fall on the same day?	common multiples
What is the biggest equal group that fits two amounts?	common factors

Check with an estimate. Refresher. Rounding first (Section 1C) gives you a quick check on any product: for 7×48 , round 48 to 50 and get $7 \times 50 = 350$, so the true answer should sit a little under 350. If your worked answer is nowhere near the estimate, something slipped.

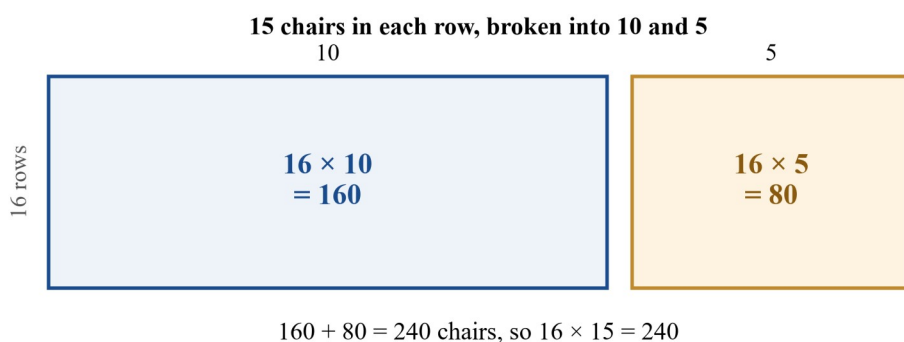
Worked examples

Example 1 — scaffolded

The Bellbird Walking Club is running a film night at the Wattle Flat Community House. The hall seats 16 rows of 15 chairs, and every ticket costs \$8.

- How many chairs are set out altogether?
- If every chair is filled, how much money do the tickets bring in?

Working	Comment
16×15	the job: 16 rows of 15 chairs
$16 \times 10 = 160$	break 15 into 10 and 5; first piece
$16 \times 5 = 80$	second piece: half of 160
$160 + 80 = 240$	add the pieces: 240 chairs
$240 \times 8 = 1\,920$	every chair filled at \$8 each
check: $15 \times 16 = 240$	turned around, same chair count
estimate: $250 \times 8 = 2\,000$	240 is near 250, so near \$2 000 — \$1 920 is sensible



The split used in Example 1: 15 chairs in each row, broken into 10 and 5.

So the hall holds 240 chairs, and a full house brings in \$1 920.

Example 2 — scaffolded

Hilltop Bakery bakes 72 lamingtons and packs them into equal trays, with no lamingtons left over. The bakery only owns trays that hold between 8 and 15 lamingtons.

- List the factor pairs of 72.
- Which tray sizes between 8 and 15 divide 72 exactly?
- How many trays of each size would be packed?

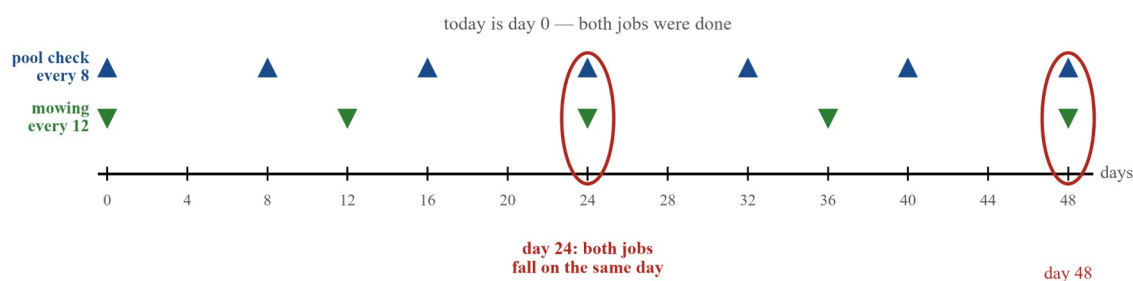
Working	Comment
$1 \times 72, 2 \times 36, 3 \times 24, 4 \times 18$	first four factor pairs of 72
$6 \times 12, 8 \times 9$	last two pairs — the pairs have met in the middle
between 8 and 15: 9 and 12	read off the pairs: 8×9 and 6×12
$72 \div 9 = 8$	trays of 9: eight trays
$72 \div 12 = 6$	trays of 12: six trays

The factor pairs of 72 are $1 \times 72, 2 \times 36, 3 \times 24, 4 \times 18, 6 \times 12$ and 8×9 . Only 9 and 12 sit between 8 and 15, so the bakery can use trays of 9 (eight trays) or trays of 12 (six trays), either way with nothing left over.

Example 3 — unscaffolded

Gum Ridge Caravan Park mows the lawns every 12 days and checks the pool every 8 days. Both jobs were done today. In how many days will both jobs next fall on the same day?

Mowing days: 12, 24, 36, 48, ... Pool-check days: 8, 16, 24, 32, 40, 48, ... The numbers in both lists are 24, 48, ..., and the first one is 24.



The two job cycles on a number line: the markers first line up on day 24.

$\therefore$ both jobs next fall on the same day in 24 days.

Example 4 — unscaffolded

Mira picks 214 tomatoes and packs them into punnets of 6. Without dividing all the way, is 214 a multiple of 6? How many full punnets does she pack, and how many tomatoes are left over?

A multiple of 6 must be even and must pass the 3 test. 214 ends in 4, so it is even; but its digits add to $2 + 1 + 4 = 7$, and 7 is not a multiple of 3, so 214 is not a multiple of 6 — there will be a leftover. $6 \times 35 = 210$, and $214 - 210 = 4$, so $214 \div 6 = 35$ remainder 4.

$\therefore$ Mira packs 35 full punnets and has 4 tomatoes left over.

Practice questions

Scaffolded

Q1. Use a strategy, not a calculator. (a) 7×9 (use $\times 10$ then take one lot away) (b) 6×14 (break 14 into 10 and 4) (c) 8×25 (double 25 three times)

Q2. Multiply or divide by 10 or 100. (a) 58×10 (b) $\$7.25 \times 100$ (c) $640 \div 100$

Q3. The numbers 6, 9 and 54 are a fact family. (a) Write $54 \div 9$. (b) Write $54 \div 6$. (c) Now step outside the family: write $61 \div 9$ with a remainder.

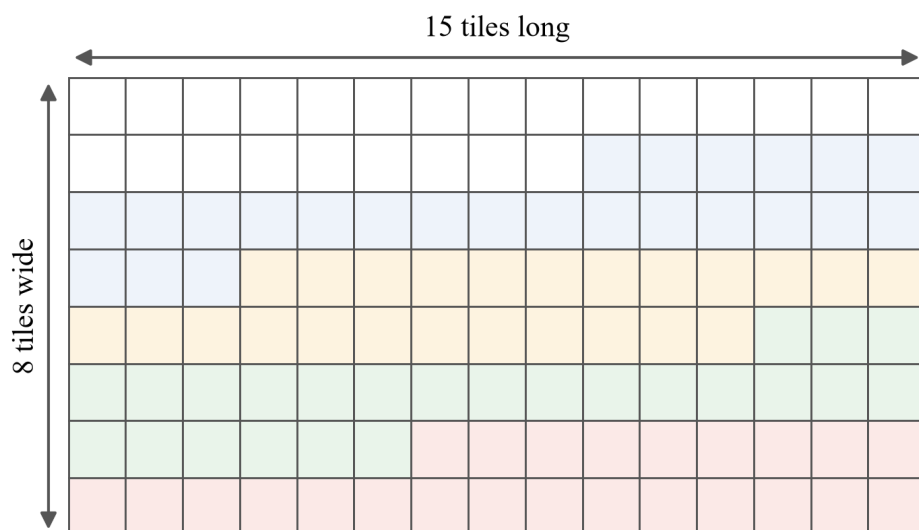
Q4. Palm Court Café makes 18 chocolate truffles. (a) List all the factors of 18. (b) Write the factors as pairs that multiply to 18. (c) The café puts 6 truffles in each box. How many boxes?

Q5. Zac puts \$15 in his savings jar every week. (a) Write the first five multiples of 15. (b) How much is in the jar after 6 weeks? (c) Will the jar ever hold exactly \$100? Explain.

Q6. Delia's cards read 1, 15 and 17. (a) Explain why 15 is composite. (b) Explain why 17 is prime. (c) Explain why 1 is neither prime nor composite.

Unscaffolded

Q7. Nate is tiling a kitchen splashback 15 tiles long and 8 tiles wide. Tiles are sold in boxes of 24.



each shaded group is one box of 24 tiles: 5 boxes cover the 120 tiles exactly

Q7: the splashback as a tile grid. Each shaded group of 24 tiles is one box, and 5 boxes cover it exactly.

- (a) How many tiles does the splashback need?
- (b) How many boxes must Nate buy?
- (c) How many tiles are left over from the last box?

Q8. Ellis Street Community House stacks 36 tables into equal piles for storage, with at least 2 tables in a pile and at least 2 piles. (a) List every pile size that works. (b) How many pile sizes is that? (c) If the tables are stacked in 4 equal piles, how many tables in each pile?

Q9. Fern Street Community Garden has 168 seedling pots, and each shelf holds 12 pots. (a) Is 168 a multiple of 12? Show how you know. (b) How many full shelves do the pots fill? (c) A second batch of 162 pots arrives. Will they fill whole shelves with none left over?

Q10. Redgum Farm Gate packs 96 eggs. (a) Can they be packed exactly into packs of 24? (b) Can they be packed exactly into packs of 12? (c) Find the first common multiple of 24 and 18.

Q11. Bellbird Walking Club raised \$1 275 at its spring raffle. (a) Shared equally between 5 causes, how much does each cause get? (b) Shared equally between 3 causes, how much does each cause get? (c) Could the money be shared equally between 10 causes with no cents left over? Explain.

Q12. Show that 13 trays of 12 eggs is 156 eggs, one step per line. (a) Hence write $156 \div 12$. (b) Is 156 a multiple of 6? Show how you know.

Q13. (a) List the prime numbers strictly between 20 and 40. (b) Explain why 51 is not prime. (c) Owen says 91 is prime. Show that he is wrong.

Q14. Wattle Flat show entrants bring in 48 jars of jam and 60 jars of honey. The jars are packed into identical boxes — same number of jars in every box, one kind of jam per box, nothing left over. (a) List the factors of 48. (b) List the factors of 60. (c) What is the largest number of jars that could go in each box?

Q15. Northside Print and Copy charges \$8.50 for 100 copies. (a) What do 200 copies cost? (b) What do 300 copies cost? (c) What do 1 000 copies cost?

Q16. A corner store sells three pack sizes.

Pack	How many in a pack	Price for one pack
Muesli bars	6	\$3.60
Juice boxes	12	\$6.00
Water bottles	24	\$9.60

Made-up data: three pretend packs with pretend prices, built for this book so you can practise the maths.

- (a) Which of the three pack sizes are factors of 24?
- (b) What does one juice box cost on its own?
- (c) What do 2 packs of muesli bars give you, in bars and in dollars?

Q17. School camp tents sleep 6 students each. (a) How many tents do 78 students need? (b) How many tents do 80 students need? (c) Explain why 13 tents are not enough for 80 students.

Q18. Riverbend Netball Club orders bibs for 5 teams of 12 players. Bibs arrive in packs of 8, and each pack costs \$54. (a) How many bibs are needed? (b) How many packs must the club buy, and how many spare bibs is that? (c) What do the packs cost altogether?

Answers

Q1. (a) 63 (b) 84 (c) 200 **Q2.** (a) 580 (b) \$725 (c) 6.4 **Q3.** (a) 6 (b) 9 (c) 6 remainder 7 **Q4.** (a) 1, 2, 3, 6, 9, 18 (b) 1×18 , 2×9 , 3×6 (c) 3 boxes **Q5.** (a) 15, 30, 45, 60, 75 (b) \$90 (c) no — 90 then 105, never 100 **Q6.** (a) factors 1, 3, 5, 15 (b) only factors 1 and 17 (c) it has only one factor **Q7.** (a) 120 tiles (b) 5 boxes (c) none left over **Q8.** (a) 2, 3, 4, 6, 9, 12, 18 (b) 7 pile sizes (c) 9 tables **Q9.** (a) yes, $12 \times 14 = 168$ (b) 14 shelves (c) no, 162 is not a multiple of 12 **Q10.** (a) yes, 4 packs (b) yes, 8 packs (c) 72 **Q11.** (a) \$255 (b) \$425 (c) no, \$1 275 does not end in 0 **Q12.** $13 \times 10 = 130$, $13 \times 2 = 26$, $130 + 26 = 156$ (a) 13 (b) yes, $156 \div 6 = 26$ **Q13.** (a) 23, 29, 31, 37 (b) $51 = 3 \times 17$ (c) $91 = 7 \times 13$ **Q14.** (a) 1, 2, 3, 4, 6, 8, 12, 16, 24, 48 (b) 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60 (c) 12 jars **Q15.** (a) \$17.00 (b) \$25.50 (c) \$85.00 **Q16.** (a) all three: 6, 12 and 24 (b) \$0.50 (c) 12 bars for \$7.20 **Q17.** (a) 13 tents (b) 14 tents (c) 13 tents hold only 78 students **Q18.** (a) 60 bibs (b) 8 packs, 4 spare (c) \$432

Fully-worked solutions

Q1. (a) $7 \times 10 = 70$, then $70 - 7 = 63$. (b) $6 \times 10 = 60$ and $6 \times 4 = 24$, so $60 + 24 = 84$. (c) $25 \rightarrow 50 \rightarrow 100 \rightarrow 200$.

Q2. (a) Digits one place left: 580. (b) Digits two places left: \$7.25 becomes \$725. (c) Digits two places right: 6.4.

Q3. (a) $54 \div 9 = 6$, from $9 \times 6 = 54$. (b) $54 \div 6 = 9$, from $6 \times 9 = 54$. (c) $9 \times 6 = 54$ and $61 - 54 = 7$, so $61 \div 9 = 6$ remainder 7.

Q4. (a) Pairs first: 1×18 , 2×9 , 3×6 — so the factors are 1, 2, 3, 6, 9, 18. (b) 1×18 , 2×9 , 3×6 . (c) $18 \div 6 = 3$ boxes.

Q5. (a) Skip count in 15s: 15, 30, 45, 60, 75. (b) 6 weeks is $6 \times 15 = 90$, so \$90. (c) No: the jar only ever holds multiples of 15 — 90, then 105 — and 100 is not one of them.

Q6. (a) 15 has factors 1, 3, 5, 15 — more than two, so composite. (b) 17 has only 1 and 17 as factors, so prime. (c) 1 has just one factor (itself), so it is neither prime nor composite.

Q7. (a) 15×8 : $15 \times 8 = 15 \times 2 \times 4 = 30 \times 4 = 120$ tiles. (b) $120 \div 24 = 5$ boxes. (c) $5 \times 24 = 120$ exactly, so nothing is left over.

Q8. (a) Pile size must be a factor of 36, not 1 and not 36: 2, 3, 4, 6, 9, 12, 18. (b) Seven pile sizes. (c) $36 \div 4 = 9$ tables in each pile.

Q9. (a) $12 \times 14 = 120 + 48 = 168$, so yes, 168 is a multiple of 12. (b) $168 \div 12 = 14$ full shelves. (c) $12 \times 13 = 156$ and $12 \times 14 = 168$; 162 sits between them, so it is not a multiple of 12 — 6 pots would be left over.

Q10. (a) $96 \div 24 = 4$ exactly, so yes. (b) $96 \div 12 = 8$ exactly, so yes. (c) Multiples of 24: 24, 48, 72, ...; multiples of 18: 18, 36, 54, 72, ...; first common one is 72.

Q11. (a) $1\,275 \div 5 = 255$, so \$255 each. (b) $1\,275 \div 3 = 425$, so \$425 each. (c) No: a multiple of 10 must end in 0, and \$1 275 ends in 5.

Q12. 13×12 : split 12 into 10 and 2. $13 \times 10 = 130$; $13 \times 2 = 26$; $130 + 26 = 156$. (a) $156 \div 12 = 13$ trays, from the same fact family. (b) $156 \div 6 = 26$ exactly (it is even, and $1 + 5 + 6 = 12$ is a multiple of 3), so yes, 156 is a multiple of 6.

Q13. (a) 23, 29, 31, 37. (b) $5 + 1 = 6$, a multiple of 3, and indeed $51 = 3 \times 17$ — so 51 has more than two factors. (c) $91 = 7 \times 13$, so 91 has factors 1, 7, 13, 91 — composite, not prime.

Q14. (a) 1, 2, 3, 4, 6, 8, 12, 16, 24, 48. (b) 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60. (c) The common factors are 1, 2, 3, 4, 6, 12; the largest is 12, so 12 jars per box (4 boxes of jam, 5 of honey).

Q15. (a) 200 is 2 lots of 100: $2 \times 8.50 = 17.00$, so \$17.00. (b) $3 \times 8.50 = 25.50$, so \$25.50. (c) 1 000 is 10 lots of 100: $10 \times 8.50 = 85.00$, so \$85.00.

Q16. (a) $24 \div 6 = 4$, $24 \div 12 = 2$, $24 \div 24 = 1$ — all three pack sizes are factors of 24. (b) $6.00 \div 12 = 0.50$, so \$0.50 a juice box. (c) $2 \times 6 = 12$ bars, and $2 \times 3.60 = 7.20$, so \$7.20.

Q17. (a) $78 \div 6 = 13$ tents exactly. (b) $80 \div 6 = 13$ remainder 2; the 2 leftovers still need a tent, so 14 tents. (c) $13 \times 6 = 78$, which is 2 students short of 80 — two students would have no bed.

Q18. (a) $5 \times 12 = 60$ bibs. (b) $60 \div 8 = 7$ remainder 4, so 7 packs are not enough: buy 8 packs (64 bibs), leaving 4 spares. (c) $8 \times 54 = 432$, so \$432.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-08.

Chapter 2 Number — 2C Rounding whole numbers and decimals

Theory

The study design lists rounding as key knowledge for this unit: rounding whole numbers, and rounding decimals to no more than two decimal places (Unit 1, Area of Study 1).

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-08.

You have already used rounding earlier in this book. In Chapter 1 it was a quick way to estimate an answer and check it. This section teaches the whole skill: how to round any whole number or decimal to the place you are asked for, every time, without guessing.

About the data in this section. The prices, times and masses in this section are **made up** (not real): pretend businesses and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

What rounding means. To *round* a number is to swap it for a nearby number that is shorter and easier to use. The rounded number is not exact — it is close enough for the job. A crowd of 3 854 people becomes “about 3 900”. A bill of \$19.97 becomes “about \$20”. A shelf measured at 2.483 m becomes 2.48 m at the saw.

Numbers get rounded for everyday reasons:

- the exact number is more detail than anyone needs (“about 350 people came”);
- money is paid in cents, so money answers are rounded to the nearest cent;
- measuring tools and calculators show more digits than the job needs;
- rounded numbers make quick estimates and checks (as in Chapter 1).

Rounding always picks the *nearest* number in the place you are asked for. When a number sits exactly halfway between two choices, this book always rounds up.

Refresher: place value names. Rounding is done to a *place*, and every place has a name. Section 2A built this chart; here it is again, because the rule below depends on it.

Place	Thousan ds	Hundred s	Tens	Ones	.	Tenths	Hundred ths
Digit in 4 528.63	4	5	2	8	.	6	3

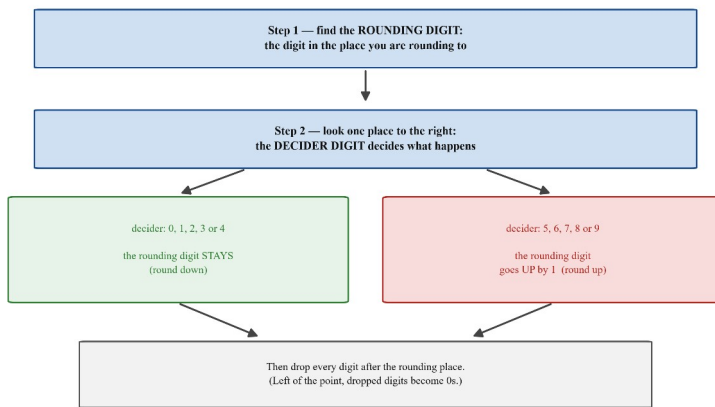
Left of the decimal point sit the ones, tens, hundreds and thousands; each place is ten times the place to its right. Right of the point sit the tenths, then the hundredths. In this book decimals go to two decimal places at most.

The rounding rule. Two steps, the same every time:

1. **Find the rounding digit.** This is the digit in the place you are rounding to.
2. **Look one place to the right. That digit is the decider digit** — it decides what happens:
 - decider digit is **0, 1, 2, 3 or 4** → the rounding digit **stays** (you round down);
 - decider digit is **5, 6, 7, 8 or 9** → the rounding digit **goes up by 1** (you round up).

Then drop every digit to the right of the rounding place. Left of the decimal point, dropped digits become 0s to hold their places: 4 528 rounded to the nearest hundred is 4 500, not 45.

The rounding rule — two steps



4 528.63 to the nearest hundred:

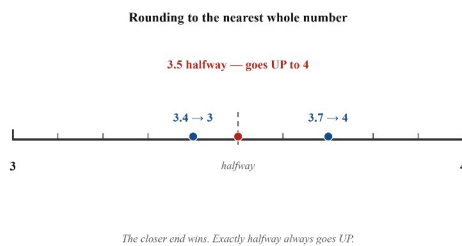
rounding digit 5, decider 2.

2 is 4 or less → the 5 stays, the tail drops:

4 528.63 → 4 500

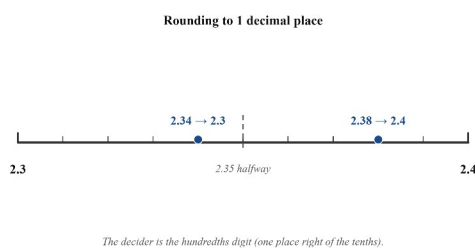
Only the decider digit matters — not the whole tail of digits after it. Look at 3.49 rounded to the nearest whole number. It feels close to 3.5, but the decider digit is the tenths digit, 4, and 4 is 4 or less, so 3.49 rounds down to 3. The 9 two places along changes nothing.

Why the rule works: closeness on a number line. A number rounds to whichever end of its gap it is closer to.



On that line, 3.4 is closer to 3, so it rounds down to 3. 3.7 is closer to 4, so it rounds up to 4. And 3.5 sits exactly halfway: equal distance from both ends, which is why the rule sends halfway numbers up.

The same picture works one place smaller. To round to 1 decimal place, look at the gap between two tenths:



2.34 is closer to 2.3, so it rounds to 2.3. 2.38 is closer to 2.4, so it rounds to 2.4. The halfway mark is now 2.35.

Rounding whole numbers. Work through one number at three different places and the pattern is clear.

Round 4 528 to ...	Rounding digit	Decider digit (one place right)	Answer
the nearest ten	2 (tens)	8 — 5 or more, round up	4 530
the nearest hundred	5 (hundreds)	2 — 4 or less, keep	4 500
the nearest thousand	4 (thousands)	5 — 5 or more, round up	5 000

One number, three different answers — because the *place asked for* changed each time. Always check which place the question wants before you start.

The place-value chart shows where the two digits you need are sitting:

4 528.63 rounded to the nearest hundred

Thousands	Hundreds	Tens	Ones		Tenths	Hundredths
4	5	2	8	.	6	3

rounding digit

decider digit

The decider is 2 — that is 4 or less — so the 5 stays.

Drop the tail (left of the point, dropped digits become 0s):

4 528.63 → 4 500 (nearest hundred)

For 1 decimal place the pair moves right: rounding digit 6, decider 3.
3 is 4 or less → stays → 4 528.6

Rounding decimals. Decimals use exactly the same rule; only the names of the places change.

- **To the nearest whole number**, the decider digit is the tenths digit: 2.76 → decider 7 → up → 3. 2.34 → decider 3 → stays → 2.
- **To 1 decimal place**, the decider digit is the hundredths digit: 2.34 → 2.3, and 2.38 → 2.4.
- **To 2 decimal places**, the decider digit is a third decimal: 8.456 → decider 6 → up → 8.46; 8.454 → decider 4 → stays → 8.45; 8.455 → decider 5 → halfway → up → 8.46.

A third decimal sometimes appears on a calculator screen, or in a measurement written in smaller units. Do not let it worry you: in this section a third decimal has one job only — to be the decider digit. It drops away when you round, so your answer never needs more than two decimal places.

Keep the zero that shows your place. If rounding pushes a number up to a whole amount but the question asked for 1 decimal place, write the zero: 4.96 to 1 decimal place is **5.0**, not 5. The .0 tells the reader the number was rounded to tenths.

Refresher: counting on past 9. Rounding sometimes has to add 1 to a 9, and $9 + 1$ does not fit in one place. This is the carry you already use in addition:

Number	One more	What happens
8	9	an ordinary step
9	10	write 0, carry 1
19	20	the 9 rolls to 0; the 1 becomes 2
39	40	the same roll in the tens
99	100	both 9s roll; the carry reaches the hundreds
3.9	4.0 (one more tenth)	the same roll works past the decimal point

When rounding rolls on. If the rounding digit is a 9 and the decider says “up”, the 9 becomes 0 and carries 1 into the next place on the left. That carry can hit another 9 and roll on again:

When rounding rolls on: a 9 becomes 0 and carries 1

196 to the nearest ten:



decider 6 $\rightarrow$ UP: the tens $9 + 1 = 10 \rightarrow$ write 0, carry 1 $\rightarrow$ hundreds $1 + 1 = 2$

3.96 to 1 decimal place:



decider 6 $\rightarrow$ UP: the tenths $9 + 1 = 10 \rightarrow$ write 0, carry 1 $\rightarrow$ ones $3 + 1 = 4$

Keep the 0: 4.0 says "rounded to 1 decimal place".
Writing 4 would say "rounded to the nearest whole".

- 196 to the nearest ten: decider 6 $\rightarrow$ up $\rightarrow$ the tens 9 rolls to 0 and carries 1 $\rightarrow$ hundreds $1 + 1 = 2 \rightarrow$ **200**.
- 3.96 to 1 decimal place: decider 6 $\rightarrow$ up $\rightarrow$ the tenths 9 rolls to 0 and carries 1 $\rightarrow$ ones $3 + 1 = 4 \rightarrow$ **4.0** (keep the zero).
- 9.97 to the nearest whole: decider 9 $\rightarrow$ up $\rightarrow$ the ones 9 rolls to 0 and carries 1 $\rightarrow$ **10**.

Rounding money.

Refresher: money is a decimal. One dollar is 100 cents, so one cent is \$0.01 — one hundredth of a dollar. Cents live in the two decimal places: \$17.53 is 17 dollars and 53 cents (Section 2A).

That gives money its two rounding places:

- **to the nearest cent** means round to **2 decimal places**: \$3.678 $\rightarrow$ decider 8 $\rightarrow$ up $\rightarrow$ \$3.68;
- **to the nearest dollar** means round to the **nearest whole number**: \$3.678 $\rightarrow$ decider 6 $\rightarrow$ up $\rightarrow$ \$4.

When money is shared, a calculator often shows more decimals than money can pay. Round the answer to 2 decimal places and let the extra digits drop — the next worked example shows this.

Rounding to estimate. Rounding first, then calculating, gives a fast estimate to check a fuller answer against. For $253 + 148$, round each number to the nearest ten: $250 + 150 = 400$. The exact answer is 401, which sits right beside the estimate — so a calculator showing 4 010 for this sum would be spotted straight away.

Two last ideas. Rounded numbers hide small differences: two different numbers can round to the same answer, so keep the exact numbers when the detail matters. And “to the nearest” always means the decider-digit rule above. Some real-life jobs force a direction instead — you cannot order 3.2 vans, as Chapter 1 showed — but when a question says *to the nearest*, the decider digit rules.

Worked examples

Example 1 — scaffolded

The show at the town grounds counted 3 854 visitors on Saturday. A reporter is writing the story.

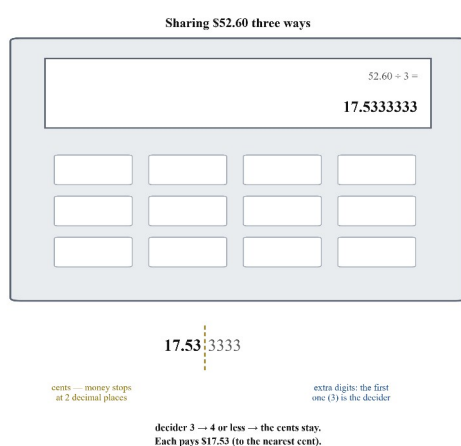
- Round the visitor count to the nearest hundred for the report.
- The editor wants it shorter still — to the nearest thousand.

Working	Comment
(a) Rounding place: hundreds. Rounding digit: 8 (in 3 854). Decider digit: 5 (the tens, one place right). 5 is 5 or more → the 8 goes up to 9. Tens and ones become 0: 3 900 .	Step 1 — find the digit in the place you are rounding to. Step 2 — look one place to the right. At or past halfway, round up.
(b) Rounding place: thousands. Rounding digit: 3 . Decider digit: 8 (the hundreds). 8 is 5 or more → the 3 goes up to 4. Hundreds, tens and ones become 0: 4 000 .	Same two steps, one place further left. Dropped digits hold their places as 0s.

To the nearest hundred the show had 3 900 visitors; to the nearest thousand it had 4 000.

Example 2 — scaffolded

Three workmates share a lunch bill of \$52.60 equally.



(a) How much does each person pay, to the nearest cent?

(b) Roughly how much is that each, to the nearest dollar?

Working	Comment
$52.60 \div 3 = 17.533333$ on the calculator.	Sharing equally means dividing by 3.
(a) Nearest cent = 2 decimal places. Rounding digit: 3 (the hundredths). Decider digit: 3 (the first extra digit). 3 is 4 or less → the cents stay: each pays \$17.53 .	Cents live in the two decimal places. The calculator shows more digits than money can pay. Drop the extra digits.
(b) Nearest dollar = nearest whole. Rounding digit: 7 (the ones). Decider digit: 5 (the tenths). 5 is 5 or more → the 7 goes up to 8: about \$18 each.	One place right of the ones is the tenths. At or past halfway, round up.

Each person pays \$17.53 to the nearest cent — about \$18 to the nearest dollar. Check: $3 \times \$17.53 = \$52.59$, one cent short of the \$52.60 bill. Rounding to the cent can leave a cent or two over; that is normal when a bill is shared.

Example 3 — unscaffolded

At a swimming carnival, Priya's time for the 50 m freestyle is recorded as 32.968 seconds. The caller reads every time out to 1 decimal place, and the club record book keeps times to the nearest whole second. What time goes on the caller's card, and what time goes in the record book?

Solution. For the caller's card, round 32.968 to 1 decimal place. The rounding digit is the tenths digit, 9, and the decider digit is the hundredths digit, 6. 6 is 5 or more, so the 9 goes up: $9 + 1 = 10$, which writes a 0 in the tenths place and carries 1 to the ones, so 32 becomes 33. The card reads 33.0.

For the record book, round 32.968 to the nearest whole second. The decider digit is the tenths digit, 9 — 5 or more — so 32 goes up to 33.

∴ The caller's card shows 33.0 seconds (1 decimal place) and the record book shows 33 seconds (nearest whole). The .0 is kept on the card because it shows the card was read to tenths.

Example 4 — unscaffolded

Four boxes wait for the goods lift at a workplace. The lift's sign gives a load limit of 450 kg. Can all four boxes go up in the lift together?



Solution. Round each mass to the nearest whole kilogram, using the decider digit (the tenths) each time: 112.6 → decider 6, up → 113; 98.4 → decider 4, stays → 98; 121.7 → decider 7, up → 122; 106.3 → decider 3, stays → 106.

Add the rounded masses: $113 + 98 + 122 + 106 = 439$ kg.

The exact masses add to $112.6 + 98.4 + 121.7 + 106.3 = 439.0$ kg, so here the estimate is exactly right — the amounts rounded up and the amounts rounded down cancel each other out.

439 kg is under the 450 kg limit, with $450 - 439.0 = 11.0$ kg to spare.

∴ Yes, all four boxes can travel together: their total mass is 439.0 kg, which is under the 450 kg limit.

Practice questions

Scaffolded

For Q1–Q6, use the two-step rule from the theory: find the rounding digit, then check the decider digit one place to the right.

Q1. Round each number to the nearest ten.

- (a) 63
- (b) 87
- (c) 245

Q2. Round each number to the nearest hundred.

- (a) 482
- (b) 1 230
- (c) 6 950

Q3. Round each number to the nearest thousand.

- (a) 5 280
- (b) 8 600
- (c) 38 472

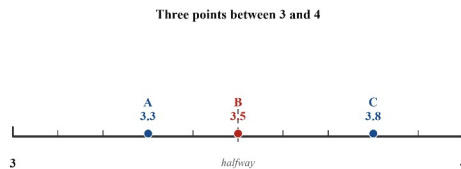
Q4. Round each number to the nearest whole number.

- (a) 6.2
- (b) 8.7
- (c) 4.5

Q5. Round each number to 1 decimal place.

- (a) 7.34
- (b) 5.86
- (c) 2.95 (there is a 9 in the tenths place — watch what the carry does)

Q6. The number line shows three points between 3 and 4.



Round each point to the nearest whole number.

- (a) Round point A to the nearest whole number.
- (b) Point B sits exactly halfway between two whole numbers. Which way does it round?
- (c) Round point C to the nearest whole number.

Unscaffolded

Q7. A concert sold 24 815 tickets. Round this count to:

- (a) the nearest ten
- (b) the nearest hundred
- (c) the nearest thousand

Q8. A plank of timber measures 2.483 m. Round this length to:

- (a) the nearest metre
- (b) 1 decimal place
- (c) the nearest centimetre (in metres, that is 2 decimal places)

Q9. A cake shop sells a pack of 6 muffins for \$14.45.

- (a) What division gives the price of one muffin?
- (b) A basic calculator shows 2.4083333. Which digit is the decider digit when you round to the nearest cent?
- (c) Write the price of one muffin to the nearest cent.

Q10. Round each measurement as asked.

- (a) A canteen served 198 hot meals. Round to the nearest ten.
- (b) A bag of potatoes has a mass of 9.96 kg. Round to the nearest whole kilogram.
- (c) A jug holds 0.96 L of juice. Round to 1 decimal place.

Q11. A service station's sign shows fuel at \$1.469 per litre. The next week the sign shows \$1.512 per litre. You pay in cents, so round each price to the nearest cent.

- (a) \$1.469
- (b) \$1.512

Q12. A student buys a notebook for \$4.65, a pack of pens for \$7.20 and a folder for \$2.85.

- (a) Round each price to the nearest dollar, then add your rounded prices to estimate the total.
- (b) The exact total is \$14.70. Round it to the nearest dollar.
- (c) Does your estimate agree with the exact total at that precision?

Q13. Round each number as asked. These all sit exactly halfway, or very close to it.

- (a) \$4.35 to the nearest 10 cents
- (b) 7.25 m to 1 decimal place
- (c) 650 to the nearest hundred

Q14. A postal shop weighs four parcels.

Parcel	Mass (kg)
A	3.482
B	3.458
C	3.505
D	3.449

Made-up data: four pretend parcels weighed on a pretend postal scale.

- (a) Round each mass to 2 decimal places.
- (b) Round each mass to 1 decimal place.
- (c) At 1 decimal place, parcels A, B and C all read 3.5 kg. Using the original masses, which of these three parcels is the heaviest?

Q15. Jack was asked to round 6.47 to the nearest whole number.

Where does 6.47 sit?



Is 6.47 closer to 6 or to 7?

- (a) Look at the number line. Is 6.47 closer to 6 or to 7?
- (b) Round 6.47 to the nearest whole number in one step.
- (c) Jack rounded 6.47 to 1 decimal place first (6.5), then rounded 6.5 to the nearest whole number (7). What is wrong with Jack's method?

Q16. Make up your own numbers.

- (a) Write a decimal between 4 and 5 that rounds to 4 to the nearest whole number.
- (b) Write a decimal that rounds to 4.6 to 1 decimal place.
- (c) Bao says: “If a number rounds to 5 to the nearest whole number, then the number must be bigger than 5.” Is Bao right? Give one example to support your answer.

Q17. At a medical centre (a *dose* is the amount of medicine given at one time):

- (a) A thermometer reads 38.46 °C. Record the reading to 1 decimal place.
- (b) A medicine dose measures 2.575 mL. Record it to 2 decimal places.
- (c) A baby’s mass is 7.348 kg. Record it to the nearest whole kilogram.

Q18. A family drives 468 km on a weekend trip. The car uses 34.56 L of fuel for the trip, and snacks for the trip cost \$23.47.

- (a) Round the distance to the nearest ten kilometres.
- (b) Round the distance to the nearest hundred kilometres.
- (c) Round the fuel used to the nearest whole litre.
- (d) Round the snack cost to the nearest dollar.

Answers

Q1. (nearest ten) (a) 60 (b) 90 (c) 250 **Q2.** (nearest hundred) (a) 500 (b) 1 200 (c) 7 000 **Q3.** (nearest thousand) (a) 5 000 (b) 9 000 (c) 38 000 **Q4.** (nearest whole) (a) 6 (b) 9 (c) 5 **Q5.** (1 decimal place) (a) 7.3 (b) 5.9 (c) 3.0 **Q6.** (nearest whole) (a) 3 (b) up, to 4 (c) 4 **Q7.** (a) 24 820 (nearest ten) (b) 24 800 (nearest hundred) (c) 25 000 (nearest thousand) **Q8.** (a) 2 m (nearest metre) (b) 2.5 m (1 decimal place) (c) 2.48 m (nearest cm) **Q9.** (a) $\$14.45 \div 6$ (b) the 8 (c) $\$2.41$ (nearest cent) **Q10.** (a) 200 (nearest ten) (b) 10 kg (nearest whole kg) (c) 1.0 L (1 decimal place) **Q11.** (nearest cent) (a) $\$1.47$ (b) $\$1.51$ **Q12.** (nearest dollar) (a) estimate $\$15$ (b) $\$15$ (c) yes, they agree **Q13.** (a) $\$4.40$ (nearest 10 c) (b) 7.3 m (1 decimal place) (c) 700 (nearest hundred) **Q14.** (2 d.p.) (a) A 3.48, B 3.46, C 3.51, D 3.45; (1 d.p.) (b) A 3.5, B 3.5, C 3.5, D 3.4; (c) C **Q15.** (a) 6 (b) 6 (nearest whole) (c) he rounded twice — the second step rounded an already-rounded number **Q16.** examples: (a) 4.2 (b) 4.62 (c) false — 4.7 rounds to 5 and $4.7 < 5$ **Q17.** (a) 38.5°C (1 d.p.) (b) 2.58 mL (2 d.p.) (c) 7 kg (nearest whole kg) **Q18.** (a) 470 km (nearest ten) (b) 500 km (nearest hundred) (c) 35 L (nearest whole L) (d) $\$23$ (nearest dollar)

Fully-worked solutions

Q1. (a) Nearest ten: rounding digit 6, decider 3 $\rightarrow$ 4 or less $\rightarrow$ stays $\rightarrow$ 60. (b) Rounding digit 8, decider 7 $\rightarrow$ 5 or more $\rightarrow$ up $\rightarrow$ 90. (c) Rounding digit 4, decider 5 $\rightarrow$ 5 or more $\rightarrow$ up $\rightarrow$ 250. All three answers are to the nearest ten.

Q2. (a) Nearest hundred: rounding digit 4, decider 8 $\rightarrow$ up $\rightarrow$ 500. (b) Rounding digit 2, decider 3 $\rightarrow$ stays $\rightarrow$ 1 200. (c) Rounding digit 9, decider 5 $\rightarrow$ up; the 9 rolls to 0 and carries 1 $\rightarrow$ 7 000. All to the nearest hundred.

Q3. (a) Nearest thousand: rounding digit 5, decider 2 $\rightarrow$ stays $\rightarrow$ 5 000. (b) Rounding digit 8, decider 6 $\rightarrow$ up $\rightarrow$ 9 000. (c) Rounding digit 8, decider 4 $\rightarrow$ stays $\rightarrow$ 38 000. All to the nearest thousand.

Q4. (a) Nearest whole: decider (tenths) 2 $\rightarrow$ stays $\rightarrow$ 6. (b) Decider 7 $\rightarrow$ up $\rightarrow$ 9. (c) Decider 5 $\rightarrow$ halfway $\rightarrow$ up $\rightarrow$ 5. All to the nearest whole number.

Q5. (a) 1 decimal place: rounding digit 3, decider 4 $\rightarrow$ stays $\rightarrow$ 7.3. (b) Rounding digit 8, decider 6 $\rightarrow$ up $\rightarrow$ 5.9. (c) Rounding digit 9, decider 5 $\rightarrow$ up; $9 + 1 = 10$, so the tenths show 0 and 1 carries to the ones $\rightarrow$ 3.0. The 0 is kept because the question asked for 1 decimal place.

Q6. (a) A is 3.3: decider 3 $\rightarrow$ stays $\rightarrow$ 3. It is closer to 3 on the line. (b) B is 3.5, exactly halfway, and halfway always rounds up $\rightarrow$ 4. (c) C is 3.8: decider 8 $\rightarrow$ up $\rightarrow$ 4. All to the nearest whole number.

Q7. (a) Nearest ten: rounding digit 1, decider 5 $\rightarrow$ up $\rightarrow$ 24 820. (b) Nearest hundred: rounding digit 8, decider 1 $\rightarrow$ stays $\rightarrow$ 24 800. (c) Nearest thousand: rounding digit 4, decider 8 $\rightarrow$ up $\rightarrow$ 25 000.

Q8. (a) Nearest metre: decider (tenths) 4 $\rightarrow$ stays $\rightarrow$ 2 m. (b) 1 decimal place: rounding digit 4, decider 8 $\rightarrow$ up $\rightarrow$ 2.5 m. (c) Nearest centimetre = 2 decimal places: rounding digit 8, decider 3 $\rightarrow$ stays $\rightarrow$ 2.48 m.

Q9. (a) The price of one muffin is the pack price shared 6 ways: $\$14.45 \div 6$. (b) The calculator shows 2.4083333; cents are the first two decimals (the 4 and the 0), so the decider digit is the next one, 8. (c) 8 is 5 or more $\rightarrow$ the cents go up: 2.40 becomes 2.41, so one muffin costs **$\$2.41$** to the nearest cent.

Q10. (a) 198 to the nearest ten: rounding digit 9, decider 8 $\rightarrow$ up; the 9 rolls to 0 and carries 1 $\rightarrow$ 200 meals. (b) 9.96 kg to the nearest whole kg: decider 9 $\rightarrow$ up; 9 rolls to 0 and carries 1 $\rightarrow$ 10 kg. (c) 0.96 L to 1 decimal place: rounding digit 9, decider 6 $\rightarrow$ up; the 9 rolls to 0 and carries 1 $\rightarrow$ 1.0 L (the zero is kept to show tenths).

Q11. (a) $\$1.469$ to the nearest cent (2 d.p.): rounding digit 6, decider 9 $\rightarrow$ up $\rightarrow$ $\$1.47$. (b) $\$1.512$ to the nearest cent: rounding digit 1, decider 2 $\rightarrow$ stays $\rightarrow$ $\$1.51$. The third decimal on the sign is only ever the decider digit.

Q12. (a) Rounded to the nearest dollar: $\$4.65 \rightarrow$ decider 6 $\rightarrow$ $\$5$; $\$7.20 \rightarrow$ decider 2 $\rightarrow$ $\$7$; $\$2.85 \rightarrow$ decider 8 $\rightarrow$ $\$3$. Estimate: $5 + 7 + 3 = \$15$. (b) Exact total $\$14.70$ to the nearest dollar: decider 7 $\rightarrow$ up $\rightarrow$ $\$15$. (c) Yes — the estimate ($\$15$) and the exact total rounded to the nearest dollar ($\$15$) agree, so the estimate is a good check.

Q13. (a) Nearest 10 cents is 1 decimal place for dollars: $\$4.35 \rightarrow$ rounding digit 3, decider 5 $\rightarrow$ up $\rightarrow$ $\$4.40$ (the zero is kept: it is a 10-cent amount). (b) 7.25 m to 1 decimal place: rounding digit 2, decider 5 $\rightarrow$ up $\rightarrow$ 7.3 m. (c) 650 to the nearest hundred: rounding digit 6, decider 5 $\rightarrow$ up $\rightarrow$ 700. Each one sat at or past halfway, so each rounded up.

Q14. (a) To 2 decimal places, the decider is the third decimal: A $3.482 \rightarrow$ decider 2 $\rightarrow 3.48$; B $3.458 \rightarrow$ decider 8 $\rightarrow 3.46$; C $3.505 \rightarrow$ decider 5 $\rightarrow$ up $\rightarrow 3.51$; D $3.449 \rightarrow$ decider 9 $\rightarrow 3.45$. (b) To 1 decimal place, the decider is the hundredths digit: A $\rightarrow$ decider 8 $\rightarrow 3.5$; B $\rightarrow$ decider 5 $\rightarrow 3.5$; C $\rightarrow$ decider 0 $\rightarrow 3.5$; D $\rightarrow$ decider 4 $\rightarrow 3.4$. (c) Comparing the original masses, 3.505 is more than 3.482 and 3.458, so parcel **C** is the heaviest of the three — even though all three read 3.5 kg once rounded.

Q15. (a) On the number line, 6.47 sits before the halfway mark 6.5, so it is closer to **6**. (b) One step: the decider digit is the tenths digit, 4 $\rightarrow$ 4 or less $\rightarrow$ stays $\rightarrow$ **6**. (c) Jack rounded twice. His second step rounded 6.5, which was already a rounded number, not the original 6.47 — and 6.5 sits at the halfway mark, so it jumped up to 7. Always round once, straight from the starting number.

Q16. Answers vary; these work. (a) $4.2 \rightarrow$ decider 2 $\rightarrow$ stays $\rightarrow 4$. (Any of 4.0, 4.1, 4.2, 4.3, 4.4 works; 4.5 would go up to 5.) (b) $4.62 \rightarrow$ decider 2 $\rightarrow$ stays $\rightarrow 4.6$. (4.57 also works: decider 7 $\rightarrow$ up $\rightarrow 4.6$.) (c) Bao is **wrong**. 4.7 rounds to 5 to the nearest whole number (decider 7 $\rightarrow$ up), yet 4.7 is *less* than 5. Any number from 4.5 to 5.4 rounds to 5, so numbers below 5 round to 5 too.

Q17. (a) 38.46°C to 1 decimal place: rounding digit 4, decider 6 $\rightarrow$ up $\rightarrow 38.5^\circ\text{C}$. (b) 2.575 mL to 2 decimal places: rounding digit 7, decider 5 $\rightarrow$ halfway $\rightarrow$ up $\rightarrow 2.58$ mL. (c) 7.348 kg to the nearest whole kg: decider 3 $\rightarrow$ stays $\rightarrow 7$ kg.

Q18. (a) 468 km to the nearest ten: rounding digit 6, decider 8 $\rightarrow$ up $\rightarrow 470$ km. (b) 468 km to the nearest hundred: rounding digit 4, decider 6 $\rightarrow$ up $\rightarrow 500$ km. (c) 34.56 L to the nearest whole litre: decider 5 $\rightarrow$ halfway $\rightarrow$ up $\rightarrow 35$ L. (d) \$23.47 to the nearest dollar: decider 4 $\rightarrow$ stays $\rightarrow$ \$23.

Chapter 2 Number — 2D Order of operations

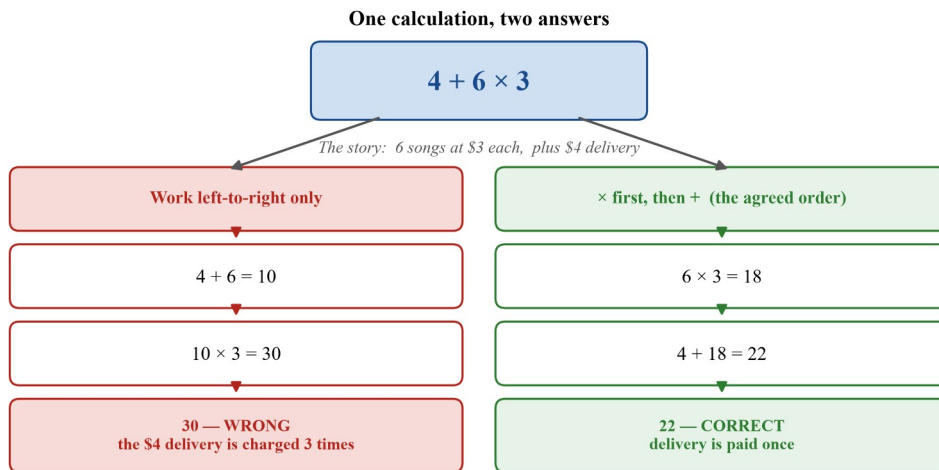
Theory

One calculation, two answers.

A calculation with more than one operation needs an agreed order. Without one, the same calculation can give two different answers. Take this one:

$$4 + 6 \times 3$$

- Working strictly left to right: $4 + 6 = 10$, then $10 \times 3 = 30$.
- Doing the multiplication first: $6 \times 3 = 18$, then $4 + 18 = 22$.



Without an agreed order, the same keys give different totals. With brackets, the left answer is $(4 + 6) \times 3$ — a different story.

Two branches from the calculation $4 + 6 \times 3$. The left branch works left to right and gets 30, marked wrong because the 4 dollar delivery is charged three times. The right branch multiplies first and gets 22, marked correct because the delivery is paid once.

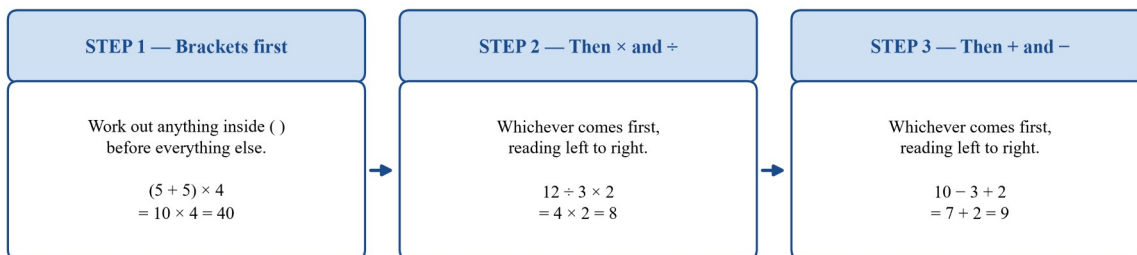
Here is the story behind it: 6 songs at \$3 each, plus \$4 delivery. The correct total is \$22 — six songs cost \$18, and the \$4 delivery is added once. The left-to-right answer of \$30 would charge the delivery three times over. So that everyone — people, tills, spreadsheets, calculators — gets the same answer, there is one agreed rule: the **order of operations**. You met a short version of this rule in Chapter 1. This section teaches it in full.

The agreed order.

Work out a calculation in this order:

1. **Brackets first.** Anything inside brackets (...) is worked out before everything else.
2. **Then $\times$ and $\div$,** reading left to right, whichever comes first.
3. **Then $+$ and $-$,** reading left to right, whichever comes first.

The agreed order — three steps



Scientific calculators and spreadsheets follow this same order.

The agreed order in three steps. Step 1 brackets first, with the example $(5 + 5) \times 4 = 10 \times 4 = 40$. Step 2 then multiply and divide left to right, with $12 \div 3 \times 2 = 4 \times 2 = 8$. Step 3 then add and subtract left to right, with $10 - 3 + 2 = 7 + 2 = 9$.

Worked model. Three packets of seeds at \$ 2.20 each, plus a \$ 4.50 watering can. The total cost is:

$$3 \times 2.20 + 4.50$$

Step 2 of the order ($\times$ before $+$): $3 \times 2.20 = 6.60$.

Step 3 of the order (the $+$ next): $6.60 + 4.50 = 11.10$.

$\therefore$ the total cost is \$ 11.10.

Same-rank steps: left to right.

$\times$ and $\div$ are **equal rank** — neither one outranks the other. When a calculation has both, do whichever comes first reading left to right. The same goes for $+$ and $-$.

- $12 \div 3 \times 2$: the $\div$ comes first, so $12 \div 3 = 4$, then $4 \times 2 = 8$. Doing the $\times$ first would give $12 \div 6 = 2$ — wrong.
- $10 - 3 + 2$: the $-$ comes first, so $10 - 3 = 7$, then $7 + 2 = 9$. Doing the $+$ first would give $10 - 5 = 5$ — wrong.

Same-rank steps: work left to right

$$12 \div 3 \times 2$$

CORRECT — left to right: $12 \div 3 = 4$, then $4 \times 2 = 8$

TRAP — doing $\times$ first: $3 \times 2 = 6$, then $12 \div 6 = 2$ (wrong)

$$10 - 3 + 2$$

CORRECT — left to right: $10 - 3 = 7$, then $7 + 2 = 9$

TRAP — doing $+$ first: $3 + 2 = 5$, then $10 - 5 = 5$ (wrong)

$\times$ and $\div$ are equal rank — so are $+$ and $-$. Neither step in a pair outranks the other, so order of pressing matters.

Two examples of equal-rank steps. For $12 \div 3 \times 2$ the correct left-to-right working gives 8 and the trap of multiplying first gives 2. For $10 - 3 + 2$ the correct left-to-right working gives 9 and the trap of adding first gives 5.

Brackets change the story.

Brackets are used when the story needs a step done first — they beat the normal order. Compare these two:

- $4 + 6 \times 3 = 22$ — six songs at \$3 each, plus \$4 delivery once.
- $(4 + 6) \times 3 = 10 \times 3 = 30$ — ten songs at \$3 each.

Same numbers, two different stories, two different answers. The brackets choose the story.

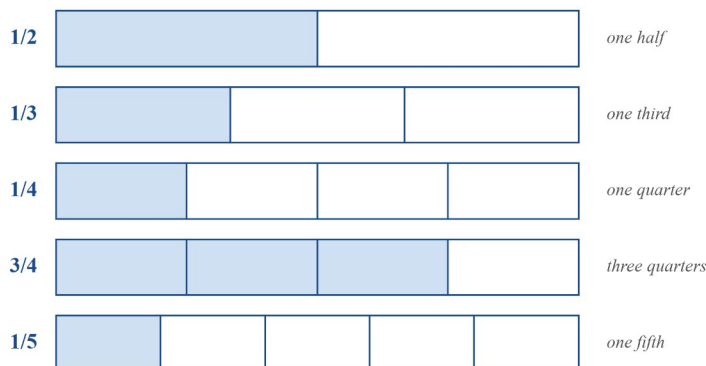
Refresher: common fractions.

Some calculations in this section use **fractions**, so here is a quick refresher. A fraction is a part of one whole, written as two numbers, one above the other, like $\frac{3}{4}$.

- The top number is the **numerator**. It says how many parts you have.
- The bottom number is the **denominator**. It says how many equal parts the whole is cut into.

Fraction	Read as	The whole is cut into	You have
$\frac{1}{2}$	one half	2 equal parts	1 part
$\frac{1}{3}$	one third	3 equal parts	1 part
$\frac{1}{4}$	one quarter	4 equal parts	1 part
$\frac{3}{4}$	three quarters	4 equal parts	3 parts
$\frac{1}{5}$	one fifth	5 equal parts	1 part

Common fractions: parts of one whole



Bottom number (denominator) = how many equal parts. Top number (numerator) = how many parts you have.

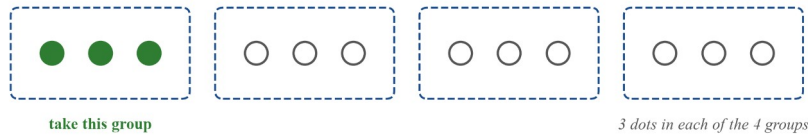
Five equal bars, one whole each. The first is cut in 2 with 1 part shaded ($1/2$, one half), then 3 with 1 shaded ($1/3$, one third), then 4 with 1 shaded ($1/4$, one quarter), then 4 with 3 shaded ($3/4$, three quarters), then 5 with 1 shaded ($1/5$, one fifth).

A fraction of an amount. To find a fraction of an amount, divide the amount by the denominator, then multiply by the numerator. In fraction language, “of” means $\times$.

- $\frac{1}{2}$ of 20: $20 \div 2 = 10$.
- $\frac{1}{4}$ of \$36: $36 \div 4 = \$9$.
- $\frac{1}{3}$ of 15: $15 \div 3 = 5$.

- $\frac{1}{5}$ of 45: $45 \div 5 = 9$.
- $\frac{3}{4}$ of 20: $20 \div 4 = 5$, then $5 \times 3 = 15$.

A fraction of an amount: $\frac{1}{4}$ of 12



Split into 4 equal groups: $12 \div 4 = 3$

Take 1 group: $\frac{1}{4}$ of 12 = 3

Take 3 groups: $\frac{3}{4}$ of 12 = 9 (divide by the bottom number, then multiply by the top)

Twelve dots split into 4 equal groups of 3. Taking 1 group gives $\frac{1}{4}$ of 12 = 3; taking 3 groups gives $\frac{3}{4}$ of 12 = 9.

Fractions inside a calculation.

A fraction-of step is a $\times$ or $\div$ step, so it happens in step 2 of the order — before any $+$ or $-$.

- $\frac{1}{2} \times 18 + 4$: first $\frac{1}{2} \times 18 = 18 \div 2 = 9$, then $9 + 4 = 13$.
- $20 - \frac{1}{4} \times 20$: first $\frac{1}{4} \times 20 = 20 \div 4 = 5$, then $20 - 5 = 15$.

A fraction bar acts like a bracket.

A calculation can be written as one big fraction, with a top and a bottom. The fraction bar groups the top together, exactly like a bracket: work out the top and the bottom before you divide. A division can always be written this way

$$\text{— } 12 \div 4 = \frac{12}{4} = 3.$$

Story: a \$12 pizza and \$8 of drinks, shared 4 ways.

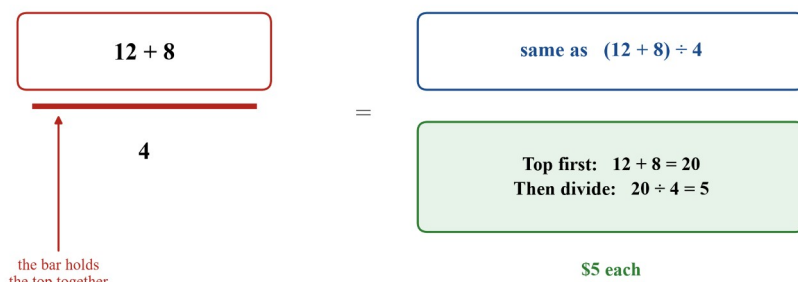
$$\frac{12 + 8}{4}$$

Top first: $12 + 8 = 20$. Then divide: $20 \div 4 = 5$.

∴ each person pays \$5. On one line this calculation is $(12 + 8) \div 4$ — the brackets do the same grouping job as the bar.

A fraction bar groups, just like a bracket

Story: a \$12 pizza and \$8 of drinks, shared 4 ways



The big fraction $12 + 8$ over 4 , with an arrow marking that the bar holds the top together, shown equal to $(12 + 8) \div 4$. Top first: $12 + 8 = 20$, then $20 \div 4 = 5$, so 5 dollars each.

From words to one number sentence.

The story tells you which operations to use; the order tells you which one to do first. The clue words from Chapter 1 still apply — “each” and “per” point to $\times$, “total” and “altogether” point to $+$, “left” and “change” point to $-$, “shared equally” points to $\div$ — and now “of” points to $\times$ as well. Write the whole story as one number sentence, then apply the three steps.

Two pizzas at \$11.50 each, with \$3 off the order:

$$2 \times 11.50 - 3$$

$\times$ first: $2 \times 11.50 = 23.00$. Then $-$: $23.00 - 3 = 20.00$.

∴ the order costs \$20.00.

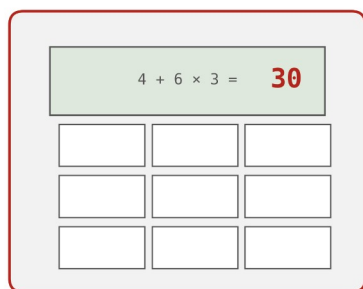
Calculators and the agreed order.

A **scientific calculator** follows the agreed order for you. A **basic calculator** (a simple pocket or phone calculator) often works in the order you press the keys, so it would do the $+$ before the $\times$ and get the story wrong. Pressing the keys $4 + 6 \times 3 =$:

- a basic calculator shows 30 — it did $4 + 6 = 10$, then 10×3 ;

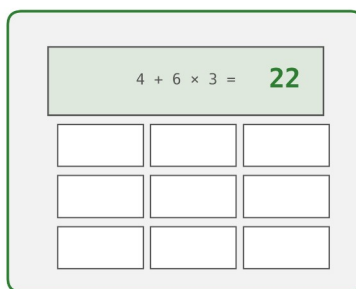
- a scientific calculator shows 22 — it did $6 \times 3 = 18$, then $4 + 18$.

Same keys, different answers: $4 + 6 \times 3 =$



BASIC calculator

works in key order:
 $4 + 6 = 10$, then $10 \times 3 = 30$
 — WRONG for this story



SCIENTIFIC calculator

follows the agreed order:
 $6 \times 3 = 18$, then $4 + 18 = 22$
 — CORRECT

Type $2 + 3 \times 4 =$ to find out which calculator you have: 14 means it follows the order; 20 means it does not.

Two calculators given the same keys $4 + 6 \times 3 =$. The basic calculator displays 30 because it works in key order; the scientific calculator displays 22 because it follows the agreed order.

Which one do I have? Type $2 + 3 \times 4 =$. If the display shows 14, your calculator follows the agreed order. If it shows 20, it works in key order — so do the $\times$ and $\div$ steps yourself first, write each result down, then finish the calculation (or use the bracket keys if it has them). Every calculation in this section can be done with pen, paper and a calculator you understand.

Spreadsheets follow the agreed order too. In a spreadsheet formula, $*$ means $\times$ and $/$ means $\div$, so typing $=4+6*3$ into a cell gives 22.

About the data in this section. Every price, count and measurement in this section is **made up** (synthetic): invented shops, jobs and situations, built for practice. Nothing here is real data about any real business, person or place.

Worked examples

Example 1 — scaffolded

Priya buys 4 exercise books at \$2.30 each and a pen for \$3.75. How much does she pay altogether?

Working

Comment

Write one number sentence: total $= 4 \times 2.30 + 3.75$.

“each” points to $\times$, “total” points to $+$.

Step 2 of the order — $\times$ first: $4 \times 2.30 = 9.20$.

The $\times$ happens before the $+$.

Step 3 of the order — $+$ next: $9.20 + 3.75 = 12.95$.

Add the pen.

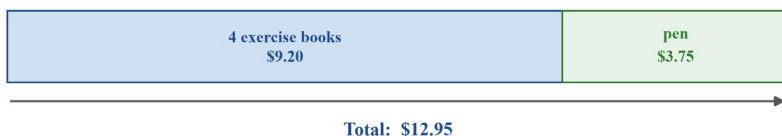
Check with an estimate: 4 books at about \$2 each is about \$8, and the pen is about \$4 — about \$12 altogether. \$12.95 is close.

Estimating first catches slips.

Answer: $\therefore$ Priya pays \$12.95 altogether.

Money is written to two decimal places.

Example 1: Priya's total = $4 \times 2.30 + 3.75$



The $\times$ step goes first ($4 \times 2.30 = 9.20$), then the $+$ step ($9.20 + 3.75 = 12.95$).

Part-whole bar for Priya's total: 4 exercise books, 9.20 dollars, plus a pen, 3.75 dollars, giving a total of 12.95 dollars.

Example 2 — scaffolded

Five friends share the bill for a meal. The bill is \$56, and they use a \$6 voucher before they split the rest equally. How much does each friend pay?

Write one number sentence: each pays $(56 - 6) \div 5$.

The voucher comes off *before* the split — brackets make that happen.

Step 1 of the order — brackets: $56 - 6 = 50$.

Brackets first.

Step 2 of the order — $\div$ next: $50 \div 5 = 10$.

Share \$50 between 5 friends.

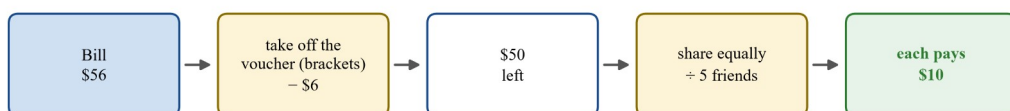
Check: $5 \times 10 = 50$, the amount left after the voucher.

Multiplying back checks the share.

Answer: $\therefore$ each friend pays \$10.00.

Without the brackets the story breaks: in $56 - 6 \div 5$ the $\div$ would go first, giving $6 \div 5 = 1.20$ and then $56 - 1.20 = 54.80$ — which is not anyone's share of the bill.

Example 2: $(56 - 6) \div 5$



Brackets first: $56 - 6 = 50$. Then divide: $50 \div 5 = 10$. Check: $5 \times 10 = 50$.

Without brackets, $56 - 6 \div 5$ does the $\div$ first: $6 \div 5 = 1.20$, then $56 - 1.20 = 54.80$ — not a fair share.

Flow of five boxes: bill 56 dollars, take off the voucher (brackets) 6 dollars, 50 dollars left, share equally between 5 friends, each pays 10 dollars.

Example 3 — unscaffolded

Marco has a 12 m vegetable row in his garden. He plants beans along $\frac{1}{3}$ of the row and peas along the rest. How many metres of the row are peas?

Write one number sentence. The beans take $\frac{1}{3}$ of 12 m and the peas take the rest, so:

$$\text{peas} = 12 - \frac{1}{3} \times 12$$

Apply the order. The $\times$ step goes first: $\frac{1}{3} \times 12 = 12 \div 3 = 4$, so the beans take 4 m.

Then the $-$ step: $12 - 4 = 8$.

Check. $4 + 8 = 12$ — the two parts add back to the whole row.

Example 3: Marco's 12 m veggie row



Number sentence: $12 - \frac{1}{3} \times 12 = 12 - 4 = 8$ (the $\times$ step goes first). Check: $4 + 8 = 12$.

Marco's 12 m row as a bar: beans, $\frac{1}{3}$ of $12\text{ m} = 4\text{ m}$, then peas, the rest, $12 - 4 = 8\text{ m}$, with marks at 0 m, 4 m and 12 m.

$\therefore$ Marco plants 8 m of the row with peas.

Example 4 — unscaffolded

A sports club buys 1 first-aid kit for \$8 and 15 medals at \$4 each. Dana presses the keys $8 + 15 \times 4 =$ on a basic calculator and the display shows 92. Explain why 92 cannot be right, and find the correct total.

Correct order. The number sentence is $8 + 15 \times 4$. The $\times$ step goes first: $15 \times 4 = 60$.

Then the $+$ step: $8 + 60 = 68$.

Check with an estimate. Fifteen medals at \$4 is \$60, and the kit adds \$8 — so a total around \$68 makes sense. A total of \$92 is far above the estimate, so the display cannot be right.

What did the calculator do? A basic calculator works in key order: $8 + 15 = 23$, then $23 \times 4 = 92$. That multiplied the \$8 kit by 15 as well — as if the club bought 15 first-aid kits.

Example 4: why the display showed 92

1 first-aid kit at \$8, plus 15 medals at \$4 each: $8 + 15 \times 4$



The basic calculator did $8 + 15 = 23$ first, then $23 \times 4 = 92$ — it multiplied the \$8 kit by 15 as well, as if the club bought 15 kits.

Estimate check: 15 medals at \$4 = \$60, plus the kit = \$68. 92 is far above the estimate, so it cannot be right.

Two bars comparing totals: the correct total, $8 + 60 = 68$ dollars, and the basic calculator's $(8 + 15) \times 4 = 92$ dollars, which is much longer because the 8 dollar kit was multiplied by 15 too.

$\therefore$ 92 is wrong: the correct total is \$68.00.

Practice questions

Scaffolded

Q1. Work out each calculation. Do the $\times$ step first.

- (a) $6 + 3 \times 7$
- (b) $20 - 4 \times 3$
- (c) $8 \times 3 + 6$

Q2. Work out each calculation. Brackets first; same-rank steps go left to right.

- (a) $(9 + 3) \times 2$
- (b) $12 \div 4 \times 3$
- (c) $15 - 6 + 4$

Q3. Work out each money calculation. Give your answers in dollars and cents.

- (a) $2 \times 1.25 + 3.50$
- (b) $10.00 - 3 \times 2.40$
- (c) $(7.50 + 4.50) \div 3$

Q4. Find each amount. Divide by the bottom number (the denominator).

- (a) $\frac{1}{2}$ of 18
- (b) $\frac{1}{4}$ of \$ 40
- (c) $\frac{1}{3}$ of 24

Q5. Work out each calculation. The fraction step is a $\times$ step, so it goes first.

- (a) $\frac{1}{2} \times 16 + 5$
- (b) $12 - \frac{1}{4} \times 12$
- (c) $\frac{1}{5} \times 30 + 9$

Q6. Zoe puts \$ 7 on her game card at the arcade. Each game costs \$ 2.50 and she plays 5 games.

- (a) Write Zoe's total spend as one number sentence.
- (b) Work out the cost of the 5 games.
- (c) Find her total spend.

Un scaffolded

Q7. At a cafe, 3 coffees cost \$ 4.20 each and a slice of cake costs \$ 3.50. Work out the total cost of the order.

Q8. Three households share the water bill for a community garden. The bill is \$ 100 and the council takes \$ 15 off it. The rest is split equally three ways.

- (a) Work out each household's share using the number sentence $(100 - 15) \div 3$. Give your answer to the nearest cent.
- (b) Explain why the brackets are needed. What would go wrong without them?

Q9. At work, an 18 L drum of cleaning solution is poured equally into 3 buckets. A job uses 2 of the buckets. Sam works out the litres used as $18 \div (3 \times 2) = 3$. Is Sam right? Explain your answer and give the correct number of litres.

Q10. A bake stall has a tray of 24 muffins. $\frac{1}{4}$ of them are choc-chip and the rest are plain.

- (a) How many muffins are choc-chip?
- (b) How many muffins are plain?
- (c) Show that $\frac{3}{4} \times 24$ gives the same answer as part (b).

Q11. Three friends share a taxi home. The fare is \$ 18.50 and there is a \$ 2.20 late-night fee. Each person's share can be written as:

$$\frac{18.50 + 2.20}{3}$$

- (a) Work out each person's share.
- (b) The fraction bar in this calculation acts like which symbol?
- (c) Check your answer to part (a) by multiplying it by 3.

Q12. Wei presses $3 + 5 \times 6 =$ on a new calculator and the display shows 48.

- (a) Does Wei's calculator follow the order of operations? Explain how you know.
- (b) Work out the correct answer to $3 + 5 \times 6$.
- (c) Wei still needs $9 + 4 \times 15$. Show how he can get the right answer on this calculator by doing one step first and writing it down.

Q13. Ben has \$ 20. He spends \$ 7 on lunch, then a friend pays him back \$ 3.

- (a) Work out how much money Ben has now.
- (b) Ben's mate worked it out as $20 - (7 + 3) = 10$. Explain what the brackets did to the story, and why that answer is wrong.

Q14. The label on a 100 mL bottle of cough mixture says: adults take 12.5 mL three times a day.

- (a) Write a number sentence for how much is left in the bottle after one full day of doses.
- (b) Work out how much is left after one full day.
- (c) Work out how much is left after two full days.

Q15. A netball match runs for 40 minutes. The warm-up takes $\frac{1}{4}$ of the match time. How many minutes does the team spend on the warm-up and the match altogether?

Q16. A school class is setting up for an art stall. They buy 6 boxes of markers at \$ 8.40 a box and 2 packs of paper at \$ 3.30 a pack, and pay with a \$ 100 note.

- (a) Work out the cost of the marker boxes.
- (b) Work out the total cost.
- (c) How much change does the class get?

Q17. A painter quotes for a job: 4 tins of paint at \$ 45.50 a tin, plus \$ 120 for the work.

- (a) Write the total as one number sentence.
- (b) Work out the total of the quote.
- (c) Estimate the total by rounding \$ 45.50 to \$ 45, and use your estimate to check that your answer to part (b) is sensible.

Q18. Kelly runs a jam stall at a weekend market. She buys 5 boxes of jars at \$ 12.40 a box and pays an \$ 18 stall fee. (Profit means the money left over after the costs are paid.)

- (a) Show that Kelly's total costs are \$ 80.00.
 - (b) She sells all her jam for \$ 140 altogether. What is her profit?
 - (c) She shares the profit equally between 4 helpers. How much does each helper get?
 - (d) Estimate the costs in part (a) by rounding \$ 12.40 to \$ 12, and check that your answer is sensible.
-

Answers

Q1. (a) 27. (b) 8. (c) 30.

Q2. (a) 24. (b) 9. (c) 13.

Q3. (a) \$6.00. (b) \$2.80. (c) \$4.00.

Q4. (a) 9. (b) \$10.00. (c) 8.

Q5. (a) 13. (b) 9. (c) 15.

Q6. (a) $7 + 5 \times 2.50$. (b) \$12.50. (c) \$19.50.

Q7. \$16.10.

Q8. (a) \$28.33 (to the nearest cent). (b) The brackets make $100 - 15$ happen first; without them the $\div$ goes first: $100 - 15 \div 3 = 100 - 5 = 95$, which is not a share of the reduced bill.

Q9. No. $\div$ and $\times$ are equal rank, so left to right: $18 \div 3 = 6$, then $6 \times 2 = 12$ L. Sam multiplied 3×2 first ($18 \div 6 = 3$).

Q10. (a) 6. (b) 18. (c) $24 \div 4 = 6$, then $6 \times 3 = 18$ — same as (b).

Q11. (a) \$6.90. (b) Brackets. (c) $3 \times 6.90 = 20.70 = 18.50 + 2.20$.

Q12. (a) No — it worked in key order: $3 + 5 = 8$, then $8 \times 6 = 48$; the agreed order gives 33. (b) 33. (c) Do the $\times$ step first: $4 \times 15 = 60$, then press $60 + 9 = 69$.

Q13. (a) \$16.00. (b) $20 - (7 + 3) = 20 - 10 = 10$: the brackets make the paid-back \$3 get taken away instead of added.

Q14. (a) $100 - 3 \times 12.5$. (b) 62.5 mL. (c) 25 mL.

Q15. 50 minutes.

Q16. (a) \$50.40. (b) \$57.00. (c) \$43.00.

Q17. (a) $4 \times 45.50 + 120$. (b) \$302.00. (c) $4 \times 45 + 120 = 300$ — \$302.00 is close, so it is sensible.

Q18. (a) $5 \times 12.40 = 62.00$, then $62.00 + 18 = 80.00$. (b) \$60.00. (c) \$15.00 each. (d) $5 \times 12 + 18 = 78$ — close to \$80.00, so it is sensible.

Fully-worked solutions

Q1. (a) $\times$ first: $3 \times 7 = 21$. Then $6 + 21 = 27$.

(b) $\times$ first: $4 \times 3 = 12$. Then $20 - 12 = 8$.

(c) $\times$ first: $8 \times 3 = 24$. Then $24 + 6 = 30$.

Q2. (a) Brackets first: $9 + 3 = 12$. Then $12 \times 2 = 24$.

(b) $\div$ and $\times$ are equal rank — left to right: $12 \div 4 = 3$. Then $3 \times 3 = 9$.

(c) $-$ and $+$ are equal rank — left to right: $15 - 6 = 9$. Then $9 + 4 = 13$.

Q3. (a) $\times$ first: $2 \times 1.25 = 2.50$. Then $2.50 + 3.50 = 6.00$. The answer is \$6.00.

(b) $\times$ first: $3 \times 2.40 = 7.20$. Then $10.00 - 7.20 = 2.80$. The answer is \$2.80.

(c) Brackets first: $7.50 + 4.50 = 12.00$. Then $12.00 \div 3 = 4.00$. The answer is \$4.00.

Q4. (a) $18 \div 2 = 9$.

(b) $40 \div 4 = 10$. The answer is \$10.00.

(c) $24 \div 3 = 8$.

Q5. (a) Fraction ($\times$) step first: $\frac{1}{2} \times 16 = 16 \div 2 = 8$. Then $8 + 5 = 13$.

(b) Fraction ($\times$) step first: $\frac{1}{4} \times 12 = 12 \div 4 = 3$. Then $12 - 3 = 9$.

(c) Fraction ($\times$) step first: $\frac{1}{5} \times 30 = 30 \div 5 = 6$. Then $6 + 9 = 15$.

Q6. (a) Total $= 7 + 5 \times 2.50$.

(b) $\times$ first: $5 \times 2.50 = 12.50$. The games cost \$12.50.

(c) Then $7 + 12.50 = 19.50$.

$\therefore$ Zoe spends \$19.50 altogether.

Q7. $\times$ first: $3 \times 4.20 = 12.60$. Then $12.60 + 3.50 = 16.10$.

$\therefore$ the order costs \$16.10.

Q8. (a) Brackets first: $100 - 15 = 85$. Then $85 \div 3 = 28.333\dots$, so to the nearest cent each household's share is \$28.33.

(b) The brackets make the subtraction happen first — the \$15 comes off the bill before the split. Without brackets the $\div$ goes first: $15 \div 3 = 5$, then $100 - 5 = 95$. But 3 shares of \$95 would be $3 \times 95 = 285$ — far more than the \$100 bill — so that cannot be a share.

Q9. Sam is not right. $\div$ and $\times$ are equal rank, so they run left to right:

$18 \div 3 = 6$ — each bucket holds 6 L.

$6 \times 2 = 12$ — the job uses 2 buckets.

Sam did a bracket step, $3 \times 2 = 6$, then $18 \div 6 = 3$, which would leave most of the drum unused.

$\therefore$ the job uses 12 L of solution.

Q10. (a) $\frac{1}{4} \times 24 = 24 \div 4 = 6$ choc-chip muffins.

(b) The rest are plain: $24 - 6 = 18$ plain muffins.

(c) $\frac{3}{4} \times 24$: divide by the bottom number, $24 \div 4 = 6$.

Multiply by the top number: $6 \times 3 = 18$.

$18 = 18$, the same as part (b). $\therefore \frac{3}{4} \times 24$ gives the plain muffins.

Q11. (a) Top first: $18.50 + 2.20 = 20.70$. Then divide: $20.70 \div 3 = 6.90$ exactly — no rounding needed. Each person's share is \$6.90.

(b) The fraction bar acts like a **bracket**: it groups $18.50 + 2.20$ together, just like $(18.50 + 2.20) \div 3$.

(c) $3 \times 6.90 = 20.70$, which matches the fare plus the fee — the share checks out.

Q12. (a) No. The agreed order does the $\times$ first: $5 \times 6 = 30$, then $3 + 30 = 33$. The display shows 48, so the calculator worked in key order instead: $3 + 5 = 8$, then $8 \times 6 = 48$.

(b) 33.

(c) Do the $\times$ step by hand first: $4 \times 15 = 60$. Write it down, then press $60 + 9 =$ to get 69. Check with the agreed order: $9 + 60 = 69$. $\therefore$ the right answer is 69.

Q13. (a) $-$ and $+$ are equal rank — left to right: $20 - 7 = 13$. Then $13 + 3 = 16$. Ben has \$16.00 now.

(b) In $20 - (7 + 3)$ the brackets go first: $7 + 3 = 10$, then $20 - 10 = 10$. The brackets treat the paid-back \$3 as money that went *out*. But the \$3 came *in*, so it must be added: the right sentence is $20 - 7 + 3 = 16$.

Q14. (a) Left = $100 - 3 \times 12.5$.

(b) $\times$ first: $3 \times 12.5 = 37.5$ mL taken on day one. Then $100 - 37.5 = 62.5$. There is 62.5 mL left.

(c) Two full days is $2 \times 3 = 6$ doses: $6 \times 12.5 = 75$ mL taken. Then $100 - 75 = 25$. There is 25 mL left.

Q15. Warm-up: $\frac{1}{4} \times 40 = 40 \div 4 = 10$ minutes.

Altogether: $40 + 10 = 50$.

$\therefore$ the team spends 50 minutes on the warm-up and the match altogether.

Q16. (a) $6 \times 8.40 = 50.40$. The marker boxes cost \$50.40.

(b) Paper: $2 \times 3.30 = 6.60$. Total: $50.40 + 6.60 = 57.00$. The total cost is \$57.00.

(c) Change: $100 - 57.00 = 43.00$. The class gets \$43.00 change.

Q17. (a) Total = $4 \times 45.50 + 120$.

(b) $\times$ first: $4 \times 45.50 = 182.00$. Then $182.00 + 120 = 302.00$. The quote totals \$302.00.

(c) Estimate: round \$45.50 to \$45: $4 \times 45 = 180$, then $180 + 120 = 300$. The exact answer \$302.00 is close to the \$300 estimate, so it is sensible.

Q18. (a) Cost of the jars:

$$5 \times 12.40 = 62.00$$

Add the stall fee:

$$62.00 + 18 = 80.00$$

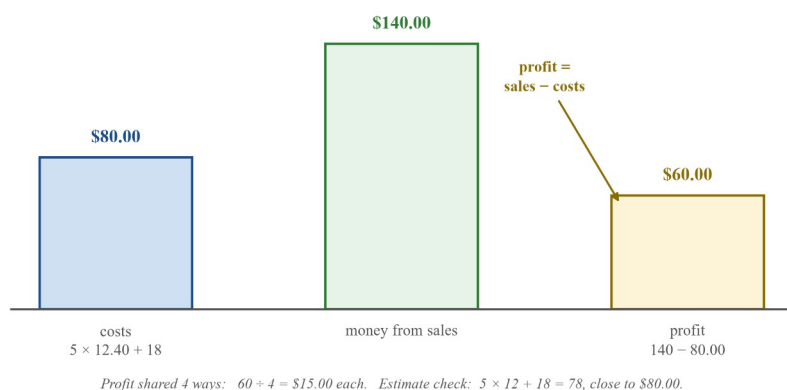
$\therefore$ Kelly's total costs are \$80.00.

(b) Profit = money from sales – costs: $140 - 80.00 = 60.00$. Her profit is \$60.00.

(c) $60 \div 4 = 15$. Each helper gets \$15.00.

(d) Estimate: round \$12.40 to \$12: $5 \times 12 = 60$, then $60 + 18 = 78$. The estimate \$78 is close to the exact \$80.00, so the answer is sensible.

Kelly's market stall: costs, sales and profit



Kelly's market stall as three bars: costs 80.00 dollars ($5 \times 12.40 + 18$), money from sales 140.00 dollars, and profit 60.00 dollars ($140 - 80.00$), with profit shared 4 ways at 15.00 dollars each.

Chapter 2 Number — 2E Common fractions, decimals and percentages

Theory

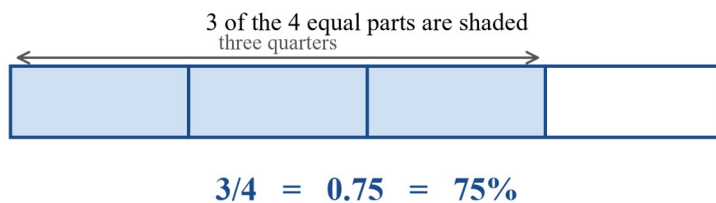
Three ways to write the same amount.

A **fraction** splits a whole into equal parts. The bottom number (the **denominator**) says how many equal parts the whole is split into. The top number (the **numerator**) says how many of those parts we have. So $\frac{3}{4}$ means the whole is split into 4 equal parts and we have 3 of them.

A **decimal** writes part of a whole using a decimal point. 0.75 means 75 hundredths of one whole.

A **percentage** writes part of a whole out of 100. The words *per cent* mean “out of 100”, and the sign is %. So 75 % means 75 out of 100.

These three are just three ways of writing one amount. Here is the same amount written all three ways:



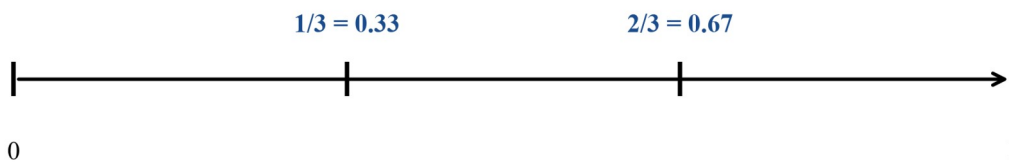
The common fractions and their equivalents.

Fraction	Decimal	Percentage
$\frac{1}{2}$	0.5	50 %
$\frac{1}{3}$	0.33 (to 2 decimal places)	33 %
$\frac{2}{3}$	0.67 (to 2 decimal places)	67 %
$\frac{1}{4}$	0.25	25 %
$\frac{3}{4}$	0.75	75 %
$\frac{1}{5}$	0.2	20 %
$\frac{2}{5}$	0.4	40 %
$\frac{3}{5}$	0.6	60 %
$\frac{4}{5}$	0.8	80 %
$\frac{1}{10}$	0.1	10 %

To get the decimal from a fraction, divide the numerator by the denominator: $\frac{1}{4}$ is $1 \div 4 = 0.25$.

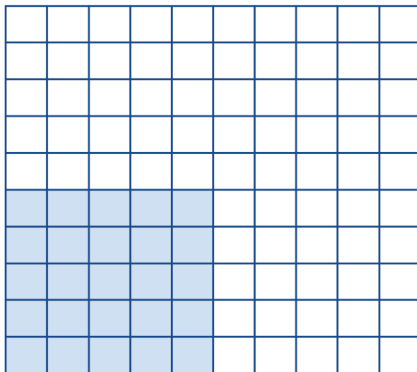
Thirds behave differently: $1 \div 3 = 0.333\dots$ never ends. In this book we round it — **to 2 decimal places**, $1 \div 3 = 0.33$ and $2 \div 3 = 0.67$.

Thirds do not end: $1 \div 3 = 0.333\dots$ — shown rounded to 2 decimal places



A percentage is “how many out of 100”, so a grid of 100 squares shows it straight away:

25 squares of 100 are shaded



$$25\% = 0.25 = 1/4$$

Refresher: rounding to 2 decimal places. Look at the third decimal digit. If it is 5 or more, push the second digit up by one. If it is less than 5, leave the second digit alone and drop the rest.

- $0.333\dots$: the third digit is 3, so to 2 decimal places it is 0.33.
- $0.666\dots$: the third digit is 6, so to 2 decimal places it is 0.67.
- \$14.9975 to the nearest cent (2 decimal places): the third digit is 7, so push up — \$15.00.

Refresher: moving the decimal point. Multiplying and dividing by 10 and 100 just slides the point along.

- Multiply by 10: the point jumps one place right — $0.37 \times 10 = 3.7$.
- Multiply by 100: the point jumps two places right — $0.37 \times 100 = 37$.
- Divide by 100: the point jumps two places left — $37 \div 100 = 0.37$.

That slide is the whole trick between decimals and percentages:

- **decimal** → **percentage**: multiply by 100. $0.6 \times 100 = 60$, so $0.6 = 60\%$.
- **percentage** → **decimal**: divide by 100. $25\% = 25 \div 100 = 0.25$.

Refresher: the same fraction in smaller numbers. Divide the top and the bottom by the same number and the amount does not change: $\frac{40}{100} = \frac{4}{10} = \frac{2}{5}$, and $\frac{6}{10} = \frac{3}{5}$.

Finding a fraction of an amount.

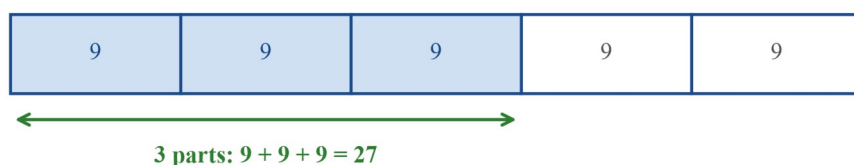
Divide by the bottom number, then multiply by the top number.

Worked model. $\frac{3}{5}$ of the 45 students in a room walk home. How many students walk home?

- $45 \div 5 = 9$ — one fifth of the room is 9 students.
- $9 \times 3 = 27$ — three fifths is 27 students.

Check down the other road: $\frac{3}{5} = 0.6$, and $0.6 \times 45 = 27$ ✓ — same answer.

\$45 split into 5 equal parts — each part is \$9



Finding a common percentage of an amount.

Road 1 — change the percentage to a decimal, then multiply. 20 % of \$ 60: write $20\% = 0.2$, then $0.2 \times 60 = \$12$.

Refresher: multiplying a decimal by a whole number. Do the times-tables part with no decimal point, then put the point back. For 0.25×60 : $25 \times 60 = 1500$; 0.25 has two decimal places, so the answer keeps two decimal places — 15.00. So $0.25 \times 60 = \$15.00$.

Road 2 — build from 10%. Dividing by 10 gives 10 % of any amount. Every other common percentage stacks up from there.

What you want	How to get it	On \$ 250
10 %	divide by 10	\$ 25
5 %	halve the 10 %	\$ 12.50
20 %	double the 10 %	\$ 50
25 %	divide by 4	\$ 62.50
50 %	halve the amount	\$ 125
75 %	add 50 % + 25 %	\$ 187.50

The whole bar is \$250. Each block is one tenth: \$25

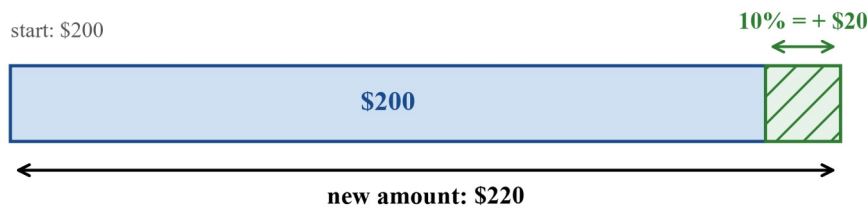


Increasing by a common percentage.

A price rise of 10 % on \$ 200:

- find the rise: 10 % of 200 = \$ 20;
- add it on: $200 + 20 = \$220$.

Calculator shortcut: the new amount is 110 % of the old amount, so multiply by 1.10: $200 \times 1.10 = \$220$ — same answer.

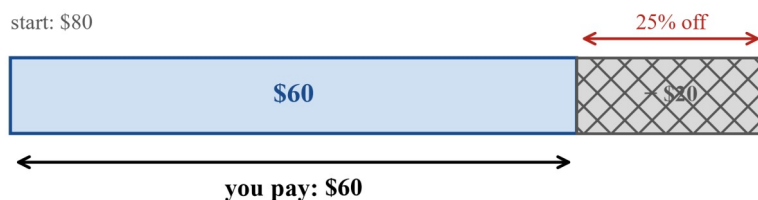


Decreasing by a common percentage (discounts).

A **discount** is an amount taken off a price. A 25 % discount on an \$ 80 jacket:

- find the discount: 25 % of 80 = \$ 20;
- take it off: $80 - 20 = \$60$.

Calculator shortcut: paying 75 % of the price is $\times 0.75$: $80 \times 0.75 = \$60$ — same answer.



Words to know. A **sale price** is the price after a discount. A **deposit** is a part-payment made at the start — the rest is still owed. An **increase** makes an amount bigger; a **decrease** makes it smaller.

About the data in this section. The prices, votes, surveys and numbers here are **made up** (not real): pretend shops, pretend plans and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Worked examples

Example 1 — scaffolded

The park's water tank is $\frac{3}{5}$ full. Write $\frac{3}{5}$ as a decimal and as a percentage.

Working

Comment

Decimal: $3 \div 5 = 0.6$.

A fraction is a division waiting to happen: numerator $\div$ denominator.

Percentage: $0.6 \times 100 = 60$, so 60 %.

Decimal $\rightarrow$ percentage: multiply by 100 (the point jumps two places right).

Check: on a 100-square grid, $\frac{3}{5}$ shades 60 squares — 60 out of 100 is 60 % ✓.

The grid picture and the division agree, so the answer is trustworthy.

Example 2 — scaffolded

Maya buys a \$ 250 phone on lay-by. The shop asks for a 20 % deposit. How much is the deposit?

Working	Comment
Find 10 %: $250 \div 10 = 25$.	Dividing by 10 always gives 10 %.
Double it for 20 %: $25 \times 2 = 50$.	20 % is two lots of 10 %.
Check by Road 1: $0.2 \times 250 = 50$ ✓.	The decimal road and the block road agree.
Estimate: 20 % is a bit less than a quarter; a quarter of \$ 250 is \$ 62.50, and $50 < 62.50$ ✓.	A quick sense-check before trusting the answer.

The deposit is \$ 50.

Example 3 — unscaffolded

Lee's rent is \$ 180 a week. The rent goes up by 10 %. What is the new weekly rent?

Find the rise: 10 % of $180 = 180 \div 10 = \$ 18$.

Add it on: $180 + 18 = \$ 198$.

Check by the shortcut: $180 \times 1.10 = \$ 198$ ✓.

∴ the new weekly rent is \$ 198.

Example 4 — unscaffolded

A bike with a \$ 320 price tag is in the sale at 25 % off. What is the sale price of the bike?



Find the discount: 25 % of $320 = 320 \div 4 = \$ 80$.

Take it off: $320 - 80 = \$ 240$.

Check: $240 + 80 = 320$ ✓ — the sale price and the discount add back to the tag price.

∴ the sale price of the bike is \$ 240.

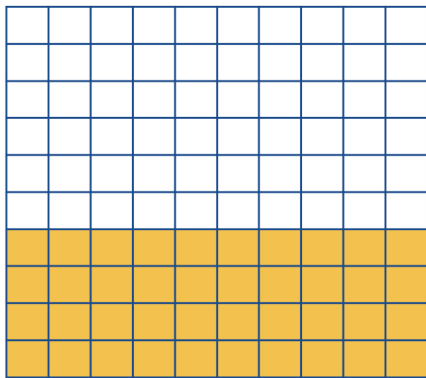
Practice questions

Scaffolded

Q1. Use the table of common equivalents. (a) Write $\frac{1}{2}$ as a decimal and as a percentage. (b) Write $\frac{3}{4}$ as a decimal and as a percentage. (c) Write $\frac{2}{5}$ as a decimal and as a percentage.

Q2. Look at the 100-square grid below.

How much of the grid is shaded?



- (a) What percentage of the grid is shaded?
- (b) Write the shaded part as a decimal.
- (c) Write the shaded part as a fraction in its smallest numbers.

Q3. Write each decimal as a percentage. (a) 0.7 (b) 0.25 (c) 0.08

Q4. Ben drives 180 km to visit his aunt and stops for a break part of the way. (a) How many km is 50 % of the trip? (b) How many km is 25 % of the trip? (c) How many km is 75 % of the trip? Check by adding your answers to (a) and (b).

Q5. A \$ 45 bill offers a discount for paying on time. (a) How much is 10 % of \$ 45? (b) How much is 5 % of \$ 45? (c) How much is 20 % of \$ 45?

Q6. (a) A football match runs for 90 minutes. How many minutes is $\frac{1}{3}$ of the match? (b) $\frac{2}{5}$ of a group of 45 students sing in the choir. How many students is that? (c) How much money is $\frac{3}{4}$ of a \$ 60 gift voucher?

Unscaffolded

Q7. Priya is cooking. (a) A recipe asks for $\frac{3}{4}$ of a cup of milk. Write $\frac{3}{4}$ as a decimal and as a percentage of a cup. (b) The jug shows 0.6 L of juice. Write 0.6 as a fraction in its smallest numbers, and as a percentage. (c) A cereal box says one serve gives 7 % of the daily iron a person needs. Write 7 % as a decimal.

Q8. A club has 100 members. At a vote, 65 members vote yes to a new club shirt. (a) What percentage of the members voted yes? (b) Write that percentage as a decimal. (c) Did more than half the members vote yes? Use your decimal from (b) to explain in one sentence.

Q9. An electricity bill is \$ 220. Paying on time takes 5 % off the bill. (a) How much is the discount? (b) How much is the bill after the discount?

Q10. A party venue costs \$ 480 for the night. The venue asks for a 25 % deposit to hold the date. (a) How much is the deposit? (b) How much is still to pay after the deposit?

Q11. A gym membership costs \$ 35 a month. The price rises by 20 %. (a) How much is the rise? (b) What is the new monthly price?

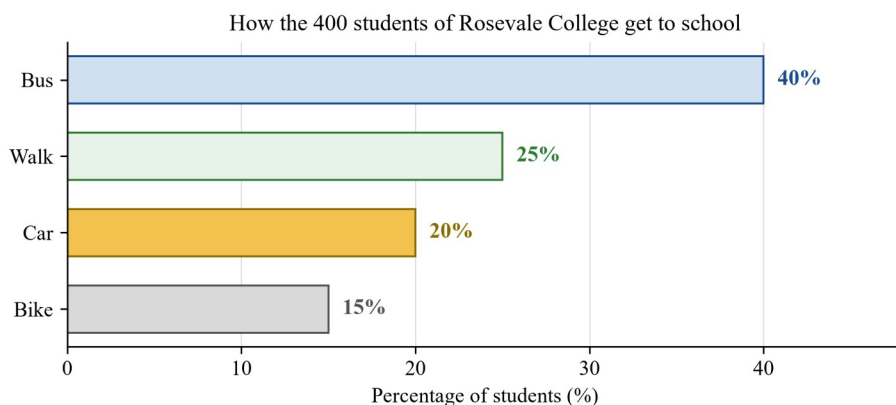
Q12. Shoes are tagged \$ 59.99. The sale takes 25 % off. (a) How much is the discount, to the nearest cent? (b) What is the sale price, to the nearest cent?

Q13. Ana and Ben read the same 300-page book over the holidays. Ana reads $\frac{1}{3}$ of it. Ben reads 25 % of it. (a) How many pages did Ana read? (b) How many pages did Ben read? (c) Who read more pages, and by how many?

Q14. A 2 m rope is cut into 3 equal pieces. (a) What fraction of the rope is each piece? (b) How long is each piece, in metres, to 2 decimal places? (c) Multiply your answer to (b) by 3. Why is that total 1 cm longer than the 2 m rope?

Q15. (a) Show that 20 % of \$ 175 is \$ 35. One step per line, with the target value at the end. (b) A pair of boots tagged \$ 175 is 20 % off. What is the sale price?

Q16. The chart shows how the 400 students of Rosevale College get to school.



Made-up data: the college name and every percentage in the chart are made up for this section.

- (a) Which way of getting to school is the most common?
- (b) What percentage of the students ride a bike?
- (c) How many students walk to school?

Q17. Kai works out 5 % of \$ 60 by writing 5 % as the decimal 0.5, and gets \$ 30. (a) Explain Kai's mistake in one sentence. (b) Work out 5 % of \$ 60 correctly. (c) Check your answer using the 10 % block.

Q18. A winter coat tagged \$ 120 is half price in the sale. (a) What is the sale price? (b) A store card takes a further 10 % off the sale price. What is the price with the card? (c) Write a “ $\therefore$ ” sentence giving the final price with the card.

Answers

Q1. (a) 0.5; 50 %. (b) 0.75; 75 %. (c) 0.4; 40 %. **Q2.** (a) 40 %. (b) 0.4. (c) $\frac{2}{5}$. **Q3.** (a) 70 %. (b) 25 %. (c) 8 %. **Q4.** (a) 90 km. (b) 45 km. (c) 135 km; check $90 + 45 = 135$ ✓. **Q5.** (a) \$ 4.50. (b) \$ 2.25. (c) \$ 9.00. **Q6.** (a) 30 minutes. (b) 18 students. (c) \$ 45. **Q7.** (a) 0.75; 75 %. (b) $\frac{3}{5}$; 60 %. (c) 0.07. **Q8.** (a) 65 %. (b) 0.65. (c) Yes — $0.65 > 0.5$, so more than half. **Q9.** (a) \$ 11. (b) \$ 209. **Q10.** (a) \$ 120. (b) \$ 360. **Q11.** (a) \$ 7. (b) \$ 42. **Q12.** (a) \$ 15.00. (b) \$ 44.99. **Q13.** (a) 100 pages. (b) 75 pages. (c) Ana, by 25 pages. **Q14.** (a) $\frac{1}{3}$. (b) 0.67 m. (c) 2.01 m — each piece was rounded up, so three rounded pieces overshoot. **Q15.** (a) shown: $0.2 \times 175 = 35$. (b) \$ 140. **Q16.** (a) Bus. (b) 15 %. (c) 100 students. **Q17.** (a) 0.5 is 50 %, not 5 % — 5 % is 0.05. (b) \$ 3.00. (c) 10 % of 60 = \$ 6.00; half of that is \$ 3.00 ✓. **Q18.** (a) \$ 60. (b) \$ 54. (c) $\therefore$ the coat costs \$ 54 with the card.

Fully-worked solutions

Q1. (a) $1 \div 2 = 0.5$; $0.5 \times 100 = 50$, so 50 %. (b) $3 \div 4 = 0.75$; 75 %. (c) $2 \div 5 = 0.4$; 40 %.

Q2. (a) 40 of the 100 squares are shaded, so 40 %. (b) $40 \div 100 = 0.4$. (c) $\frac{40}{100} = \frac{4}{10} = \frac{2}{5}$.

Q3. Multiply by 100 — the point jumps two places right. (a) 70 %. (b) 25 %. (c) 8 %.

Q4. (a) 50 % is half: $180 \div 2 = 90$ km. (b) 25 % is a quarter: $180 \div 4 = 45$ km. (c) $75 \% = 50 \% + 25 \%$, so $90 + 45 = 135$ km; the check matches ✓.

Q5. (a) $45 \div 10 = \$ 4.50$. (b) 5 % is half of 10 %: $4.50 \div 2 = \$ 2.25$. (c) 20 % is double 10 %: $4.50 \times 2 = \$ 9.00$.

Q6. (a) $90 \div 3 = 30$ minutes. (b) $45 \div 5 = 9$; $9 \times 2 = 18$ students. (c) $60 \div 4 = 15$; $15 \times 3 = \$ 45$.

Q7. (a) $3 \div 4 = 0.75$; $0.75 \times 100 = 75$, so 75 % of a cup. (b) $0.6 = \frac{6}{10} = \frac{3}{5}$; and $0.6 \times 100 = 60$, so 60 %. (c) $7 \div 100 = 0.07$.

Q8. (a) 65 members out of 100 is 65 out of 100 — that is 65 %. (b) $65 \div 100 = 0.65$. (c) Half of the members is 0.5 of them; $0.65 > 0.5$, so yes, more than half voted yes.

Q9. (a) 10 % of 220 = \$ 22; 5 % is half of that: $22 \div 2 = \$ 11$. (b) $220 - 11 = \$ 209$.

Q10. (a) 25 % is a quarter: $480 \div 4 = \$ 120$. (b) $480 - 120 = \$ 360$ still to pay.

Q11. (a) 10 % of 35 = \$ 3.50; 20 % is double: $3.50 \times 2 = \$ 7$. (b) $35 + 7 = \$ 42$. Check: $35 \times 1.20 = \$ 42$ ✓.

Q12. (a) Exact discount: $59.99 \div 4 = \$ 14.9975$. To the nearest cent that is \$ 15.00. (b) Exact sale price: $59.99 - 14.9975 = \$ 44.9925$. To the nearest cent that is \$ 44.99.

Q13. (a) $300 \div 3 = 100$ pages. (b) 25 % is a quarter: $300 \div 4 = 75$ pages. (c) $100 - 75 = 25$: Ana read more, by 25 pages.

Q14. (a) The rope is cut into 3 equal pieces, so each piece is $\frac{1}{3}$ of the rope. (b) $2 \div 3 = 0.666\dots$; to 2 decimal places each piece is 0.67 m. (c) $0.67 \times 3 = 2.01$ m. The extra 1 cm comes from the rounding: each piece's exact length 0.666... m was rounded up to 0.67 m, so three rounded pieces overshoot the 2 m rope by 1 cm.

Q15. (a)

$$20\% = 0.2$$

$$0.2 \times 175 = 35$$

$\therefore$ 20 % of \$ 175 is \$ 35. (b) $175 - 35 = \$ 140$.

Q16. (a) The longest bar is the bus, at 40 % — the bus is the most common way. (b) 15 %. (c) 25 % of $400 = 400 \div 4 = 100$ students walk.

Q17. (a) 0.5 means five tenths, which is 50 % — 5 % is five hundredths, 0.05, so Kai found 50 % instead of 5 %. (b) $0.05 \times 60 = \$ 3.00$. (c) 10 % of 60 = \$ 6.00; 5 % is half of 10 %, and $6.00 \div 2 = \$ 3.00$ ✓ — it matches.

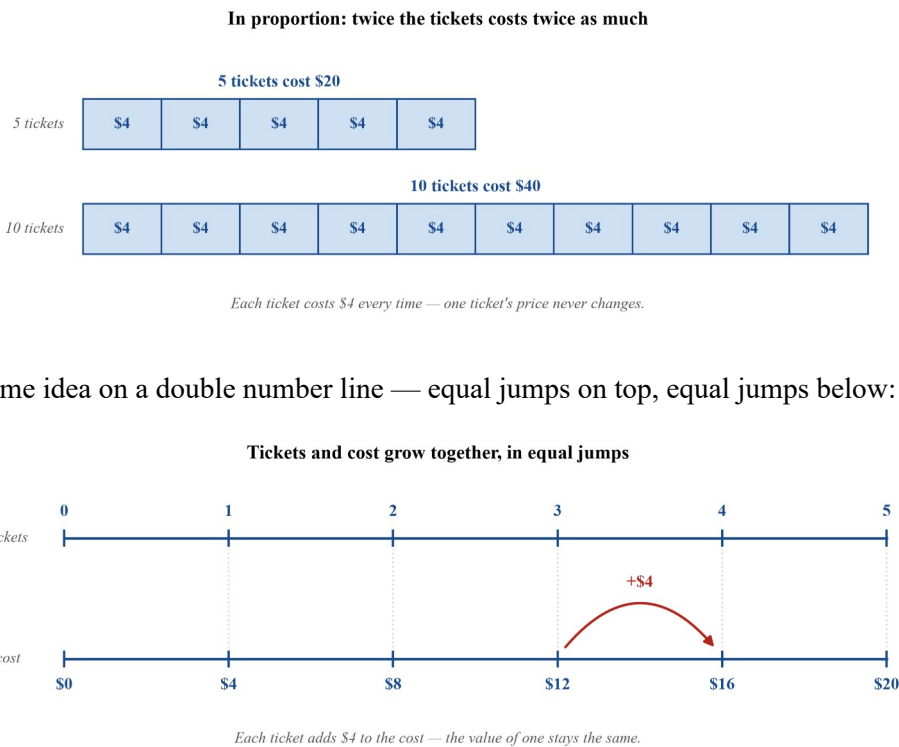
Q18. (a) Half price: $120 \div 2 = \$ 60$. (b) 10 % of 60 = \$ 6; $60 - 6 = \$ 54$. (c) $\therefore$ the coat costs \$ 54 with the store card.

Theory

This section is about quantities that grow together in a steady way. A Key Skill for this part of the course includes working with simple proportions (see the study design’s Unit 1, Area of Study 1). Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-08.

About the data in this section. The prices, stalls and numbers here are **made up** (not real): pretend stalls and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

What “in proportion” means. Two quantities are **in proportion** when they grow together at a steady pace: whatever number you multiply one by, you multiply the other by the same number. Buy twice as many raffle tickets and you pay twice as much. Halve the serves in a recipe and every ingredient halves too. The check that never fails is the **value of one**: in a proportion, one ticket always costs the same, one serve always needs the same flour, one pack always holds the same number of bars. When the value of one changes, the quantities are not in proportion and the methods in this section do not apply.



Proportions turn up in every kind of everyday task:

Situation	The two quantities that grow together
Shopping	number of packs ↔ total price
Cooking	number of serves ↔ amount of each ingredient
Event planning	number of guests ↔ food and drink needed
Work	number of boxes ↔ items packed or sheets printed

Method 1: find the value of one first. The most-used proportion method has two steps: divide to find the value of ONE, then multiply up to the number you want. At the market, 2 dozen eggs cost \$ 9.60. What do 5 dozen cost?

Refresher: dividing money. Dividing a money amount by a whole number is ordinary division — share the amount out evenly. The answer keeps two decimal places, because cents are hundredths of a dollar. Check every division by multiplying back.

Divide	One part	Check
$\$20.00 \div 5$	$\$4.00$	$4.00 \times 5 = 20.00$
$\$13.50 \div 6$	$\$2.25$	$2.25 \times 6 = 13.50$
$\$9.60 \div 2$	$\$4.80$	$4.80 \times 2 = 9.60$

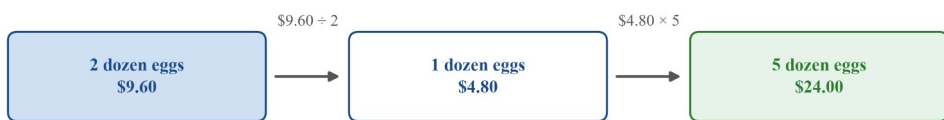
On the eggs, step 1 finds one dozen and step 2 multiplies up to five dozen:

$$\$9.60 \div 2 = \$4.80$$

$$\$4.80 \times 5 = \$24.00$$

So five dozen eggs cost \$24.00.

Method 1: find the value of ONE first



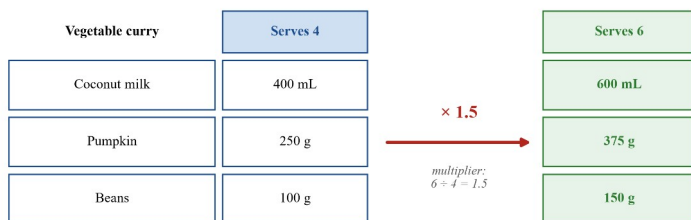
Divide down to one, then multiply up to the number you want.

Method 2: find the multiplier. Sometimes the number you want is a multiple of the number you have — recipes especially. Divide the NEW count by the OLD count: the answer is the **multiplier**, the number every amount gets multiplied by. A curry recipe serves 4 and you need it to serve 6, so the multiplier is $6 \div 4 = 1.5$, and every ingredient amount gets multiplied by 1.5: coconut milk $400 \times 1.5 = 600$ mL, pumpkin $250 \times 1.5 = 375$ g, beans $100 \times 1.5 = 150$ g.

Refresher: multiplying by 0.5, 1.5 and 0.75. These multipliers come up constantly in scaling, and each has a shortcut in your head.

Multiply by	What it does	Example
0.5	halves the amount	$80 \times 0.5 = 40$
1.5	the amount plus half of it	$200 \times 1.5 = 300$ (that is $200 + 100$)
0.75	the amount minus a quarter of it	$400 \times 0.75 = 300$ (that is $400 - 100$)

Method 2: find the multiplier — serves 4 to serves 6



Every amount gets the same multiplier — that is what keeps it in proportion.

A proportion is two equal fractions. Because the two quantities grow together, you can write a proportion as two equal fractions and scale it by doing the same to the top and the bottom. Take $\frac{5}{8} = \frac{15}{?}$. The top goes $5 \rightarrow 15$, which is $\times 3$, so the bottom must get $\times 3$ as well: $8 \times 3 = 24$, and $\frac{5}{8} = \frac{15}{24}$.

A proportion is two equal fractions



Top $\times 3$ gives 15, so bottom $\times 3$ gives 24. $5/8$ and $15/24$ are equal.

Refresher: equivalent fractions. Section 2E built equivalent fractions; here is the piece this section needs. Multiplying top and bottom by the same number keeps the fraction the same size.

Fraction	Equal fractions
$\frac{1}{2}$	$= \frac{2}{4} = \frac{5}{10}$
$\frac{1}{3}$	$= \frac{2}{6} = \frac{4}{12}$
$\frac{3}{4}$	$= \frac{6}{8} = \frac{12}{16}$

Proportion tables. A proportion table holds two quantities that grow together, and any empty cell is filled by either method. This stall's bread table carries a third row that checks the value of one:

Loaves of bread	2	5	8	10
Cost	\$ 7.00	\$ 17.50	\$ 28.00	\$ 35.00
Value of one loaf	\$ 3.50	\$ 3.50	\$ 3.50	\$ 3.50

Made-up data: the stall and every number in this table are made up for this section.

Read the table along a row or down a column. To fill an empty cell, travel through the value of one: if the cost of 8 loaves were empty, $\$ 3.50 \times 8 = \$ 28.00$; if the cost \$ 35.00 were given and the loaves empty, $\$ 35.00 \div \$ 3.50 = 10$ loaves. The check row is the point of the table — the value of one is \$ 3.50 in every single column, which is exactly what “in proportion” means.

Better buys: compare the value of one. To compare packs of different sizes, find the cost of ONE item in each pack — the **unit price** — and compare those. The pack with the cheaper unit price is the **better buy**. If the division does not come out exact, the question says how to round, usually “to the nearest cent”, and you round only at that stated step.

Refresher: rounding to the nearest cent. Cents are two decimal places, so look at the third decimal place: 5 or more rounds the cent up, 4 or less leaves it where it is.

Amount	To the nearest cent	Why
\$ 1.4166...	\$ 1.42	third decimal is 6, so round up
\$ 0.754	\$ 0.75	third decimal is 4, so leave it
\$ 4.125	\$ 4.13	third decimal is 5, so round up

Watch out: not everything grows in proportion. Some prices carry a fixed starting cost, so the value of one changes as the count grows. Showground entry is \$ 4 plus \$ 2 a ride: one ride costs \$ 6 in all (so \$ 6.00 a ride), two rides cost \$ 8 in all (so \$ 4.00 a ride). The value of one ride is not the same both times, so the total cost and the number of rides are not in proportion — Method 1 and Method 2 would both give wrong answers here.

Watch out: a fixed starting cost breaks the pattern

Showground rides: \$4 entry, then \$2 a ride

1 ride Total: $\\$4 + \\$2 = \\$6$ Value of one ride: \$6.00	2 rides Total: $\\$4 + \\$2 + \\$2 = \\$8$ Value of one ride: \$4.00
---	---

\$6.00 is not the same as \$4.00 — the value of one changes, so these numbers are NOT in proportion.

One question to ask before using any method in this section: is the value of one the same every time? If yes, the methods work. Q14 gives you two deals to check.

Picking a method.

What you are given	Best method
A price or amount for some count, and you want another count's price	Method 1 — value of one
A recipe or list to scale up or down	Method 2 — multiplier
Two equal fractions with a gap in one	Same to the top, same to the bottom
Two packs of the same item to compare	Unit price of one item

Technology. A basic calculator does every division and multiplication in this section in one go. A spreadsheet will fill a whole proportion table for you: put the value of one in one cell and let each cost cell multiply it. Nothing here needs a device, though — pen, paper and a basic calculator are always enough, and technology is a way to check your answer, not a way to skip the thinking.

Worked examples

Example 1 — scaffolded

The school fete's honey stall sells jars that are all the same size. 4 jars cost \$23.00. What does 1 jar cost, and what do 9 jars cost?

Working	Comment
4 jars cost \$23.00	The pair you are given.
$\$23.00 \div 4 = \$5.75$	Method 1, step 1 — divide to find the value of one jar.
$\$5.75 \times 9 = \$51.75$	Method 1, step 2 — multiply up to nine jars.
Check: $\$5.75 \times 8 = \$46.00$, then $\$46.00 + \$5.75 = \$51.75$	Eight jars is double four jars; nine jars is eight plus one more.

One jar costs \$5.75, and nine jars cost \$51.75.

Example 2 — scaffolded

The recipe card below makes a banana bread that serves 4. The Nguyen family needs the bread to serve 6. How much of each ingredient do they need?

Banana bread	
Serves 4	
Flour	200 g
Milk	300 mL
Eggs	2
Bananas	2

Working

Multiplier: $6 \div 4 = 1.5$

Flour: $200 \times 1.5 = 300$ g

Milk: $300 \times 1.5 = 450$ mL

Eggs: $2 \times 1.5 = 3$, bananas: $2 \times 1.5 = 3$

Check: more serves means more of everything

Comment

Method 2 — new serves divided by old serves.

Every amount gets the same multiplier.

Same multiplier, ingredient by ingredient.

Counts scale too — three eggs and three bananas.

The direction of the answer is right.

For six serves the family needs 300 g of flour, 450 mL of milk, 3 eggs and 3 bananas.

Example 3 — unscaffolded

Shop A sells muesli bars in 6-packs for \$4.68. Shop B sells the same bars in 10-packs for \$7.50. Which pack is the better buy?

Which pack is the better buy?

SHOP A	SHOP B
Muesli bars, 6-pack	Muesli bars, 10-pack
6 for \$4.68	10 for \$7.50

Same bars, different pack sizes — to compare, find the cost of ONE bar in each shop.

Find the unit price — the cost of one bar — in each shop. Shop A: $\$4.68 \div 6 = \$0.78$ a bar. Shop B: $\$7.50 \div 10 = \$0.75$ a bar. Both divisions come out exact, so no rounding is needed. Comparing the two unit prices, \$0.75 is less than \$0.78, by $\$0.78 - \$0.75 = \$0.03$ a bar.

$\therefore$ Shop B's 10-pack is the better buy: each bar costs \$0.75, which is 3 c less per bar than Shop A's \$0.78.

Example 4 — unscaffolded

A muffin recipe makes 12 muffins and uses 240 g of flour. Maree has a 900 g bag of flour and plenty of everything else. How many muffins can she make?

How many muffins can the bag of flour make?

Muffin recipe	Bag of flour
Makes 12 muffins	
Flour: 240 g	900 g

Everything else is in the cupboard — only the flour runs the show.

Use Method 1. The flour in one muffin is $240 \div 12 = 20$ g. The bag then makes $900 \div 20 = 45$ muffins. Check with Method 2: the bag holds $900 \div 240 = 3.75$ times the recipe's flour, and $12 \times 3.75 = 45$ muffins — the same answer, so both methods agree.

$\therefore$ Maree can make 45 muffins from the 900 g bag of flour.

Practice questions

Scaffolded

Q1. Fill in the missing number that makes each pair of fractions equal.

(a) $\frac{2}{3} = \frac{6}{?}$

(b) $\frac{4}{5} = \frac{?}{20}$

(c) $\frac{3}{7} = \frac{12}{?}$

Q2. The school office buys exercise books in bundles of the same size. 4 books cost \$13.00.

- (a) What does 1 book cost?
- (b) What do 6 books cost?
- (c) What do 10 books cost?

Q3. A smoothie recipe for 2 serves uses 150 g of strawberries and 200 mL of yoghurt. Tamsin makes the recipe for 6 serves.

- (a) What is the multiplier from 2 serves to 6 serves?
- (b) How many grams of strawberries does she need?
- (c) How many mL of yoghurt does she need?

Q4. A scone recipe serves 8 and uses 300 g of flour and 60 g of sugar. Duy wants only 2 serves.

- (a) What is the multiplier from 8 serves to 2 serves?
- (b) How much flour does Duy need?
- (c) How much sugar does Duy need?

Q5. The tuck shop sells stickers in proportion. Two cells of its price table are empty.

Stickers	4	14	?
Cost	\$2.00	?	\$9.00

Made-up data: this tuck-shop price table is made up for this section.

- (a) What is the cost of 1 sticker?
- (b) Fill in the cost of 14 stickers.
- (c) Fill in how many stickers \$9.00 buys.

Q6. Two shops sell the same apples. Shop A sells 4 apples for \$2.60. Shop B sells 6 apples for \$3.60.

- (a) What does one apple cost at Shop A?
- (b) What does one apple cost at Shop B?
- (c) Which shop is the better buy for apples?

Un scaffolded

Q7. The footy club sells raffle tickets in proportion. 7 tickets cost \$ 24.50.

- (a) What does 1 ticket cost?
- (b) What do 9 tickets cost?
- (c) Amy spends \$ 52.50 on tickets. How many tickets does she get?

Q8. Pancake day: a recipe serves 4 and uses 240 g of flour, 400 mL of milk and 60 g of butter. The club needs the recipe to serve 7.

- (a) What is the multiplier?
- (b) How much flour and how much milk does the club need?
- (c) How much butter does the club need?

Q9. Nan's jam recipe makes 12 jars and uses 1500 g of sugar and 2000 g of fruit. This year she wants only 3 jars.

- (a) What is the multiplier from 12 jars to 3 jars?
- (b) How much sugar does she need?
- (c) How much fruit does she need?

Q10. A supermarket sells two packs of the same soap, in bars of the same size. A 3-pack costs \$ 4.25 and a 5-pack costs \$ 6.90.

- (a) What does one bar cost in the 3-pack, to the nearest cent?
- (b) What does one bar cost in the 5-pack, to the nearest cent?
- (c) Which pack is the better buy, and by how much per bar, using your rounded answers?

Q11. An office buys printer paper in reams (packs of 500 sheets). The price table is in proportion, with two cells empty.

Reams	2	7	?
Cost	\$ 11.00	?	\$ 44.00

Made-up data: this paper price table is made up for this section.

- (a) What does 1 ream cost?
- (b) Fill in the cost of 7 reams.
- (c) Fill in how many reams \$ 44.00 buys.

Q12. A recipe serves 4. Priya scales it up to serve 10, so the multiplier is the fraction $\frac{10}{4}$.

- (a) Complete the equal fractions: $\frac{10}{4} = \frac{5}{?}$
- (b) Write the multiplier as a decimal.
- (c) The recipe uses 100 g of butter for 4 serves. How much butter does Priya need for 10 serves?

Q13. A candle maker uses 320 g of wax for 8 of the same candle. She has 1200 g of wax left, and plenty of wick and scent.

- (a) How much wax does one candle use?
- (b) How many candles can she make from the 1200 g of wax?

Q14. Two ride deals at the show are pictured.

Two ride deals at the show

DEAL 1 — ride cards	DEAL 2 — pay as you go
4 rides: \$12	\$5 entry + \$3 a ride
7 rides: \$21	1 ride: \$8 in total
10 rides: \$30	2 rides: \$11 in total

- (a) For Deal 1, find the cost per ride on the 4-ride card and on the 7-ride card.
- (b) For Deal 2, find the cost per ride when 1 ride costs \$8 in all, and when 2 rides cost \$11 in all.
- (c) Which deal keeps the same cost per ride? For that deal, is the total cost in proportion to the number of rides?

Q15. A fruit stall sells bags of oranges in proportion: 3 bags cost \$8.40.

- (a) Show that 7 bags cost \$19.60.
- (b) Hence find the cost of 12 bags.

Q16. The soccer club's sausage sizzle needs 150 sausages. Sausages come in packs of 12, and one pack costs \$7.80. The club can only buy whole packs.

- (a) How many packs must the club buy? Round up to the next whole pack if you need to.
- (b) What do those packs cost?
- (c) How many sausages are left over after the sizzle uses 150?

Q17. At the dairy, 5 small tubs of the same yoghurt weigh 1.75 kg in all.

- (a) What does one tub weigh?
- (b) What do 8 tubs weigh?
- (c) What do 3 tubs weigh?

Q18. A community garden buys seedlings in trays, in proportion. 6 trays hold 108 seedlings, and one tray costs \$8.60.

- (a) How many seedlings are in one tray?
- (b) How many trays are needed for 180 seedlings?
- (c) What do those trays cost?

Answers

Q1. (a) 9 (b) 16 (c) 28 **Q2.** (a) \$3.25 (b) \$19.50 (c) \$32.50 **Q3.** (a) 3 (b) 450 g (c) 600 mL **Q4.** (a) 0.25 (b) 75 g (c) 15 g **Q5.** (a) \$0.50 (b) \$7.00 (c) 18 stickers **Q6.** (a) \$0.65 (b) \$0.60 (c) Shop B **Q7.** (a) \$3.50 (b) \$31.50 (c) 15 tickets **Q8.** (a) 1.75 (b) 420 g flour, 700 mL milk (c) 105 g butter **Q9.** (a) 0.25 (b) 375 g (c) 500 g **Q10.** (a) \$1.42 (b) \$1.38 (c) the 5-pack, by \$0.04 a bar **Q11.** (a) \$5.50 (b) \$38.50 (c) 8 reams **Q12.** (a) 2 (b) 2.5 (c) 250 g **Q13.** (a) 40 g (b) 30 candles **Q14.** (a) \$3.00 and \$3.00 (b) \$8.00 and \$5.50 (c) Deal 1; yes, the total cost is in proportion to the number of rides **Q15.** (a) shown, \$19.60 (b) \$33.60 **Q16.** (a) 13 packs (b) \$101.40 (c) 6 sausages **Q17.** (a) 0.35 kg (b) 2.8 kg (c) 1.05 kg **Q18.** (a) 18 seedlings (b) 10 trays (c) \$86.00

Fully-worked solutions

Q1. (a) The top goes $2 \rightarrow 6$, which is $\times 3$, so the bottom is $3 \times 3 = 9$. (b) The bottom goes $5 \rightarrow 20$, which is $\times 4$, so the top is $4 \times 4 = 16$. (c) The top goes $3 \rightarrow 12$, which is $\times 4$, so the bottom is $7 \times 4 = 28$.

Q2. (a) The value of one book: $\$13.00 \div 4 = \$3.25$. (b) Six books: $\$3.25 \times 6 = \$19.50$. (c) Ten books: $\$3.25 \times 10 = \$32.50$.

Q3. (a) New serves divided by old serves: $6 \div 2 = 3$. (b) Strawberries: $150 \times 3 = 450$ g. (c) Yoghurt: $200 \times 3 = 600$ mL.

Q4. (a) $2 \div 8 = 0.25$. (b) Flour: $300 \times 0.25 = 75$ g. (c) Sugar: $60 \times 0.25 = 15$ g.

Q5. (a) The value of one sticker: $\$2.00 \div 4 = \$0.50$. (b) Fourteen stickers: $\$0.50 \times 14 = \$7.00$. (c) \$9.00 buys $\$9.00 \div \$0.50 = 18$ stickers.

Q6. (a) Shop A: $\$2.60 \div 4 = \$0.65$ an apple. (b) Shop B: $\$3.60 \div 6 = \$0.60$ an apple. (c) Shop B, because \$0.60 is cheaper than \$0.65 for the same apple.

Q7. (a) One ticket: $\$24.50 \div 7 = \$3.50$. (b) Nine tickets: $\$3.50 \times 9 = \$31.50$. (c) \$52.50 buys $\$52.50 \div \$3.50 = 15$ tickets.

Q8. (a) $7 \div 4 = 1.75$. (b) Flour: $240 \times 1.75 = 420$ g; milk: $400 \times 1.75 = 700$ mL. (c) Butter: $60 \times 1.75 = 105$ g.

Q9. (a) $3 \div 12 = 0.25$. (b) Sugar: $1500 \times 0.25 = 375$ g. (c) Fruit: $2000 \times 0.25 = 500$ g.

Q10. (a) 3-pack: $\$4.25 \div 3 = \$1.4166\dots$, which is \$1.42 to the nearest cent. (b) 5-pack: $\$6.90 \div 5 = \$1.38$ to the nearest cent (exact). (c) The 5-pack is the better buy; using the rounded answers it is cheaper by $\$1.42 - \$1.38 = \$0.04$ a bar.

Q11. (a) One ream: $\$11.00 \div 2 = \$5.50$. (b) Seven reams: $\$5.50 \times 7 = \$38.50$. (c) \$44.00 buys $\$44.00 \div \$5.50 = 8$ reams.

Q12. (a) The top goes $10 \rightarrow 5$, which is $\div 2$, so the bottom is $4 \div 2 = 2$. (b) $\frac{10}{4} = 10 \div 4 = 2.5$. (c) Butter: $100 \times 2.5 = 250$ g.

Q13. (a) Wax per candle: $320 \div 8 = 40$ g. (b) Candles from the wax left: $1200 \div 40 = 30$ candles. Check: $30 \times 40 = 1200$ g, the whole bag.

Q14. (a) Deal 1: 4 rides for \$12 is $\$12 \div 4 = \$3.00$ a ride, and 7 rides for \$21 is $\$21 \div 7 = \$3.00$ a ride — the same. (b) Deal 2: 1 ride for \$8 is $\$8 \div 1 = \$8.00$ a ride, and 2 rides for \$11 is $\$11 \div 2 = \$5.50$ a ride — not the same. (c) Deal 1 keeps the same cost per ride (\$3.00 every time), so for Deal 1 the total cost is in proportion to the number of rides. Deal 2 is not, because its value of one changes.

Q15. (a) One bag: $\$8.40 \div 3 = \$2.80$. Seven bags: $\$2.80 \times 7 = \$19.60$. So 7 bags cost \$19.60, as required. (b) Twelve bags: $\$2.80 \times 12 = \$33.60$.

Q16. (a) $150 \div 12 = 12.5$, and 12 packs would give only $12 \times 12 = 144$ sausages — not enough — so the club rounds up to 13 packs. (b) Thirteen packs: $\$7.80 \times 13 = \$101.40$. (c) Thirteen packs hold $13 \times 12 = 156$ sausages, so $156 - 150 = 6$ sausages are left over.

Q17. (a) One tub: $1.75 \div 5 = 0.35$ kg. (b) Eight tubs: $0.35 \times 8 = 2.8$ kg. (c) Three tubs: $0.35 \times 3 = 1.05$ kg.

Q18. (a) One tray: $108 \div 6 = 18$ seedlings. (b) Trays for 180 seedlings: $180 \div 18 = 10$ trays. (c) Ten trays: $\$8.60 \times 10 = \$86.00$.

Chapter 2 Number — 2G Dividing quantities by a simple ratio

About the data in this section. The money, lengths, volumes and counts here are **made up** (not real): pretend people, pretend jobs and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Theory

Why we divide by a ratio.

At work, a quantity is often split between two people, two teams or two materials — not equally, but by an agreed rule: “1 to 2”, “1 part cleaner to 9 parts water”, “2 to 1”. A rule like that is written as a **ratio**, and splitting the quantity by that rule is the skill in this section. Every ratio here has two numbers, like 1 : 2, and every split is done with the same four steps.

What a ratio is.

A **ratio** compares two quantities by saying how many of one go with how many of the other. It is written with a **colon**, the symbol :, and read as “to”: the ratio 1 : 2 is read “1 to 2”, and means for every 1 of the first quantity there are 2 of the second.

When a whole is divided by a ratio, each number in the ratio stands for a number of equal **parts**. The whole is cut into that many equal parts in total, and each side of the ratio takes its own parts. A **share** is the amount one person, team or material ends up with.

The ratio 1:2 — one whole bar split into 3 equal parts



For every 1 part in the first share, the second share has 2 parts.

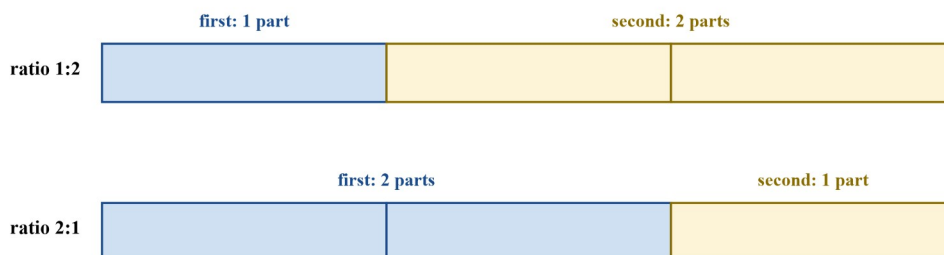
Total parts: $1 + 2 = 3$. The 3 equal parts make the whole.

Read the figure across: the whole bar is cut into 3 equal parts, because $1 + 2 = 3$. The first share is 1 part and the second share is 2 parts, so the second share is twice the first. That is all 1 : 2 says.

Order matters.

The order of the two numbers is part of the ratio, so 1 : 2 and 2 : 1 are different ratios and give different splits. Split 30 in the ratio 1 : 2 and the shares are 10 and 20; split 30 in the ratio 2 : 1 and the shares are 20 and 10. Same two numbers, different order, different answer.

Order matters: 1:2 is not 2:1



Same two numbers, a different order — a different split.

The first number always belongs to whatever is named first.

Always read the ratio in the order the question names things. “Syrup to water, 1:5” puts syrup first, so syrup gets the 1 part. Words can give the ratio indirectly too: if Noah gets twice as much as Ava, then the ratio Ava : Noah is 1:2.

Refresher. Division splits a quantity into equal parts.

To **divide** is to split a quantity into equal parts and find what one part is worth. $24 \div 6 = 4$ says: cut 24 into 6 equal parts and each part is worth 4. Check by multiplying back: $6 \times 4 = 24$, the whole you started with. Every split in this section begins with a division like this one — the whole divided by the number of equal parts — so keep that check-by-multiplying habit close.

The parts method.

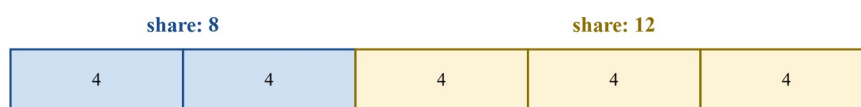
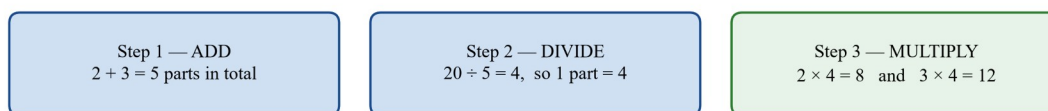
Dividing a quantity by a two-number ratio is done in four steps, called the **parts method**:

- **Step 1 — ADD.** Add the two numbers in the ratio. The answer is the total number of equal parts the whole is cut into.
- **Step 2 — DIVIDE.** Divide the whole by that total. The answer is the value of 1 part.
- **Step 3 — MULTIPLY.** Multiply the value of 1 part by each number in the ratio, in order. The answers are the shares.
- **Step 4 — CHECK.** Add the shares. They must add back to the whole — the same check-and-reflect habit as in Section 1C.

The method worked end to end, dividing 20 in the ratio 2:3:

Step 1: $2 + 3 = 5$, so 5 equal parts in total. Step 2: $20 \div 5 = 4$, so 1 part = 4. Step 3: $2 \times 4 = 8$ and $3 \times 4 = 12$. Step 4: $8 + 12 = 20$ — the shares add back to the whole.

The parts method: divide 20 in the ratio 2:3



Each of the 5 equal parts is worth 4. The shares are 8 and 12.

Check: $8 + 12 = 20$ — the shares add back to the whole.

The numbers in a ratio do not have to be small: 4:5, 1:9 and 5:3 are still two-number ratios, and the same four steps work on them unchanged.

Refresher. Fractions of an amount.

A **fraction** names some of the equal parts of a whole: in $\frac{2}{5}$, the bottom number 5 says how many equal parts the whole is cut into, and the top number 2 says how many of those parts are taken. To find a fraction of an amount, divide the amount by the bottom number, then multiply by the top number:

- $\frac{2}{5}$ of 20: $20 \div 5 = 4$, then $4 \times 2 = 8$
- $\frac{3}{5}$ of 20: $20 \div 5 = 4$, then $4 \times 3 = 12$

Shares as fractions of the whole.

Every share in a ratio split is also a fraction of the whole: the share's parts over the total parts. In the model above the shares are 8 and 12 out of 20, which is $\frac{2}{5}$ and $\frac{3}{5}$ of the whole — the two ratio numbers over the 5 total parts.

Each share as a fraction of the whole (ratio 2:3)



2 parts out of 5 is $\frac{2}{5}$. 3 parts out of 5 is $\frac{3}{5}$.

$\frac{2}{5} + \frac{3}{5} = 1$ whole — the fractions always add to 1.

Ratio	Total parts	First share of the whole	Second share of the whole
1:1	2	$\frac{1}{2}$	$\frac{1}{2}$
1:2	3	$\frac{1}{3}$	$\frac{2}{3}$
2:3	5	$\frac{2}{5}$	$\frac{3}{5}$
1:4	5	$\frac{1}{5}$	$\frac{4}{5}$

So a 1:2 split always hands out one third and two thirds of the whole, whatever the whole is, and the two fractions always add to 1 whole.

When 1 part does not divide evenly.

Step 2 does not always give a tidy number. Share \$50 in the ratio 1:2: Step 1 gives 3 parts, and Step 2 is $50 \div 3 = 16.666\dots$, where the 6s repeat forever. Money is written to two decimal places, so the shares have to be rounded: \$16.67 and \$33.33.

Refresher. Rounding to the nearest cent and to 2 decimal places.

To **round** a number to two decimal places, look at the third decimal digit. If it is 5 or more, add 1 to the second decimal digit; if it is 4 or less, leave the second decimal digit as it is; either way, drop every digit after the second place. In 16.666... the third decimal digit is 6, so the second place rounds up and 16.666... becomes 16.67. For money this is rounding to the nearest cent, because one cent is \$0.01.

Rounding moves each share by a few cents at most, so Step 4 is then done with the rounded shares, lining the decimal points up in columns — the same lined-up-points habit as in Section 2A:

$$\begin{array}{r}
 16.67 \\
 + 33.33 \\
 \hline
 50.00
 \end{array}$$

Carry the full, unrounded value through your working and round only at the end, and only where the question asks for it.

Key ideas.

- A ratio compares two quantities; 1:2 reads “1 to 2”. This section uses two-number ratios only.
- The order of the numbers is part of the ratio: 1:2 is not 2:1.

- The parts method: ADD the ratio numbers, DIVIDE the whole by that total to get 1 part, MULTIPLY by each ratio number to get the shares, CHECK the shares add back to the whole.
- Each share is a fraction of the whole: its parts over the total parts, and the two fractions add to 1.
- When 1 part does not divide evenly, carry the full value, round only where the question says and to the places it says, and check with the rounded numbers.

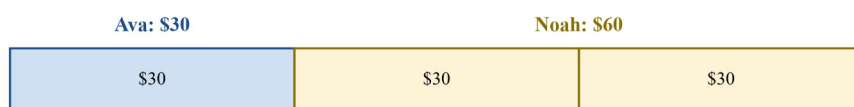
Worked examples

Example 1 — scaffolded

Ava and Noah share \$90 in the ratio 1:2 (Ava : Noah). (a) How many equal parts is the \$90 cut into? (b) What is 1 part worth? (c) How much does Ava get, and how much does Noah get? (d) Check your answer.

Working	Comment
(a) $1 + 2 = 3$ parts	Step 1: add the two numbers in the ratio.
(b) $\$90 \div 3 = \$30$	Step 2: the whole divided by the parts is the value of 1 part.
(c) Ava: $1 \times \$30 = \$30$; Noah: $2 \times \$30 = \$60$	Step 3: multiply 1 part by each ratio number, in the order the names were given.
(d) $\$30 + \$60 = \$90$	Step 4: the shares add back to the whole, so the split is right.

Sharing \$90 in the ratio 1:2



3 parts in total, and $\$90 \div 3 = \$30$, so every cell is \$30.

Check: $\$30 + \$60 = \$90$.

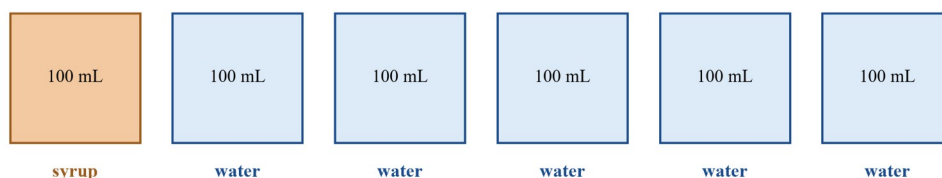
The figure shows the same split as three equal \$30 cells: 1 cell for Ava and 2 cells for Noah.

Example 2 — scaffolded

Priya makes 600 mL of cordial. The recipe says mix syrup to water in the ratio 1:5. (a) How many equal parts is the 600 mL cut into? (b) What is 1 part worth, in mL? (c) How much syrup and how much water does Priya use? (d) Check your answer.

Working	Comment
(a) $1 + 5 = 6$ parts	Step 1: syrup is named first and water second, so syrup gets the 1 part and water the 5.
(b) $600 \div 6 = 100$, so 1 part = 100 mL	Step 2: divide the whole volume by the total parts.
(c) syrup: $1 \times 100 = 100$ mL; water: $5 \times 100 = 500$ mL	Step 3: keep the recipe's order — syrup first.
(d) $100 + 500 = 600$ mL	Step 4: the two amounts add back to the cordial.

600 mL of cordial mixed in the ratio 1:5 (syrup : water)



6 parts in total, and $600 \div 6 = 100$, so every cup is 100 mL.

Syrup: $1 \times 100 = 100$ mL. Water: $5 \times 100 = 500$ mL. Check: $100 + 500 = 600$ mL.

The figure shows the six 100 mL cups: 1 cup of syrup and 5 cups of water.

Example 3 — unscaffolded

Mia and Toby share a \$100 prize in the ratio 1:2 (Mia : Toby). Find each share to the nearest cent.

Step 1 adds the ratio numbers: $1 + 2 = 3$ parts in total. Step 2 divides the prize by the parts: $100 \div 3 = 33.333\dots$, so 1 part is 33.333... dollars, with the 3s repeating. The value does not stop, so the shares are rounded at the end, to the nearest cent.

Mia's share is 1 part. In 33.333... the third decimal digit is 3, which is 4 or less, so to the nearest cent Mia gets \$33.33. Toby's share is 2 parts: $2 \times 33.333\dots = 66.666\dots$, and there the third decimal digit is 6, which rounds the cent up, so Toby gets \$66.67.

Step 4 checks with the rounded shares, points lined up: $33.33 + 66.67 = 100.00$, the whole prize.

$\therefore$ to the nearest cent Mia gets \$33.33 and Toby gets \$66.67, and the rounded shares add back to the \$100.00 prize.

Example 4 — unscaffolded

A plumber cuts a 5.5 m pipe into two pieces in the ratio 2:3 (shorter piece : longer piece). (a) Find the length of each piece. (b) How much longer is the longer piece than the shorter piece?

(a) Step 1: $2 + 3 = 5$ parts in total. Step 2: $5.5 \div 5 = 1.1$, so 1 part = 1.1 m. Step 3: the shorter piece is $2 \times 1.1 = 2.2$ m and the longer piece is $3 \times 1.1 = 3.3$ m. Step 4: $2.2 + 3.3 = 5.5$ m, the whole pipe, so the split is right.

(b) The difference between the pieces is $3.3 - 2.2 = 1.1$ m. That is exactly 1 part, which makes sense: the ratio numbers 2 and 3 are 1 part apart.

$\therefore$ the pieces are 2.2 m and 3.3 m long, and the longer piece is 1.1 m longer than the shorter one.

Practice questions

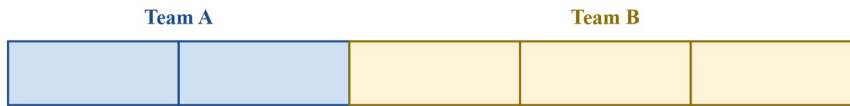
Scaffolded

Q1. Divide 12 in the ratio 1:2. (a) How many equal parts is 12 cut into? (b) What is 1 part worth? (c) Write down the two shares.

Q2. Sasha splits her \$ 45 of pocket money between savings and spending in the ratio 1 : 4 (savings : spending). (a) How many equal parts is the \$ 45 cut into? (b) What is 1 part worth? (c) How much does Sasha save, and how much does she spend?

Q3. The bar shows 40 players split into two teams.

The 40 players, shown as one bar in equal parts



The bar shows the split only — the equal parts are not valued yet.

You work out how many players are in each part.

- (a) Write down the ratio Team A : Team B that the bar shows.
- (b) How many players are in each team?
- (c) What fraction of all the players is in Team A?

Q4. Forty lollies are shared between two jars in the ratio 3 : 5. (a) How many equal parts are the lollies cut into? (b) What is 1 part worth? (c) How many lollies go in each jar?

Q5. A mix of cement and sand uses the ratio 1 : 3 (cement : sand). One batch of the mix weighs 24 kg altogether. (a) How many equal parts is the 24 kg cut into? (b) What is 1 part worth, in kg? (c) How much cement and how much sand is in the batch?

Q6. A 20 kg bag of potting mix is compost to soil in the ratio 1 : 4. (a) How many kg of compost and how many kg of soil are in the bag? (b) What fraction of the bag is compost? (c) What fraction of the bag is soil?

Unscaffolded

Q7. Dana and Eli share \$ 950 of rent in the ratio 2 : 3 (Dana : Eli). (a) How much does each person pay? (b) How much more does Eli pay than Dana?

Q8. A concrete mix uses gravel to cement in the ratio 4 : 1. One job uses 25 bags of the two materials altogether. (a) How many bags of gravel and how many bags of cement does the job use? (b) How many times the number of cement bags is the number of gravel bags?

Q9. The bar shows a 5.4 m length of timber cut into two pieces in the ratio 4 : 5.

A 5.4 m length of timber cut into two pieces in the ratio 4:5



9 equal parts in total. Each part is the same length —

find that length first, then the two pieces.

- (a) Find the length of each piece.
- (b) Check your answer by adding the two pieces.

Q10. A 10 m wire is cut into two pieces in the ratio 1 : 2. (a) Find the length of each piece to two decimal places. (b) Show that the two rounded lengths add to 10.00 m, one step per line.

Q11. A market stall splits the money it takes in a day between two charities in the ratio 1 : 3. On Friday the stall takes in \$ 80, and the charities receive \$ 20 and \$ 60. On Saturday the stall again takes in \$ 80, and the charities receive \$ 30 and \$ 50. (a) Is Friday's split a 1 : 3 split of \$ 80? Explain. (b) Is Saturday's split a 1 : 3 split of \$ 80? Explain.

Q12. A quiz night prize pool of \$ 400 is split between first and second place in the ratio 5 : 3. (a) How much does each place win? (b) Is first prize more than half the prize pool? Explain.

Q13. The jug shows 2 000 mL of cleaning mix, made from cleaner to water in the ratio 1 : 9.

2 000 mL of mixed cleaner — 1 part cleaner to 9 parts water



10 equal parts in total. Each part is the same number of mL —
find that number first, then the two amounts.

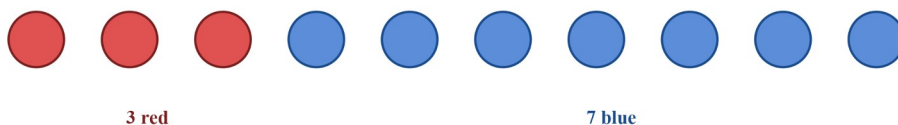
- (a) How much cleaner and how much water is in the jug?
- (b) How much more water than cleaner is in the jug?

Q14. Sam divides 30 kg in the ratio 2 : 3 and writes the shares as 10 kg and 20 kg. (a) Find the correct shares. (b) Sam's two numbers add to 30 kg, so Sam says the answer must be right. Explain why Sam is wrong.

Q15. Jordan splits a 90-minute training session between gym work and track work in the ratio 1 : 1. (a) How many minutes are spent on each? (b) What fraction of the session is gym work?

Q16. The picture shows the marbles in a bag.

The marbles in the bag



- (a) Write down the ratio of red marbles to blue marbles.
- (b) Write down the ratio of blue marbles to red marbles.
- (c) What fraction of the marbles are red? Give your answer as a decimal as well.

Q17. A club receives a grant of \$ 2 400 — a **grant** is money given to a group for an agreed purpose — and splits it between a small project and a big project in the ratio 1 : 3. (a) How much of the grant goes to each project? (b) How much more goes to the big project than to the small project? (c) What fraction of the grant goes to the small project?

Q18. The bar shows a 36 m fence that two crews paint, shared in the ratio 2 : 1 (Crew A : Crew B).

The 36 m fence, painted in the ratio 2:1 (Crew A : Crew B)



*3 equal parts in total. Each part is the same number of metres —
find that number first, then each crew's length.*

- (a) How many metres of fence does each crew paint?
 - (b) How many more metres does Crew A paint than Crew B?
 - (c) What fraction of the fence does Crew B paint?
-

Answers

Q1. (a) 3. (b) 4. (c) 4 and 8. **Q2.** (a) 5. (b) \$9. (c) saves \$9, spends \$36. **Q3.** (a) 2:3. (b) Team A 16, Team B 24. (c) $\frac{2}{5}$. **Q4.** (a) 8. (b) 5. (c) 15 and 25. **Q5.** (a) 4. (b) 6 kg. (c) cement 6 kg, sand 18 kg. **Q6.** (a) compost 4 kg, soil 16 kg. (b) $\frac{1}{5}$. (c) $\frac{4}{5}$. **Q7.** (a) Dana \$380, Eli \$570. (b) \$190. **Q8.** (a) gravel 20 bags, cement 5 bags. (b) 4 times. **Q9.** (a) 2.4 m and 3.0 m. (b) $2.4 + 3.0 = 5.4$ m, the whole length. **Q10.** (a) 3.33 m and 6.67 m, to two decimal places. (b) shown in solutions. **Q11.** (a) yes — the 1:3 split of \$80 is \$20 and \$60, which is Friday's split. (b) no — the 1:3 split of \$80 is \$20 and \$60, not \$30 and \$50. **Q12.** (a) first \$250, second \$150. (b) yes — half the pool is \$200, and \$250 is more than \$200. **Q13.** (a) cleaner 200 mL, water 1800 mL. (b) 1600 mL. **Q14.** (a) 12 kg and 18 kg. (b) adding to 30 kg is only Step 4; 10 kg and 20 kg is the 1:2 split of 30 kg, not the 2:3 split. **Q15.** (a) 45 minutes each. (b) $\frac{1}{2}$. **Q16.** (a) 3:7. (b) 7:3. (c) $\frac{3}{10} = 0.3$. **Q17.** (a) small project \$600, big project \$1800. (b) \$1200. (c) $\frac{1}{4}$. **Q18.** (a) Crew A 24 m, Crew B 12 m. (b) 12 m. (c) $\frac{1}{3}$.

Fully-worked solutions

Q1. (a) Step 1: $1 + 2 = 3$ parts. (b) Step 2: $12 \div 3 = 4$, so 1 part = 4. (c) Step 3: $1 \times 4 = 4$ and $2 \times 4 = 8$. Check: $4 + 8 = 12$.

Q2. (a) Step 1: $1 + 4 = 5$ parts. (b) Step 2: $\$45 \div 5 = \$9$, so 1 part = \$9. (c) Step 3: savings $1 \times \$9 = \$9$; spending $4 \times \$9 = \$36$. Check: $9 + 36 = 45$.

Q3. (a) The bar shows 2 equal cells for Team A and 3 equal cells for Team B, so the ratio is 2:3. (b) Step 1: $2 + 3 = 5$ parts. Step 2: $40 \div 5 = 8$, so 1 part = 8 players. Step 3: Team A $2 \times 8 = 16$ players, Team B $3 \times 8 = 24$ players. Check: $16 + 24 = 40$. (c) Team A is 2 parts out of 5, so Team A is $\frac{2}{5}$ of the players — the same fraction as $\frac{16}{40}$.

Q4. (a) Step 1: $3 + 5 = 8$ parts. (b) Step 2: $40 \div 8 = 5$, so 1 part = 5 lollies. (c) Step 3: $3 \times 5 = 15$ and $5 \times 5 = 25$ lollies. Check: $15 + 25 = 40$.

Q5. (a) Step 1: $1 + 3 = 4$ parts. (b) Step 2: $24 \div 4 = 6$, so 1 part = 6 kg. (c) Step 3: cement $1 \times 6 = 6$ kg; sand $3 \times 6 = 18$ kg. Check: $6 + 18 = 24$ kg.

Q6. (a) Step 1: $1 + 4 = 5$ parts. Step 2: $20 \div 5 = 4$, so 1 part = 4 kg. Step 3: compost $1 \times 4 = 4$ kg, soil $4 \times 4 = 16$ kg. Check: $4 + 16 = 20$ kg. (b) Compost is 1 part out of 5: $\frac{1}{5}$ of the bag. (c) Soil is 4 parts out of 5: $\frac{4}{5}$ of the bag.

Q7. (a) Step 1: $2 + 3 = 5$ parts. Step 2: $950 \div 5 = 190$, so 1 part = \$190. Step 3: Dana $2 \times \$190 = \$380$; Eli $3 \times \$190 = \$570$. Check: $380 + 570 = 950$. (b) $570 - 380 = 190$, so Eli pays \$190 more — exactly 1 part, because the ratio numbers are 1 part apart.

Q8. (a) Step 1: $4 + 1 = 5$ parts. Step 2: $25 \div 5 = 5$, so 1 part = 5 bags. Step 3: gravel $4 \times 5 = 20$ bags; cement $1 \times 5 = 5$ bags. Check: $20 + 5 = 25$. (b) $20 \div 5 = 4$, so the gravel is 4 times the cement — the same as the ratio's first number, because the second number is 1.

Q9. (a) Step 1: $4 + 5 = 9$ parts. Step 2: $5.4 \div 9 = 0.6$, so 1 part = 0.6 m. Step 3: piece 1 is $4 \times 0.6 = 2.4$ m; piece 2 is $5 \times 0.6 = 3.0$ m. (b) $2.4 + 3.0 = 5.4$ m, the whole length, so the split is right.

Q10. (a) Step 1: $1 + 2 = 3$ parts. Step 2: $10 \div 3 = 3.333\dots$, so 1 part is $3.333\dots$ m. Step 3: the shorter piece is 1 part and the longer piece is 2 parts, $2 \times 3.333\dots = 6.666\dots$ m. Round at the end, to two decimal places: the shorter piece is 3.33 m (third decimal digit 3, so the second place stays) and the longer piece is 6.67 m (third decimal digit 6, so the second place rounds up). (b) One step per line:

$$3.33 \text{ m} + 6.67 \text{ m}$$

$$= 10.00 \text{ m}$$

$\therefore$ the two rounded lengths add to 10.00 m.

Q11. (a) A 1:3 split of \$80: Step 1 gives $1 + 3 = 4$ parts, Step 2 gives $80 \div 4 = 20$, and Step 3 gives $1 \times \$20 = \$20$ and $3 \times \$20 = \$60$. Friday's \$20 and \$60 are exactly those shares, so yes, Friday is a 1:3 split. (b) Saturday's shares are \$30 and \$50. They do add to \$80, but they are not the 1:3 shares of \$80 — those are \$20 and \$60 — so no, Saturday is not a 1:3 split of the money.

Q12. (a) Step 1: $5 + 3 = 8$ parts. Step 2: $400 \div 8 = 50$, so 1 part = \$50. Step 3: first place $5 \times \$50 = \$250$; second place $3 \times \$50 = \$150$. Check: $250 + 150 = 400$. (b) Half the pool is $400 \div 2 = 200$, so \$200. First prize is \$250, which is more than \$200, so yes — first prize is more than half the pool. (Second prize, \$150, is less than half.)

Q13. (a) Step 1: $1 + 9 = 10$ parts. Step 2: $2000 \div 10 = 200$, so 1 part = 200 mL. Step 3: cleaner $1 \times 200 = 200$ mL; water $9 \times 200 = 1800$ mL. Check: $200 + 1800 = 2000$ mL. (b) $1800 - 200 = 1600$, so the jug holds 1600 mL more water than cleaner.

Q14. (a) Step 1: $2 + 3 = 5$ parts. Step 2: $30 \div 5 = 6$, so 1 part = 6 kg. Step 3: $2 \times 6 = 12$ kg and $3 \times 6 = 18$ kg. Check: $12 + 18 = 30$ kg. (b) Adding to 30 kg is only Step 4, and on its own it is not enough: many pairs of numbers add to 30. The shares must also come from the ratio. 10 kg and 20 kg is the 1:2 split of 30 kg — 3 parts of 10 kg — not the 2:3 split, so Sam divided by the wrong ratio. The 2:3 check is $12 + 18 = 30$ kg with the shares in the ratio 2:3.

Q15. (a) Step 1: $1 + 1 = 2$ parts. Step 2: $90 \div 2 = 45$, so 1 part = 45 minutes, and each activity gets 45 minutes. Check: $45 + 45 = 90$. (b) Gym work is 1 part out of 2: $\frac{1}{2}$ of the session. A 1:1 split is always a half-each split.

Q16. (a) 3 red to 7 blue is written 3:7. (b) The same marbles in the other order: 7:3. (c) There are $3 + 7 = 10$ marbles in all, so red is $\frac{3}{10}$ of the bag, which as a decimal is 0.3.

Q17. (a) Step 1: $1 + 3 = 4$ parts. Step 2: $2400 \div 4 = 600$, so 1 part = \$600. Step 3: small project $1 \times \$600 = \$600$; big project $3 \times \$600 = \$1800$. Check: $600 + 1800 = 2400$. (b) $1800 - 600 = 1200$, so the big project gets \$1200 more than the small one. (c) The small project is 1 part out of 4: $\frac{1}{4}$ of the grant.

Q18. (a) Step 1: $2 + 1 = 3$ parts. Step 2: $36 \div 3 = 12$, so 1 part = 12 m. Step 3: Crew A $2 \times 12 = 24$ m; Crew B $1 \times 12 = 12$ m. Check: $24 + 12 = 36$ m. (b) $24 - 12 = 12$, so Crew A paints 12 m more than Crew B. (c) Crew B is 1 part out of 3: $\frac{1}{3}$ of the fence.

Chapter 02 — Test A (multiple choice)

Chapter 2 (Number), sections 2A to 2G. Materials: pen, paper; a calculator may be used. Test A: 12 multiple-choice questions (12 marks). Approximate time: 20 minutes.

About the data in this test. The prices, times and other numbers here are **made up** (not real): pretend people, pretend businesses and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Choose the response that is correct for the question.

Question 1

The ticket machine at the Wandella Show counts 63 408 tickets sold. In this number, the value of the digit 3 is

- A. 300
- B. 30 000
- C. 3 000
- D. 3

Question 2

Four market stalls sell the same jar of honey. Their prices are \$ 4.7, \$ 4.07, \$ 4.77 and \$ 4.17. Which list shows the prices from lowest to highest?

- A. \$ 4.7, \$ 4.07, \$ 4.17, \$ 4.77
- B. \$ 4.07, \$ 4.17, \$ 4.7, \$ 4.77
- C. \$ 4.77, \$ 4.7, \$ 4.17, \$ 4.07
- D. \$ 4.07, \$ 4.7, \$ 4.17, \$ 4.77

Question 3

Rosa borrows library books every 6 weeks. Ollie borrows library books every 9 weeks. They both borrow books today. How many weeks pass before they next borrow on the same day?

- A. 3
- B. 15
- C. 54
- D. 18

Question 4

A sports club takes 50 people on a day trip. Each minibus seats 12 people. How many minibuses does the club need?

- A. 4
- B. 2
- C. 5
- D. 6

Question 5

A shop sells a pack of 8 identical exercise books for \$11.40. The price of one book, correct to the nearest cent, is

- A. \$1.43
- B. \$1.42
- C. \$1.40
- D. \$1.425

Question 6

A crowd of 5 263 people watches a football match. Rounded to the nearest hundred, the crowd is

- A. 5 200
- B. 5 260
- C. 5 000
- D. 5 300

Question 7

A garden shop sells 3 bags of potting mix at \$8.50 each, and delivery costs \$4. The total cost of the order is

- A. \$37.50
- B. \$20.50
- C. \$29.50
- D. \$25.50

Question 8

Tess types $4 + 5 \times 7$ into a calculator that follows the agreed order of operations. The display shows

- A. 63
- B. 39
- C. 33
- D. 35

Question 9

A download bar shows that a file is 0.8 complete. As a fraction in simplest form and as a percentage, the part of the file that is complete is

- A. $\frac{4}{5}$ and 8 %
- B. $\frac{4}{5}$ and 80 %
- C. $\frac{8}{10}$ and 8 %
- D. $\frac{8}{10}$ and 80 %

Question 10

A jacket marked \$ 48 is on sale at 25 % off. The sale price is

- A. \$ 36
- B. \$ 12
- C. \$ 23
- D. \$ 60

Question 11

Shop A sells a 4-pack of juice cartons for \$ 5.20. Shop B sells a 6-pack of the same cartons for \$ 7.20. Which statement is correct?

- A. Shop A is the better buy, at \$ 1.30 per carton.
- B. Shop A is the better buy, because \$ 5.20 is less than \$ 7.20.
- C. Shop B is the better buy, at \$ 1.20 per carton.
- D. Shop B is the better buy, at \$ 0.12 per carton.

Question 12

A prize of \$ 280 is shared between two teams in the ratio 3 : 4. The two shares, in ratio order, are

- A. \$ 120 and \$ 160
- B. \$ 140 and \$ 140
- C. \$ 70 and \$ 210
- D. \$ 160 and \$ 120

End of Test A

Test A — Answers

Que stion	1	2	3	4	5	6	7	8	9	10	11	12
Ans wer	C	B	D	C	A	D	C	B	B	A	C	A

Test A — Fully-worked solutions

Question	Answer	Working
1	C	$63\,408 = 60\,000 + 3\,000 + 400 + 8$. The digit 3 sits in the thousands place, so its value is $3 \times 1000 = 3\,000$. Option A is the hundreds place, option B is the ten-thousands place, and option D is the digit on its own.
2	B	Pad every price to two decimal places: \$ 4.70, \$ 4.07, \$ 4.77, \$ 4.17. Compare digit by digit from the left: $4.07 < 4.17 < 4.70 < 4.77$. Option A compares the prices like whole numbers ($47 < 407 < 417 < 477$), option C runs from highest to lowest, and option D compares the digits after the point like whole numbers (7 before 17), so it puts \$ 4.7 before \$ 4.17.
3	D	Multiples of 6: 6, 12, 18, 24, ... Multiples of 9: 9, 18, 27, ... The first shared multiple is 18, so they next borrow on the same day in 18 weeks. Option A is the largest common factor of 6 and 9, option B is $6 + 9$, and option C is $6 \times 9 = 54$ — a shared multiple, but not the first one.
4	C	$50 \div 12 = 4$ remainder 2. Four buses seat 48 people, and the 2 people left over still need a bus, so the club needs $4 + 1 = 5$ minibuses. Option A leaves 2 people behind, option B is the remainder, and option D counts one bus too many.
5	A	$\$11.40 \div 8 = \$1.425$. The question asks for the nearest cent, so keep two decimal places; the decider is the third decimal, 5, and halfway always rounds up: \$ 1.43. Option B rounds the 5 down, option C rounds to the wrong place, and option D is not rounded to cents at all.
6	D	Nearest hundred: keep the hundreds digit (2); the decider is 6, so round up: $5\,263 \rightarrow 5\,300$. Option A rounds down, option B

Question	Answer	Working
		is the nearest ten (5 260), and option C is the nearest thousand (5 000).
7	C	Multiply first, then add: $3 \times 8.50 = 25.50$, then $25.50 + 4 = \$29.50$. Option A is $3 \times (8.50 + 4) = \$37.50$, which pays for delivery three times; option B multiplies the wrong pair ($8.50 + 4 \times 3 = \$20.50$); option D forgets the delivery.
8	B	Multiply first: $5 \times 7 = 35$. Then add: $4 + 35 = 39$. Option A is the key-order answer $(4 + 5) \times 7 = 63$; option C pairs 4×7 first and then adds 5; option D stops after the multiplication step.
9	B	$0.8 = \frac{8}{10}$. Divide the top and bottom by 2: $\frac{4}{5}$, which is the simplest form. To write it as a percentage, multiply by 100: $0.8 \times 100 = 80\%$. Options A and C give 8%, which is 0.08, and options C and D leave the fraction as $\frac{8}{10}$, which is not in simplest form.
10	A	25% of \$48: $0.25 \times 48 = \$12$ off. Sale price: $48 - 12 = \$36$. Option B is the discount on its own, option C subtracts 25 dollars instead of 25%, and option D adds the discount on instead of taking it off.
11	C	Find the price of one carton. Shop A: $\$5.20 \div 4 = \$1.30$. Shop B: $\$7.20 \div 6 = \$1.20$. $\$1.20 < \$1.30$, so Shop B is the better buy, at \$1.20 per carton. Option A has the right unit price but picks the dearer shop; option B compares the pack totals, not the value of one carton; option D slides the decimal point to the wrong spot.
12	A	Add the parts: $3 + 4 = 7$ parts. Divide: $\$280 \div 7 = \$40$ a part. Multiply: $3 \times 40 = \$120$ and

Question	Answer	Working
		$4 \times 40 = \$160$. Check: $120 + 160 = 280$. Option B splits evenly and ignores the ratio; option C divides by 4, which gives a 1:3 split; option D reverses the order of the shares.

Chapter 02 — Test B (written response)

Chapter 2 (Number), sections 2A to 2G. Materials: pen, paper; a calculator may be used. Test B: 7 questions (32 marks). Approximate time: 45 minutes.

Answer all questions in the spaces provided. Only round when a question tells you to, and round to the precision it states. Where more than one mark is available, show your working.

About the data in this test. The prices, times and other numbers here are **made up** (not real): pretend people, pretend businesses and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Question 1 (4 marks)

The Harkness Park community newsletter is going to print. These questions are about the numbers in it.

a. The newsletter reports this year's park visits in words: "eighty-four thousand and six". Write this number in numerals. 1 mark

b. What is the value of the digit 8 in this number? 1 mark

c. A stall at the park markets sells a jar of jam for \$9.06. Write this price in cents. 1 mark

d. The gardening page lists a garden bed that is 9.63 m long. Write 9.63 in expanded form. 1 mark

Question 2 (4 marks)

Ollie is helping at his school's stall.

a. Ollie has 45 stickers to give away. List all the factors of 45. 1 mark

b. His friend says that 49 is a prime number. Is 49 prime or composite? Explain your answer in one sentence. 1 mark

c. The stall has 20 cupcakes and 30 biscuits. The treats are packed into identical boxes so that every box holds the same number of treats, cupcakes and biscuits are never mixed, and the boxes are as full as possible. How many treats go in each box, and how many boxes are used in total? 2 marks

Question 3 (5 marks)

Rosa is working at the market on Saturday.

- a.** The market gate counted 4 672 visitors on Saturday. Round this count to the nearest hundred. 1 mark

- b.** A rope that ties down a stall is 7.96 m long. Round this length to one decimal place. 1 mark

- c.** Four friends share a lunch bill of \$ 47.50 equally. How much does each friend pay? Round your answer to the nearest cent. 2 marks

- d.** The fuel sign down the road shows \$ 1.529 per litre. Round this price to the nearest cent. 1 mark

Question 4 (5 marks)

Nadia's numeracy class is practising number sentences.

- a.** Work out $7 + 3 \times 4$. 1 mark

- b.** Work out $(7 + 3) \times 4$. 1 mark

- c.** Both calculations use the same numbers. Explain in one sentence why the answers are different. 1 mark

- d.** The class books a bus trip. Tickets for the 6 children cost \$ 7 each, and there is a \$ 12 booking fee. Write the total cost as one number sentence, then work it out. 2 marks

Question 5 (5 marks)

The sports club is raising money at its weekend stall.

- a.** The club's poster says "75% of all money raised stays at the club". Write 75 % as a decimal and as a fraction in simplest form. 1 mark

- b.** On Saturday the stall takes in \$ 240. The club keeps 25 % of this for new equipment. How much money does the club keep? 1 mark

- c.** A sports bag marked \$ 90 is sold at 20 % off. Find the discount and the sale price. 2 marks

- d.** A meat pie costs \$ 4.50 at the stall. Its price rises by 10 %. Find the new price. 1 mark

Question 6 (4 marks)

Tess sells herbs and pikelets at the garden stall.

- a.** Eight pots of herbs cost \$ 38 altogether. How much does one pot cost? 1 mark

- b.** At the same rate, how much do 13 pots cost? 1 mark

- c.** Tess's pikelet recipe makes 8 pikelets and uses 160 g of flour. She needs to make 20 pikelets. Find the multiplier, and how much flour she needs. 2 marks

Question 7 (5 marks)

The Harkness Park community garden shares its money.

- a.** The garden splits \$ 350 of stall takings between a seed fund and a tools fund in the ratio 2 : 3 (seed : tools). How much does each fund get? 2 marks

- b.** What fraction of the total is the seed fund's share? 1 mark

- c.** Two volunteers share a \$ 70 job payment in the ratio 1 : 2. Find each share, rounded to the nearest cent. 2 marks

End of Test B

Test B — Answers

Q1. a. 84 006 **b.** 80 000 **c.** 906 cents **d.** $9 + 0.6 + 0.03$

Q2. a. 1, 3, 5, 9, 15, 45 **b.** composite, because $49 = 7 \times 7$ (three factors) **c.** 10 treats per box; 5 boxes in total

Q3. a. 4 700 **b.** 8.0 m **c.** \$ 11.88 **d.** \$ 1.53

Q4. a. 19 **b.** 40 **c.** the brackets make the addition happen first, so the same numbers tell a different story **d.** $6 \times 7 + 12 = 54$, so the total cost is \$ 54

Q5. a. 0.75; $\frac{3}{4}$ **b.** \$ 60 **c.** discount \$ 18; sale price \$ 72 **d.** \$ 4.95

Q6. a. \$ 4.75 **b.** \$ 61.75 **c.** multiplier 2.5; 400 g of flour

Q7. a. seed fund \$ 140; tools fund \$ 210 **b.** $\frac{2}{5}$ **c.** \$ 23.33 and \$ 46.67

Test B — Fully-worked solutions

Question 1.

- a. “Eighty-four thousand and six” means 84 thousands and 6 ones: $84\,000 + 6 = 84\,006$. Zeros hold the empty hundreds and tens places. **Answer:** 84 006
- b. In 84 006, the digit 8 sits in the ten-thousands place, so its value is $8 \times 10\,000 = 80\,000$. **Answer:** 80 000
- c. $\$1 = 100$ cents, so $\$9.06 = 9.06 \times 100 = 906$ cents. **Answer:** 906 cents
- d. Each digit keeps its place value: the 9 is 9 ones, the 6 is 6 tenths and the 3 is 3 hundredths, so $9.63 = 9 + 0.6 + 0.03$. **Answer:** $9 + 0.6 + 0.03$

Question 2.

- a. Factor pairs of 45: 1×45 , 3×15 , 5×9 . **Answer:** 1, 3, 5, 9, 15, 45
- b. $49 = 7 \times 7$, so its factors are 1, 7 and 49 — that is three factors, not two. A prime number has exactly two factors, so 49 is composite. **Answer:** composite, because $49 = 7 \times 7$, so it has more than two factors
- c. The number of treats in each box must be a common factor of 20 and 30, and as large as possible. Factors of 20: 1, 2, 4, 5, 10, 20. Factors of 30: 1, 2, 3, 5, 6, 10, 15, 30. The largest common factor is 10, so each box holds 10 treats. Boxes: $20 \div 10 = 2$ boxes of cupcakes and $30 \div 10 = 3$ boxes of biscuits, so $2 + 3 = 5$ boxes in total. **Answer:** 10 treats per box; 5 boxes

Question 3.

- a. Round to the nearest hundred: keep the hundreds digit (6); the decider is 7, which is 5 or more, so round up: $4\,672 \rightarrow 4\,700$. **Answer:** 4 700
- b. Round to one decimal place: keep the tenths digit (9); the decider is 6, so round the 9 up. 9 tenths plus 1 tenth is 10 tenths, which carries into the ones: $7.96 \rightarrow 8.0$. Keep the zero, because it shows the answer is rounded to one decimal place. **Answer:** 8.0 m
- c. $\$47.50 \div 4 = \$11.875$. Round to the nearest cent, as the question asks: keep two decimal places, and the decider is the third decimal, 5. Halfway always rounds up, so each friend pays \$11.88. **Answer:** \$11.88
- d. Round to the nearest cent: keep two decimal places; the decider is 9, so round up: $\$1.529 \rightarrow \$1.53$. **Answer:** \$1.53

Question 4.

- a. Multiply first: $3 \times 4 = 12$. Then add: $7 + 12 = 19$. **Answer:** 19
- b. Brackets first: $7 + 3 = 10$. Then multiply: $10 \times 4 = 40$. **Answer:** 40
- c. In part a the multiplication comes first, but in part b the brackets make the addition come first. The same numbers tell a different story, so the answers are different. **Answer:** the brackets change which step happens first
- d. Number sentence: $6 \times 7 + 12$. Multiply first: $6 \times 7 = 42$. Then add: $42 + 12 = 54$. **Answer:** $6 \times 7 + 12 = 54$, so the total cost is \$54

Question 5.

- a. To change a percentage to a decimal, divide by 100: $75\% = 75 \div 100 = 0.75$. As a fraction: $\frac{75}{100}$, and dividing the top and bottom by 25 gives $\frac{3}{4}$. **Answer:** 0.75; $\frac{3}{4}$
- b. $25\% = 0.25$, so $0.25 \times 240 = 60$. (Or: 25% is one quarter, and $240 \div 4 = 60$.) **Answer:** \$ 60
- c. Discount: $20\% = 0.20$, so $0.20 \times 90 = \$18$ off. Sale price: $90 - 18 = \$72$. **Answer:** discount \$ 18; sale price \$ 72
- d. Rise: $10\% = 0.10$, so $0.10 \times 4.50 = \$0.45$. New price: $4.50 + 0.45 = \$4.95$. **Answer:** \$ 4.95

Question 6.

- a. Divide the total by the number of pots: $\$38 \div 8 = \$4.75$. **Answer:** \$ 4.75
- b. Multiply the cost of one pot by 13: $\$4.75 \times 13 = \$61.75$. The value of one pot stays the same, so the numbers are in proportion. **Answer:** \$ 61.75
- c. Multiplier: new amount divided by old amount, $20 \div 8 = 2.5$. Flour: $160 \times 2.5 = 400$ g. **Answer:** multiplier 2.5; 400 g of flour

Question 7.

- a. Add the parts: $2 + 3 = 5$ parts. Divide: $\$350 \div 5 = \$70$ for one part. Multiply: seed fund $2 \times 70 = \$140$; tools fund $3 \times 70 = \$210$. Check: $140 + 210 = 350$. **Answer:** seed fund \$ 140; tools fund \$ 210
- b. The seed fund has 2 of the 5 equal parts, so its share is $\frac{2}{5}$ of the total. Check: $\frac{2}{5} \times 350 = 140$. **Answer:** $\frac{2}{5}$
- c. Add the parts: $1 + 2 = 3$ parts. Divide: $\$70 \div 3 = \$23.333\ldots$ for one part. Round each share to the nearest cent, as the question asks: the smaller share is \$ 23.33, and the larger share is $2 \times 23.333\ldots = \$46.666\ldots$, which rounds to \$ 46.67. Check: $23.33 + 46.67 = \$70.00$, which matches the total. **Answer:** \$ 23.33 and \$ 46.67