# Mathematics Level 6

# Chapter 2 — Fractions, decimals and percentages



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## Contents

## Equivalent fractions: comparing and ordering on one number line

> **Content description VC2M6N03:** apply knowledge of equivalence to compare, order and represent common fractions, including halves, thirds and quarters, on the same number line and justify their order

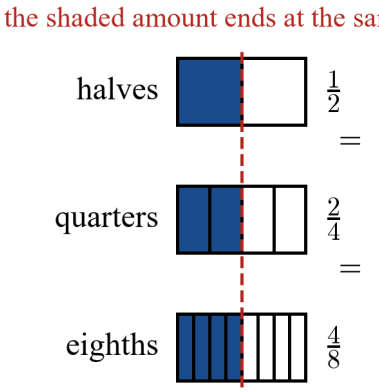
*One half, two quarters, four eighths — three names, one amount. This subtopic is about putting fractions in their right place on a number line, and being able to say why they belong there.*

### Theory

#### *Same amount, different names*

Last year you compared unit fractions such as $\frac{1}{3}$ and $\frac{1}{6}$. This year you work with **equivalent fractions**: different fractions that name the same amount.

Three strips, each the same one whole, are cut different ways:




*Three strips the same size: one cut into halves with one half shaded, one cut into quarters with two quarters shaded, one cut into eighths with four eighths shaded. The shaded amount ends at the same place in all three, so one half equals two quarters equals four eighths.*

The shaded amount ends at exactly the same place every time, so

$$\frac{1}{2}=\frac{2}{4}=\frac{4}{8}.$$

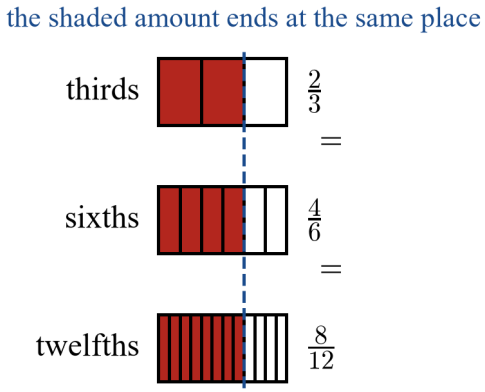
The rule that makes them equal: **multiply the top and the bottom by the same number**, and the fraction keeps its value. From $\frac{1}{2}$: top and bottom × 2 gives $\frac{2}{4}$; × 4 gives $\frac{4}{8}$. Dividing top and bottom by the same number works the other way: $\frac{4}{8}=\frac{2}{4}$.

#### *Denominator families*

From subtopic 1A you know **factors** and **multiples**. They tell you which denominators belong to the same family:

- **Halves family** (multiples of 2): 2, 4, 8, 12, …
- **Thirds family** (multiples of 3): 3, 6, 9, 12, …

Notice that **12 is in both families**. That single fact does a lot of work in this subtopic, because it means halves, thirds and quarters can all be written in twelfths.



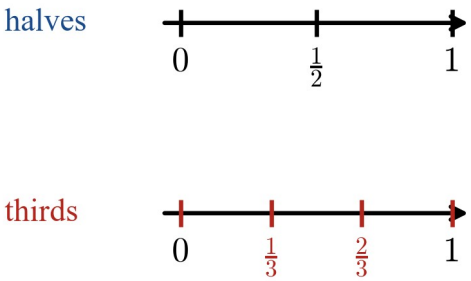

*Three strips the same size: one cut into thirds with two thirds shaded, one cut into sixths with four sixths shaded, one cut into twelfths with eight twelfths shaded. The shaded amount ends at the same place in all three, so two thirds equals four sixths equals eight twelfths.*

The strips show the thirds family at work: $\frac{2}{3}=\frac{4}{6}=\frac{8}{12}$.

### *Fractions are numbers on a line*

A fraction is a **number**, and numbers live on the number line. To place a fraction between 0 and 1, cut that part of the line into equal parts:

- the **bottom number (the denominator)** says how many equal parts the whole is cut into;
- the **top number** says how many of those parts you count from 0.




*Two number lines from 0 to 1. The top line is marked in halves at one half; the bottom line is marked in thirds at one third and two thirds.*

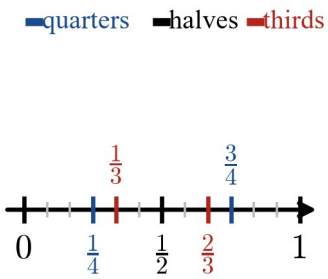
The top line is cut into halves; the bottom line into thirds. Each fraction sits at its own exact point.

### *Halves, thirds and quarters on one line*

Now the big one: halves, thirds and quarters on the **same** number line. For the marks to be exact, every family must be counted in parts of the same size — and the parts that fit all three families are **twelfths**. So write each fraction in twelfths:

| Fraction | In twelfths |
|---|---|
| $\frac{1}{4}$ | $\frac{3}{12}$ |
| $\frac{1}{3}$ | $\frac{4}{12}$ |

| Fraction | In twelfths |
|---|---|
| $\frac{1}{2}$ | $\frac{6}{12}$ |
| $\frac{2}{3}$ | $\frac{8}{12}$ |
| $\frac{3}{4}$ | $\frac{9}{12}$ |



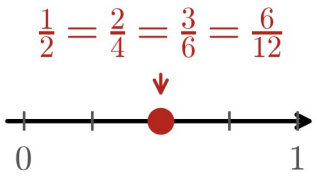

*One number line from 0 to 1 with faint marks at the twelfths. Quarters are marked in blue at one quarter and three quarters, thirds in red at one third and two thirds, and the half in black at one half. Reading across from left to right: one quarter, one third, one half, two thirds, three quarters.*

The faint marks are twelfths. Reading from left to right, the order is

$$\frac{1}{4} < \frac{1}{3} < \frac{1}{2} < \frac{2}{3} < \frac{3}{4},$$

and the **reason** for that order is exactly the table: 3, 4, 6, 8 and 9 twelfths, and $3 < 4 < 6 < 8 < 9$. That is what "justify the order" means in practice — name the fractions in the same parts, then read the top numbers.

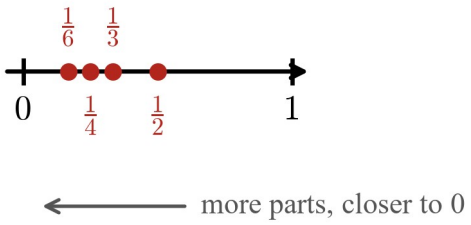
One more idea the line makes clear: **equivalent fractions sit on the same point**.




*A number line from 0 to 1 with one large dot at the halfway point, named one half, two quarters, three sixths and six twelfths.*

If two fractions land on the same point of the line, they are equivalent. The number line is the judge, and it never argues back.

### *Unit fractions: more parts, closer to 0*




*A number line from 0 to 1 with dots at one half, one third, one quarter and one part in six. An arrow along the bottom points towards 0, labelled more parts, closer to 0.*

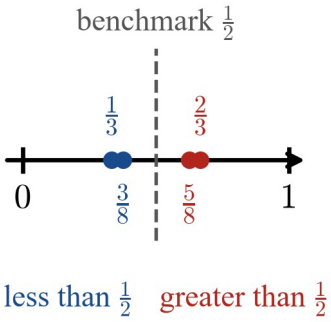
When the top number is 1, the more parts the whole is cut into, the **smaller** each part is:

$$\frac{1}{6}<\frac{1}{4}<\frac{1}{3}<\frac{1}{2}.$$

So $\frac{1}{6}<\frac{1}{4}$, even though 6 is more than 4 — cutting one whole into 6 makes smaller parts than cutting it into 4.

### *A benchmark to measure against*

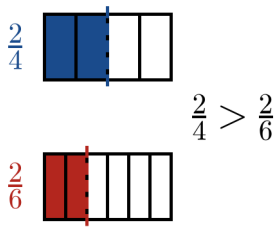
A **benchmark** is a fraction you know so well that you can measure other fractions against it — usually 0, $\frac{1}{2}$ or 1.




*A number line from 0 to 1 with a dashed line at the benchmark one half. One third and three eighths sit to the left of it, less than one half; five eighths and two thirds sit to the right of it, greater than one half.*

Is $\frac{5}{8}$ more or less than $\frac{1}{2}$? Half of 8 is 4, so $\frac{1}{2}=\frac{4}{8}$ — and 5 eighths is more than 4 eighths, so $\frac{5}{8}>\frac{1}{2}$. In the same way $\frac{3}{8}<\frac{1}{2}$, because 3 eighths is less than 4 eighths. A quick check against a benchmark often orders fractions without writing any equivalence at all.

### *Same top number? Compare the size of the parts*




fourths are more than sixths, so 2 fourths is more than 2 sixths

*Two strips the same size: one cut into fourths with two parts shaded, one cut into sixths with two parts shaded. The fourths strip's shading reaches further along, so two fourths is more than two sixths.*

$\frac{2}{4}$ and $\frac{2}{6}$ have the same top number. But fourths are more than sixths, so 2 fourths is more than 2 sixths: $\frac{2}{4} > \frac{2}{6}$. A common slip is to say the opposite because "6 is more than 4" — it is the size of the parts that decides, not the numbers alone.

### *Compare, order, justify: the method*

To compare or order any common fractions:

1. **Same bottom number?** Compare the top numbers: $\frac{5}{8} > \frac{3}{8}$.
2. **Same top number?** The fraction with the smaller bottom number is more: $\frac{2}{4} > \frac{2}{6}$.
3. **Anything else?** Rewrite both in the same parts — find a denominator the families share, like 12.
4. **Or** measure against a benchmark: more or less than $\frac{1}{2}$? More or less than 1?
5. **Check on a number line.** The fraction that is more sits further right. Always.

And because the content description says *justify their order*, every comparison in this subtopic carries a "because". A correct order with no reason is only half the job.

**Words for this subtopic**, with what they mean here:

| Term | Meaning here |
|---|---|
| **equivalent fractions** | different fractions that name the same amount, like $\frac{1}{2}$ and $\frac{4}{8}$ |
| **common fractions** | the fractions you meet every day — halves, thirds, quarters and their friends |
| **denominator** | the bottom number: how many equal parts the whole is cut into |
| **benchmark** | a fraction you know well (0, $\frac{1}{2}$, 1) used to judge other fractions |
| **justify** | give a reason someone else could check |

In subtopic 2B you will use this same equivalence to add and subtract fractions with related denominators.

## Worked examples

### *Example 1 — with help*

Which is more, $\frac{2}{3}$ or $\frac{3}{4}$?

| Working | Comment |
|---|---|
| The bottom numbers 3 and 4 do not match. 12 is a multiple of 3 and of 4. | Find parts both families share. |
| $\frac{2}{3}=\frac{8}{12}$ (top and bottom × 4). | Same amount, new name. |
| $\frac{3}{4}=\frac{9}{12}$ (top and bottom × 3). | Same amount, new name. |
| 9 twelfths is more than 8 twelfths, so $\frac{3}{4}>\frac{2}{3}$. | Same parts, so compare the top numbers. |

Check on the number line: the one-line figure above shows $\frac{3}{4}$ sitting to the right of $\frac{2}{3}$. ✓

### *Example 2 — with help*

Order $\frac{1}{2}, \frac{2}{3}, \frac{1}{4}$ and $\frac{3}{4}$ from smallest to biggest, mark them on one number line from 0 to 1, and justify the order.

| Working | Comment |
|---|---|
| In twelfths: $\frac{6}{12}, \frac{8}{12}, \frac{3}{12}, \frac{9}{12}$. | 12 is a multiple of 2, 3 and 4. |
| Top numbers in order: 3, 6, 8, 9. | Same parts, so the top numbers give the order. |
| So $\frac{1}{4}<\frac{1}{2}<\frac{2}{3}<\frac{3}{4}$. | The reason is the line of top numbers. |
| Marked on the line: exactly as in the halves–thirds–quarters figure. | The number line is the check. |

### *Example 3 — on your own*

Priya says $\frac{5}{8}$ is more than $\frac{1}{2}$ and $\frac{3}{8}$ is less than $\frac{1}{2}$. Explain why she is right, then order the three fractions.

Half of 8 is 4, so $\frac{1}{2}=\frac{4}{8}$. Then $\frac{5}{8}$ counts 5 parts against 4, so it is more than $\frac{1}{2}$; $\frac{3}{8}$ counts 3 parts against 4, so it is less.

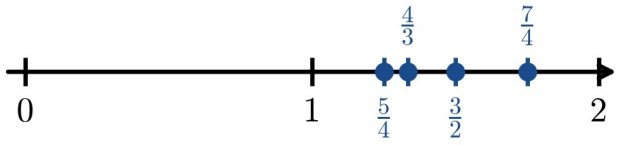
The order is $\frac{3}{8}<\frac{1}{2}<\frac{5}{8}$ — the benchmark figure shows exactly that.

### *Example 4 — on your own*

Order $\frac{5}{4}, \frac{4}{3}, \frac{3}{2}$ and $\frac{7}{4}$ from smallest to biggest, and place them on a number line from 0 to 2.

In twelfths: $\frac{15}{12}, \frac{16}{12}, \frac{18}{12}, \frac{21}{12}$. The top numbers give $15<16<18<21$, so

$$\frac{5}{4}<\frac{4}{3}<\frac{3}{2}<\frac{7}{4}.$$




*A number line from 0 to 2 with dots at five quarters, four thirds, three halves and seven quarters, in that order from left to right.*

All four points sit to the right of 1, which is a good check: each of these fractions is more than one whole.

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## Practice questions

### *With help*

**Q1.** Fill in the missing numbers to make equivalent fractions. (a) $\frac{1}{2} = \frac{?}{4} = \frac{?}{8}$ (b) $\frac{2}{3} = \frac{?}{6} = \frac{?}{12}$ (c) $\frac{3}{4} = \frac{?}{8} = \frac{?}{12}$ (d) $\frac{4}{8} = \frac{?}{4} = \frac{?}{2}$

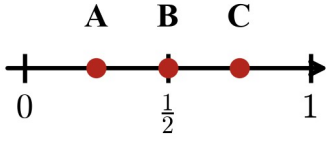
**Q2.** Look at the halves–quarters–eighths strip figure. (a) How many quarters make $\frac{1}{2}$? (b) How many eighths make $\frac{1}{2}$? (c) Write $\frac{1}{2}$ as a fraction in eighths.

**Q3.** Here are seven denominators: 2, 3, 4, 6, 8, 9, 12. (a) Which belong to the halves family? (b) Which belong to the thirds family? (c) Which one belongs to both — so halves and thirds can both be written in those parts?

**Q4.** Fill in each ◯ with < or >. Then give the reason in one sentence. (a) $\frac{1}{3} \bigcirc \frac{1}{6}$ (b) $\frac{1}{4} \bigcirc \frac{1}{2}$ (c) $\frac{1}{8} \bigcirc \frac{1}{5}$ (d) $\frac{1}{6} \bigcirc \frac{1}{4}$

**Q5.** Fill in each ◯ with <, > or =. (a) $\frac{3}{8} \bigcirc \frac{5}{8}$ (b) $\frac{2}{3} \bigcirc \frac{1}{3}$ (c) $\frac{5}{12} \bigcirc \frac{7}{12}$ (d) $\frac{4}{6} \bigcirc \frac{2}{3}$

**Q6.** The number line below is marked only at 0, $\frac{1}{2}$ and 1, with three points A, B and C on it. Match each point to one of the fractions $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and say how you know.




*A number line from 0 to 1 marked at 0, one half and 1, with three points labelled A, B and C. Point A is halfway between 0 and one half, point B is at one half, point C is halfway between one half and 1.*

### *On your own*

**Q7.** Write both fractions in twelfths, then fill in the ◯ with <, > or =. (a) $\frac{1}{2}$ ◯ $\frac{5}{12}$ (b) $\frac{2}{3}$ ◯ $\frac{3}{4}$ (c) $\frac{1}{4}$ ◯ $\frac{2}{12}$ (d) $\frac{5}{6}$ ◯ $\frac{11}{12}$

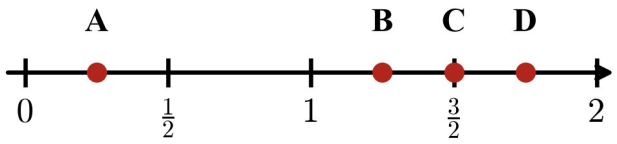
**Q8.** Order $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$ and $\frac{1}{6}$ from smallest to biggest, and give your reason in one sentence.

**Q9.** Sort these fractions into three groups: less than $\frac{1}{2}$, equal to $\frac{1}{2}$, and greater than $\frac{1}{2}$. $\frac{1}{4}$, $\frac{3}{8}$, $\frac{4}{8}$, $\frac{5}{8}$, $\frac{2}{3}$

**Q10.** Tom says $\frac{2}{6} > \frac{2}{4}$ "because 6 is more than 4". Explain Tom's mistake, then write the true comparison with a reason.

**Q11.** Order $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$ and $\frac{3}{4}$ from smallest to biggest. Justify your order.

**Q12.** The number line below runs from 0 to 2 and is marked in halves. Name each point A, B, C and D as a fraction, then order the four fractions from smallest to biggest.




*A number line from 0 to 2 marked in halves at one half, 1 and three halves, with four points labelled A, B, C and D between the marks.*

**Q13.** For a class banner, Lena cuts a red ribbon $\frac{5}{8}$ m long and a blue ribbon $\frac{1}{2}$ m long. Which ribbon is longer? Explain how you know without measuring.

**Q14.** Write down a fraction that sits between $\frac{1}{2}$ and $\frac{3}{4}$ on the number line, and justify that it really is between them.

## Answers

**Q1.** (a) 2, 4; (b) 4, 8; (c) 6, 9; (d) 2, 1. **Q2.** (a) 2; (b) 4; (c) $\frac{4}{8}$. **Q3.** (a) 2, 4, 8, 12; (b) 3, 6, 9, 12; (c) 12. **Q4.** (a) >; (b) <; (c) <; (d) < — more parts means smaller parts. **Q5.** (a) <; (b) >; (c) <; (d) =. **Q6.** A = $\frac{1}{4}$, B = $\frac{1}{2}$, C = $\frac{3}{4}$. **Q7.** (a) >; (b) <; (c) >; (d) <. **Q8.** $\frac{1}{6} < \frac{1}{4} < \frac{1}{3} < \frac{1}{2}$. **Q9.** less: $\frac{1}{4}$, $\frac{3}{8}$; equal: $\frac{4}{8}$; greater: $\frac{5}{8}$, $\frac{2}{3}$. **Q10.** mistake — same top number: smaller parts lose; $\frac{2}{6} < \frac{2}{4}$. **Q11.** $\frac{3}{8} < \frac{1}{2} < \frac{5}{8} < \frac{3}{4}$. **Q12.** A = $\frac{1}{4}$, B = $\frac{5}{4}$, C = $\frac{3}{2}$, D = $\frac{7}{4}$; order A < B < C < D. **Q13.** the red ribbon. **Q14.** for example $\frac{5}{8}$ (other answers possible).

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## Worked solutions

**Q1.** (a) Top and bottom × 2, then × 4: $\frac{1}{2} = \frac{2}{4} = \frac{4}{8}$. (b) × 3, then × 6: $\frac{2}{3} = \frac{4}{6} = \frac{8}{12}$. (c) × 2, then × 3: $\frac{3}{4} = \frac{6}{8} = \frac{9}{12}$. (d) Divide top and bottom by 2, then by 4: $\frac{4}{8} = \frac{2}{4} = \frac{1}{2}$.

**Q2.** (a) 2 quarters — the shaded part of the quarters strip is 2 parts. (b) 4 eighths. (c) $\frac{1}{2} = \frac{4}{8}$, because all three strips' shading ends at the same place.

**Q3.** (a) Multiples of 2: 2, 4, 8, 12. (b) Multiples of 3: 3, 6, 9, 12. (c) 12 — a common multiple of 2 and 3, so halves, thirds and quarters can all be written in twelfths.

**Q4.** (a) $\frac{1}{3} > \frac{1}{6}$; (b) $\frac{1}{4} < \frac{1}{2}$; (c) $\frac{1}{8} < \frac{1}{5}$; (d) $\frac{1}{6} < \frac{1}{4}$. Reason: with top number 1, more parts means smaller parts, so the fraction is closer to 0.

**Q5.** (a) $\frac{3}{8} < \frac{5}{8}$ — same parts, 3 of them is less than 5. (b) $\frac{2}{3} > \frac{1}{3}$. (c) $\frac{5}{12} < \frac{7}{12}$. (d) $\frac{4}{6} = \frac{2}{3}$ — divide top and bottom of $\frac{4}{6}$ by 2; equivalent fractions sit on the same point.

**Q6.** A = $\frac{1}{4}$: it sits halfway between 0 and $\frac{1}{2}$, and half of a half is a quarter. B = $\frac{1}{2}$: it sits on the marked half. C = $\frac{3}{4}$: it sits halfway between $\frac{1}{2}$ and 1, a quarter past the half.

**Q7.** (a) $\frac{1}{2} = \frac{6}{12} > \frac{5}{12}$. (b) $\frac{2}{3} = \frac{8}{12} < \frac{9}{12} = \frac{3}{4}$. (c) $\frac{1}{4} = \frac{3}{12} > \frac{2}{12}$. (d) $\frac{5}{6} = \frac{10}{12} < \frac{11}{12}$.

**Q8.** $\frac{1}{6} < \frac{1}{4} < \frac{1}{3} < \frac{1}{2}$, because the more parts the whole is cut into, the smaller each part is, so the closer the point is to 0 — exactly what the unit-fraction figure shows.

**Q9.** Half of 8 is 4, so $\frac{1}{2} = \frac{4}{8}$, and half of 3 is $1\frac{1}{2}$, so $\frac{2}{3}$ (2 parts out of 3) is more than half. Less than $\frac{1}{2}$: $\frac{1}{4}$, $\frac{3}{8}$. Equal: $\frac{4}{8}$. Greater: $\frac{5}{8}$, $\frac{2}{3}$.

**Q10.** Tom read the bottom numbers as if more parts means more of the whole. With the same top number it is the other way round: sixths are smaller parts than fourths, so 2 sixths is less than 2 fourths. True comparison: $\frac{2}{6} < \frac{2}{4}$ — the strip figure shows the fourths' shading reaching further.

**Q11.** In eighths: $\frac{3}{8}$, $\frac{4}{8}$, $\frac{5}{8}$, $\frac{6}{8}$. So $\frac{3}{8} < \frac{1}{2} < \frac{5}{8} < \frac{3}{4}$ — the reason is the top numbers $3 < 4 < 5 < 6$ once every fraction is counted in eighths.

**Q12.** A sits halfway between 0 and $\frac{1}{2}$: $\frac{1}{4}$. B sits halfway between 1 and $\frac{3}{2}$: $1\frac{1}{4} = \frac{5}{4}$. C sits on $\frac{3}{2}$. D sits halfway between $\frac{3}{2}$ and 2: $1\frac{3}{4} = \frac{7}{4}$. Order: $\frac{1}{4} < \frac{5}{4} < \frac{3}{2} < \frac{7}{4}$, which is simply left to right on the line.

**Q13.** The red ribbon. $\frac{1}{2} = \frac{4}{8}$, and $\frac{5}{8}$ counts 5 parts against 4, so $\frac{5}{8} > \frac{1}{2}$ — the benchmark tells you which is longer, with no measuring and no further working.

**Q14.** One good answer is $\frac{5}{8}$: $\frac{1}{2} = \frac{4}{8}$ and $\frac{3}{4} = \frac{6}{8}$, and 5 eighths sits between 4 eighths and 6 eighths. (So do $\frac{7}{12}$ and $\frac{8}{12} = \frac{2}{3}$, since $\frac{1}{2} = \frac{6}{12}$ and $\frac{3}{4} = \frac{9}{12}$. Any fraction you can justify earns the mark.)

## Adding and subtracting fractions using equivalence

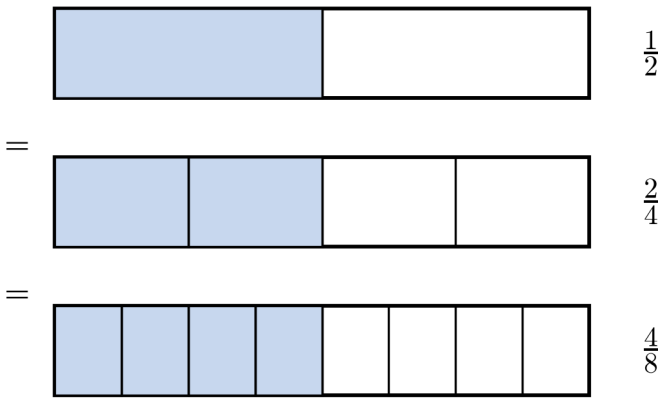
**Content description VC2M6N05:** solve problems involving addition and subtraction of fractions using knowledge of equivalent fractions

*Half a pizza plus a quarter of a pizza — how much is that? You cannot just add the top numbers, because halves and quarters are different-sized pieces. The fix is one of the most useful ideas in maths: rename the pieces until they match. That is what equivalent fractions are for, and by the end of this subtopic you will add and subtract fractions with any denominators at all.*

### Theory

**The same-sized parts rule.** You can add or subtract fractions directly only when the parts are the **same size** — that is, only when the denominators are the same. $\frac{2}{8}+\frac{3}{8}$ makes sense straight away: eighths and eighths are the same-sized parts, so you are counting 2 parts plus 3 parts. But $\frac{1}{2}+\frac{1}{3}$ cannot be done as it stands. A common mistake is to add the tops and add the bottoms and get $\frac{2}{5}$ — and that cannot be right, because $\frac{2}{5}$ is *smaller* than $\frac{1}{2}$ alone. Adding something to $\frac{1}{2}$ must give more than $\frac{1}{2}$. The mistake is adding parts of different sizes.

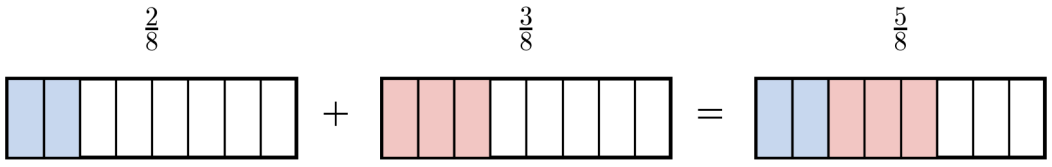
**Equivalent fractions rename the parts.** From subtopic 2A you know that one amount can have many names. Multiply the top and the bottom of a fraction by the same number, and you rename the fraction without changing its size: $\frac{1}{2}=\frac{2}{4}=\frac{4}{8}$. Divide the top and the bottom by the same number and you rename it the other way: $\frac{4}{8}=\frac{1}{2}$. That is the whole trick of this subtopic: when the parts do not match, rename one or both fractions until they do.




*the same amount shaded each time*

*Three bars of the same length. The first is split into 2 equal parts with 1 shaded, the second into 4 equal parts with 2 shaded, and the third into 8 equal parts with 4 shaded. All three show the same amount, labelled one half, two quarters and four eighths.*

**Same denominators: add or subtract the tops.** When the denominators already match, add or subtract the top numbers and keep the denominator — it names the size of the part, and the size has not changed.

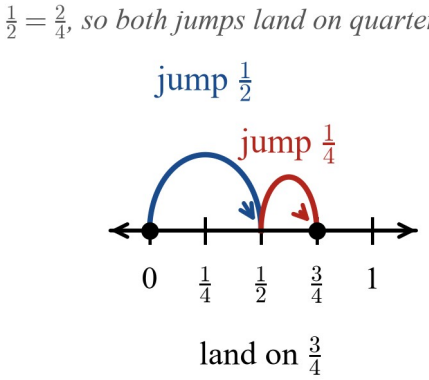



*the parts are the same size, so the top numbers can be added*

*A bar of 8 equal parts with 2 shaded, added to a bar of 8 equal parts with 3 shaded, giving a bar of 8 equal parts with 5 shaded: two eighths plus three eighths equals five eighths.*

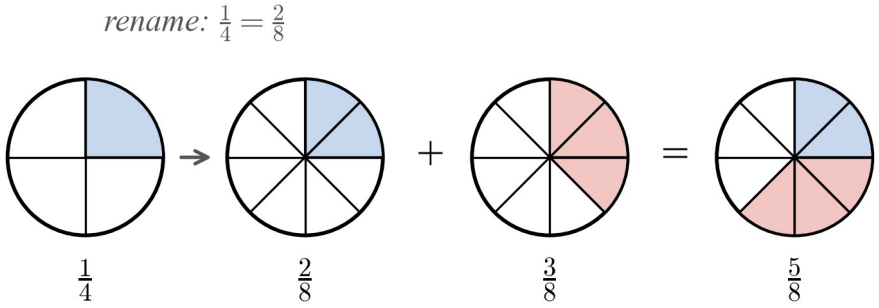
$$\frac{2}{8}+\frac{3}{8}=\frac{5}{8}$$

**Related denominators: rename just one fraction.** Often one denominator is a multiple of the other — like 4 and 8, or 3 and 6, or 5 and 10. Then only one fraction needs renaming. To find $\frac{1}{2}+\frac{1}{4}$, rename $\frac{1}{2}$ as $\frac{2}{4}$ and jump along a number line marked in quarters:




*A number line from 0 to 1 marked in quarters. A blue jump of one half goes from 0 to one half, then a red jump of one quarter goes from one half to three quarters. A note says one half equals two quarters, so both jumps land on quarter marks.*

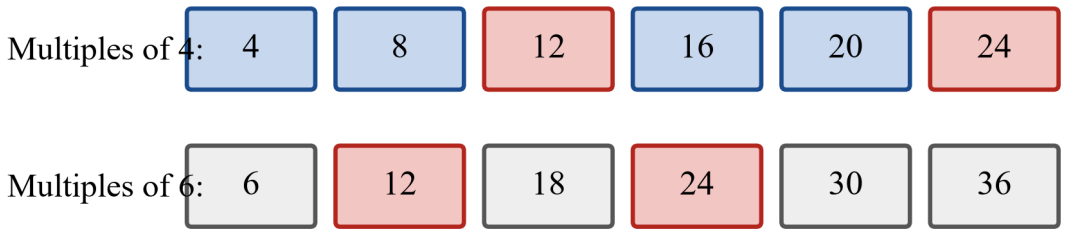
The same renaming works with parts of shapes. To find $\frac{1}{4}+\frac{3}{8}$, rename the quarter as eighths: $\frac{1}{4}=\frac{2}{8}$, so the answer is $\frac{2}{8}+\frac{3}{8}=\frac{5}{8}$.




*Four circles. The first has one quarter shaded and is labelled one quarter. An arrow renames it as the second circle, which has two eighths shaded. Added to a third circle with three eighths shaded, the result is a fourth circle with five eighths shaded.*

**Unrelated denominators: find the lowest common denominator.** When one denominator is not a multiple of the other — like 3 and 4, or 4 and 6 — both fractions need renaming, and you need a denominator the two can share. The

best choice is the **lowest common denominator**: the smallest number that is a multiple of both denominators. Listing a few multiples of each usually finds it fast. For 4 and 6:

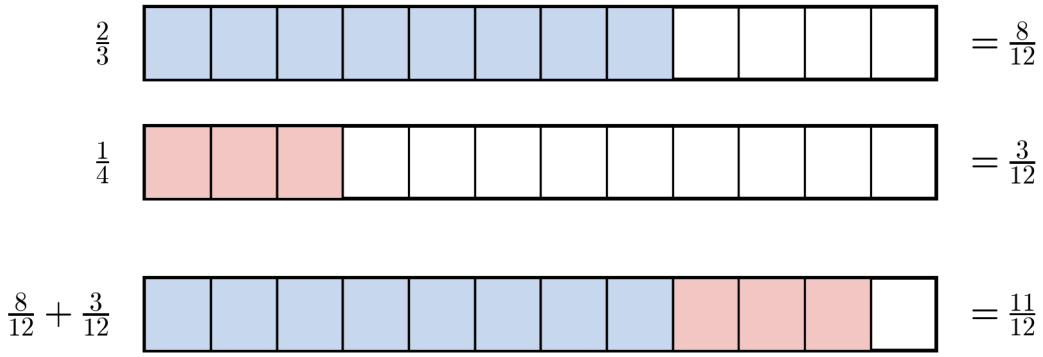



*12 and 24 are in both lists — 12 is the lowest*

*Two rows of number cards. The first row shows the multiples of 4: 4, 8, 12, 16, 20, 24. The second row shows the multiples of 6: 6, 12, 18, 24, 30, 36. The cards 12 and 24 are highlighted in both rows, and a note says 12 is the lowest.*

Your work on prime and composite numbers in 1A backs this up: $4 = 2 \times 2$ and $6 = 2 \times 3$, so a number that is a multiple of both must have two 2s and a 3 among its factors — and $2 \times 2 \times 3 = 12$.

Once you have the common denominator, rename **both** fractions and then add or subtract the tops:




*both fractions renamed with denominator 12*

*Three bars of 12 equal parts. The first has 8 parts shaded, labelled two thirds equals eight twelfths. The second has 3 parts shaded, labelled one quarter equals three twelfths. The third has 11 parts shaded, labelled eight twelfths plus three twelfths equals eleven twelfths.*

**The method, in four steps.**

1. **Rename** the fractions so both denominators match (the lowest common denominator is the friendliest choice).
2. **Add or subtract** the top numbers.
3. **Keep** the denominator — the part size has not changed.
4. **Check the answer's form**: write it in simplest form, and if the top number is more than the bottom number, rewrite it as a mixed numeral.

**Mixed numerals.** With mixed numerals, deal with the whole-number parts and the fraction parts separately — rename the fraction parts first. For $1\frac{2}{3} + 1\frac{1}{4}$: rename the fractions as twelfths, $1\frac{8}{12} + 1\frac{3}{12}$, then whole numbers together and fractions together: $2\frac{11}{12}$. If a fraction part ends up worth more than one whole, trade it in: $1\frac{7}{6}$ is $2\frac{1}{6}$.

**Does the answer make sense?** When you add a positive fraction, the amount goes up; when you subtract, it goes down. Hold your answer up against the numbers you know best: $0$, $\frac{1}{2}$ and $1$. For example, $\frac{2}{3}+\frac{3}{4}$ must be more than $1$, because each fraction on its own is more than $\frac{1}{2}$. If your working ever says $\frac{1}{2}+\frac{1}{3}=\frac{2}{5}$, the size check catches it at once: the "answer" is smaller than where you started.

**Words of this subtopic**, with what they mean here:

| Word | What it means here |
|---|---|
| **numerator** | the top number — it counts how many parts you have |
| **denominator** | the bottom number — it names the size of the parts |
| **equivalent fractions** | different names for the same amount, like $\frac{1}{2}$ and $\frac{4}{8}$ |
| **lowest common denominator** | the smallest number that is a multiple of both denominators |
| **mixed numeral** | a whole number and a fraction together, like $2\frac{11}{12}$ |
| **simplest form** | a fraction renamed so the top and bottom share no common factor except 1, like $\frac{1}{2}$ instead of $\frac{4}{8}$ |

In 2C the same add-and-check habits move across to decimals. And next year, the renaming you have learned here is exactly what multiplying and dividing fractions builds on (VC2M7N05, VC2M7N06).

---

## Worked examples

### *Example 1 — with help*

Find $\frac{3}{8}+\frac{1}{4}$.

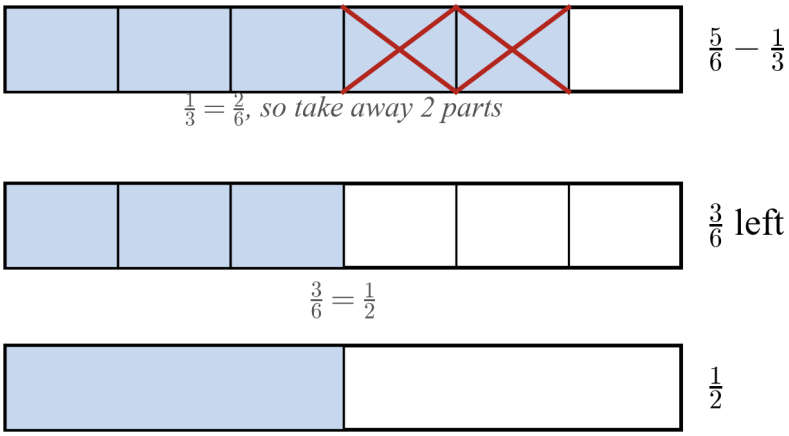
| Working | Comment |
|---|---|
| Rename $\frac{1}{4}$ with denominator 8: $\frac{1}{4}=\frac{2}{8}$. | 8 is a multiple of 4, so only one fraction needs renaming. |
| $\frac{3}{8}+\frac{2}{8}=\frac{5}{8}$ | The parts now match, so add the top numbers. |
| $\therefore \frac{3}{8}+\frac{1}{4}=\frac{5}{8}$, which is already in simplest form. | |

### *Example 2 — with help*

Find $\frac{5}{6}-\frac{1}{3}$.

| Working | Comment |
|---|---|
| Rename $\frac{1}{3}$ as sixths: $\frac{1}{3}=\frac{2}{6}$. | 6 is a multiple of 3. |
| $\frac{5}{6}-\frac{2}{6}=\frac{3}{6}$ | Subtract the top numbers; keep the denominator. |

| Working | Comment |
|---|---|
| $\frac{3}{6}=\frac{1}{2}$ | Divide top and bottom by 3 for simplest form. |




*A bar of 6 equal parts with 5 shaded, of which 2 are crossed out to show one third (two sixths) being taken away; below, a bar with 3 of 6 parts shaded; below that, a bar of 2 parts with 1 shaded, showing three sixths equals one half.*

$\therefore \frac{5}{6}-\frac{1}{3}=\frac{1}{2}.$

### *Example 3 — with help*

Find $\frac{2}{3}+\frac{1}{4}$.

| Working | Comment |
|---|---|
| Multiples of 3: 3, 6, 9, **12**, … Multiples of 4: 4, 8, **12**, … The lowest common denominator is 12. | One denominator is not a multiple of the other, so rename both fractions. |
| $\frac{2}{3}=\frac{8}{12}$ and $\frac{1}{4}=\frac{3}{12}$ | Multiply top and bottom of $\frac{2}{3}$ by 4, and of $\frac{1}{4}$ by 3. |
| $\frac{8}{12}+\frac{3}{12}=\frac{11}{12}$ | Add the top numbers; keep the denominator. |

$\therefore \frac{2}{3}+\frac{1}{4}=\frac{11}{12}$, already in simplest form.

### *Example 4 — on your own*

Find $\frac{3}{4}-\frac{2}{5}$.

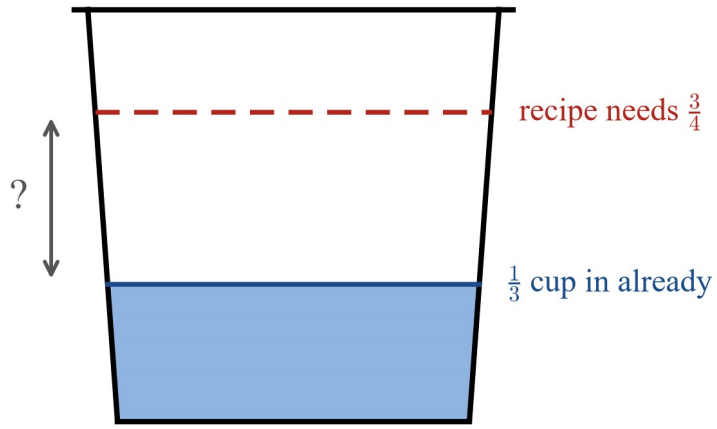
The lowest common denominator of 4 and 5 is 20, so $\frac{3}{4}=\frac{15}{20}$ and $\frac{2}{5}=\frac{8}{20}$:

$$\frac{15}{20}-\frac{8}{20}=\frac{7}{20}$$

$\therefore \frac{3}{4}-\frac{2}{5}=\frac{7}{20}.$

### *Example 5 — on your own*

A scone recipe needs $\frac{3}{4}$ of a cup of milk. Mia has already poured in $\frac{1}{3}$ of a cup. How much more milk does she need?




*How much more milk is needed?*

*A measuring cup. Milk fills it to the one third line, and a dashed line higher up shows the three quarters the recipe needs. A double arrow marks the gap between the two lines with a question mark.*

The gap between what is in and what is needed is $\frac{3}{4}-\frac{1}{3}$. The lowest common denominator of 4 and 3 is 12: $\frac{3}{4}=\frac{9}{12}$ and $\frac{1}{3}=\frac{4}{12}$, so

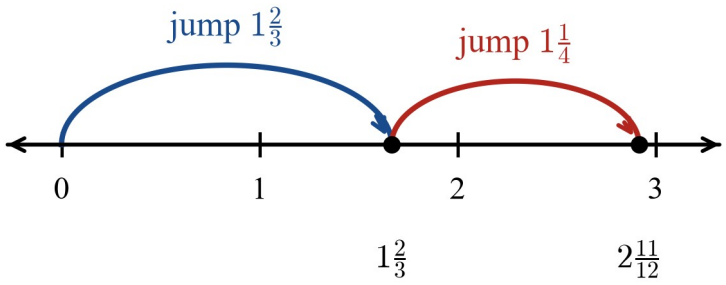
$$\frac{9}{12}-\frac{4}{12}=\frac{5}{12}$$

$\therefore$ Mia needs $\frac{5}{12}$ **of a cup** more milk.

### *Example 6 — on your own*

On Saturday a family walks $1\frac{2}{3}$ km along a rail trail, and on Sunday they walk $1\frac{1}{4}$ km more. How far do they walk altogether?

Rename the fraction parts as twelfths: $1\frac{2}{3}=1\frac{8}{12}$ and $1\frac{1}{4}=1\frac{3}{12}$.




*A number line from 0 to 3 with whole-number marks. A blue jump of one and two thirds goes from 0 to one and two thirds, then a red jump of one and a quarter goes to two and eleven twelfths.*

Whole numbers: $1+1=2$. Fractions: $\frac{8}{12}+\frac{3}{12}=\frac{11}{12}$.

$\therefore$ The family walks $2\frac{11}{12}$ **km** altogether.

---

## Practice questions

*Do every question in this subtopic without a calculator — renaming the parts and adding them by hand is the skill you are building.*

### *With help*

**Q1.** Rename each pair of fractions so they have the same denominator.

a. $\frac{1}{2}$ and $\frac{1}{6}$

b. $\frac{1}{4}$ and $\frac{3}{8}$

c. $\frac{2}{3}$ and $\frac{1}{4}$

d. $\frac{3}{5}$ and $\frac{1}{2}$

e. $\frac{5}{6}$ and $\frac{2}{3}$

f. $\frac{1}{3}$ and $\frac{2}{5}$

**Q2.** Add or subtract. Give answers in simplest form where needed.

a. $\frac{2}{7}+\frac{3}{7}$

b. $\frac{5}{9}+\frac{2}{9}$

c. $\frac{7}{10}-\frac{3}{10}$

d. $\frac{4}{5}-\frac{1}{5}$

e. $\frac{3}{8}+\frac{5}{8}$

f. $\frac{9}{12}-\frac{3}{12}$

**Q3.** Related denominators: rename one fraction, then add.

a. $\frac{1}{4}+\frac{3}{8}$

b. $\frac{2}{5}+\frac{3}{10}$

c. $\frac{1}{3}+\frac{5}{6}$

d. $\frac{1}{2}+\frac{3}{10}$

**Q4.** Related denominators: rename one fraction, then subtract.

a. $\frac{7}{8}-\frac{1}{2}$

b. $\frac{9}{10}-\frac{2}{5}$

c. $\frac{5}{6}-\frac{1}{2}$

d. $\frac{11}{12}-\frac{1}{4}$

**Q5.** The picture shows two fractions added together.

*A bar of 5 equal parts with 2 shaded, then a plus sign, then a bar of 2 equal parts with 1 shaded, then an equals sign and a question mark.*

a. What fraction does each bar show?
b. Write the addition with a common denominator, and find the answer.

**Q6.** Find the lowest common denominator for each pair.

a. 4 and 6
b. 3 and 5
c. 5 and 10
d. 6 and 8
e. 2 and 7
f. 4 and 10

**Q7.** Work out $\frac{1}{2}+\frac{3}{10}$ by drawing the two jumps on a number line you have marked in tenths. Where do you land?

**Q8.** Add or subtract, then write the answer in simplest form.

a. $\frac{3}{8}+\frac{1}{8}$

b. $\frac{1}{6}+\frac{3}{6}$

c. $\frac{5}{12}+\frac{1}{12}$

d. $\frac{7}{10}-\frac{1}{10}$

### *On your own*

**Q9.** Unrelated denominators: find the lowest common denominator, rename, then add or subtract.

a. $\frac{1}{2}+\frac{1}{3}$

b. $\frac{2}{3}+\frac{1}{5}$

c. $\frac{3}{4}+\frac{1}{6}$

d. $\frac{4}{5}-\frac{1}{3}$

e. $\frac{5}{6}-\frac{1}{4}$

f. $\frac{7}{8}-\frac{2}{3}$

**Q10.** Mixed numerals.

a. $1\frac{1}{2}+2\frac{1}{3}$

b. $2\frac{1}{4}+1\frac{1}{3}$

c. $2\frac{5}{6}-1\frac{1}{3}$

d. $3\frac{1}{2}-1\frac{3}{4}$

**Q11.** A muffin recipe uses $\frac{2}{3}$ of a cup of flour and $\frac{1}{2}$ of a cup of sugar. How many cups of dry ingredients is that altogether?

**Q12.** A bottle holds $\frac{5}{6}$ L of juice. Tom pours $\frac{1}{3}$ L into a glass. How much juice is left in the bottle?

**Q13.** Priya is painting a mural. In the morning she paints $\frac{3}{8}$ of it, and in the afternoon she paints $\frac{1}{3}$ of it.

a. What fraction of the mural has she painted altogether?
b. What fraction is still unpainted?

**Q14.** A hiking track has two legs. The first leg is $1\frac{1}{2}$ km and the second leg is $\frac{2}{3}$ km. How long is the track altogether?

**Q15.** Dana says $\frac{1}{2}+\frac{1}{3}=\frac{2}{5}$. Explain her mistake, and find the correct answer.

**Q16.** Without working it out exactly, say whether each answer is more than 1, less than 1, or equal to 1. Then check by working it out.

a. $\frac{2}{3}+\frac{3}{4}$

b. $\frac{5}{6}-\frac{1}{3}$

c. $\frac{3}{8}+\frac{5}{8}$

## Answers

**Q1.** a. $\frac{3}{6}$ and $\frac{1}{6}$; b. $\frac{2}{8}$ and $\frac{3}{8}$; c. $\frac{8}{12}$ and $\frac{3}{12}$; d. $\frac{6}{10}$ and $\frac{5}{10}$; e. $\frac{5}{6}$ and $\frac{4}{6}$; f. $\frac{5}{15}$ and $\frac{6}{15}$.

**Q2.** a. $\frac{5}{7}$; b. $\frac{7}{9}$; c. $\frac{2}{5}$; d. $\frac{3}{5}$; e. 1; f. $\frac{1}{2}$.

**Q3.** a. $\frac{5}{8}$; b. $\frac{7}{10}$; c. $\frac{7}{6} = 1\frac{1}{6}$; d. $\frac{4}{5}$.

**Q4.** a. $\frac{3}{8}$; b. $\frac{1}{2}$; c. $\frac{1}{3}$; d. $\frac{2}{3}$.

**Q5.** a. $\frac{2}{5}$ and $\frac{1}{2}$; b. $\frac{4}{10} + \frac{5}{10} = \frac{9}{10}$.

**Q6.** a. 12; b. 15; c. 10; d. 24; e. 14; f. 20.

**Q7.** $\frac{4}{5}$ (you land on $\frac{8}{10}$, which is $\frac{4}{5}$).

**Q8.** a. $\frac{1}{2}$; b. $\frac{2}{3}$; c. $\frac{1}{2}$; d. $\frac{3}{5}$.

**Q9.** a. $\frac{5}{6}$; b. $\frac{13}{15}$; c. $\frac{11}{12}$; d. $\frac{7}{15}$; e. $\frac{7}{12}$; f. $\frac{5}{24}$.

**Q10.** a. $3\frac{5}{6}$; b. $3\frac{7}{12}$; c. $1\frac{1}{2}$; d. $1\frac{3}{4}$.

**Q11.** $1\frac{1}{6}$ cups.

**Q12.** $\frac{1}{2}$ L.

**Q13.** a. $\frac{17}{24}$; b. $\frac{7}{24}$.

**Q14.** $2\frac{1}{6}$ km.

**Q15.** She added the tops and added the bottoms; the correct answer is $\frac{5}{6}$.

**Q16.** a. more than 1 ($1\frac{5}{12}$); b. less than 1 ($\frac{1}{2}$); c. equal to 1.

---

## All the working

**Q1.** a. $\frac{1}{2} = \frac{3}{6}$, so the pair is $\frac{3}{6}$ and $\frac{1}{6}$. b. $\frac{1}{4} = \frac{2}{8}$: the pair is $\frac{2}{8}$ and $\frac{3}{8}$. c. Twelfths: $\frac{2}{3} = \frac{8}{12}$, $\frac{1}{4} = \frac{3}{12}$. d. Tenths: $\frac{3}{5} = \frac{6}{10}$, $\frac{1}{2} = \frac{5}{10}$. e. Sixths: $\frac{2}{3} = \frac{4}{6}$, so the pair is $\frac{5}{6}$ and $\frac{4}{6}$. f. Fifteenths: $\frac{1}{3} = \frac{5}{15}$, $\frac{2}{5} = \frac{6}{15}$.

**Q2.** a. $\frac{2+3}{7} = \frac{5}{7}$. b. $\frac{5+2}{9} = \frac{7}{9}$. c. $\frac{7-3}{10} = \frac{4}{10} = \frac{2}{5}$. d. $\frac{4-1}{5} = \frac{3}{5}$. e. $\frac{3+5}{8} = \frac{8}{8} = 1$. f. $\frac{9-3}{12} = \frac{6}{12} = \frac{1}{2}$.

**Q3.** a. $\frac{1}{4}=\frac{2}{8}$, so $\frac{2}{8}+\frac{3}{8}=\frac{5}{8}$. b. $\frac{2}{5}=\frac{4}{10}$, so $\frac{4}{10}+\frac{3}{10}=\frac{7}{10}$. c. $\frac{1}{3}=\frac{2}{6}$, so $\frac{2}{6}+\frac{5}{6}=\frac{7}{6}=1\frac{1}{6}$. d. $\frac{1}{2}=\frac{5}{10}$, so $\frac{5}{10}+\frac{3}{10}=\frac{8}{10}=\frac{4}{5}$.

**Q4.** a. $\frac{1}{2}=\frac{4}{8}$, so $\frac{7}{8}-\frac{4}{8}=\frac{3}{8}$. b. $\frac{2}{5}=\frac{4}{10}$, so $\frac{9}{10}-\frac{4}{10}=\frac{5}{10}=\frac{1}{2}$. c. $\frac{1}{2}=\frac{3}{6}$, so $\frac{5}{6}-\frac{3}{6}=\frac{2}{6}=\frac{1}{3}$. d. $\frac{1}{4}=\frac{3}{12}$, so $\frac{11}{12}-\frac{3}{12}=\frac{8}{12}=\frac{2}{3}$.

**Q5.** a. The first bar shows $\frac{2}{5}$ and the second shows $\frac{1}{2}$. b. Tenths: $\frac{2}{5}=\frac{4}{10}$ and $\frac{1}{2}=\frac{5}{10}$, so $\frac{4}{10}+\frac{5}{10}=\frac{9}{10}$.

**Q6.** a. Multiples of 6: 6, 12 — and 12 is a multiple of 4: 12. b. 3 and 5 share no smaller multiple than $3\times5=15$. c. 10 is a multiple of 5, so 10. d. Multiples of 8: 8, 16, 24; 24 is a multiple of 6: 24. e. $2\times7=14$. f. Multiples of 10: 10, 20; 20 is a multiple of 4: 20.

**Q7.** Start at 0. Rename $\frac{1}{2}$ as $\frac{5}{10}$ and jump five tenths; then jump three more tenths. You land on $\frac{8}{10}$, which is $\frac{4}{5}$ in simplest form.

**Q8.** a. $\frac{4}{8}=\frac{1}{2}$. b. $\frac{4}{6}=\frac{2}{3}$. c. $\frac{6}{12}=\frac{1}{2}$. d. $\frac{6}{10}=\frac{3}{5}$.

**Q9.** a. Sixths: $\frac{3}{6}+\frac{2}{6}=\frac{5}{6}$. b. Fifteenths: $\frac{10}{15}+\frac{3}{15}=\frac{13}{15}$. c. Twelfths: $\frac{9}{12}+\frac{2}{12}=\frac{11}{12}$. d. Fifteenths: $\frac{12}{15}-\frac{5}{15}=\frac{7}{15}$. e. Twelfths: $\frac{10}{12}-\frac{3}{12}=\frac{7}{12}$. f. Twenty-fourths: $\frac{21}{24}-\frac{16}{24}=\frac{5}{24}$.

**Q10.** a. $1\frac{3}{6}+2\frac{2}{6}=3\frac{5}{6}$. b. $2\frac{3}{12}+1\frac{4}{12}=3\frac{7}{12}$. c. $2\frac{5}{6}-1\frac{2}{6}=1\frac{3}{6}=1\frac{1}{2}$. d. $3\frac{1}{2}=3\frac{2}{4}$; rename as $2\frac{6}{4}$ so the fraction part is big enough: $2\frac{6}{4}-1\frac{3}{4}=1\frac{3}{4}$.

**Q11.** Sixths: $\frac{2}{3}=\frac{4}{6}$ and $\frac{1}{2}=\frac{3}{6}$, so $\frac{4}{6}+\frac{3}{6}=\frac{7}{6}=1\frac{1}{6}$. The dry ingredients total $1\frac{1}{6}$ **cups**.

**Q12.** Sixths: $\frac{1}{3}=\frac{2}{6}$, so $\frac{5}{6}-\frac{2}{6}=\frac{3}{6}=\frac{1}{2}$. There is $\frac{1}{2}$ **L** left in the bottle.

**Q13.** a. Twenty-fourths: $\frac{3}{8}=\frac{9}{24}$ and $\frac{1}{3}=\frac{8}{24}$, so $\frac{9}{24}+\frac{8}{24}=\frac{17}{24}$ painted. b. The whole mural is 1, so $1-\frac{17}{24}=\frac{7}{24}$ is still unpainted.

**Q14.** Sixths: $1\frac{1}{2}=1\frac{3}{6}$ and $\frac{2}{3}=\frac{4}{6}$, so $1\frac{3}{6}+\frac{4}{6}=1\frac{7}{6}=2\frac{1}{6}$. The track is $2\frac{1}{6}$ **km** long.

**Q15.** Dana added the numerators to get 2 and the denominators to get 5. But halves and thirds are different-sized parts, so they must be renamed first: sixths give $\frac{3}{6}+\frac{2}{6}=\frac{5}{6}$. (A size check also shows $\frac{2}{5}$ cannot be right: it is less than $\frac{1}{2}$, and adding $\frac{1}{3}$ to $\frac{1}{2}$ must give more than $\frac{1}{2}$.)

**Q16.** a. More than 1, because both fractions are more than $\frac{1}{2}$. Check: twelfths give $\frac{8}{12}+\frac{9}{12}=\frac{17}{12}=1\frac{5}{12}$. b. Less than 1: $\frac{5}{6}-\frac{2}{6}=\frac{3}{6}=\frac{1}{2}$. c. Equal to 1: $\frac{3}{8}+\frac{5}{8}=\frac{8}{8}=1$.

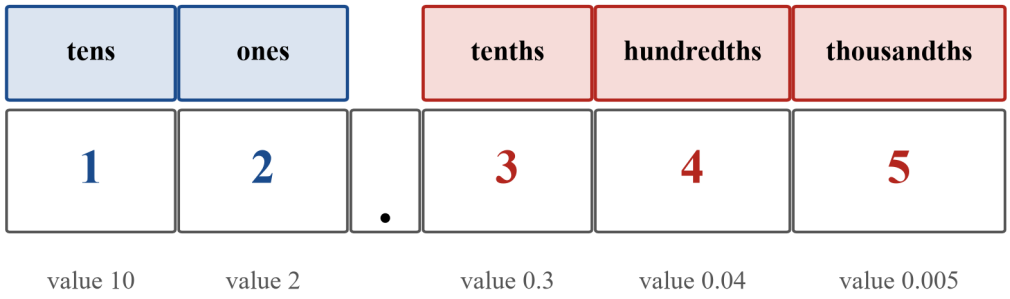
## Adding and subtracting decimals

**Content description VC2M6N04:** apply knowledge of place value to add and subtract decimals, using digital tools where appropriate; use estimation and rounding to check the reasonableness of answers

*You jump 4.6 m in the long jump, then beat your own jump by 0.35 m — how far did you jump? A 2.4 m board has 1.75 m cut off — how much is left? Questions like these run on decimal arithmetic. The good news: you already know most of what you need. Line up the places, and the rest is whole-number work.*

### Theory

**Decimals obey place value.** The number 12.345 is really $10+2+0.3+0.04+0.005$: each digit is worth what its column says, and 10 of any place make 1 of the place to its left. That one idea is the whole secret of adding and subtracting decimals. If you line up equal places — ones under ones, tenths under tenths, hundredths under hundredths — the rest is the whole-number work you already know.



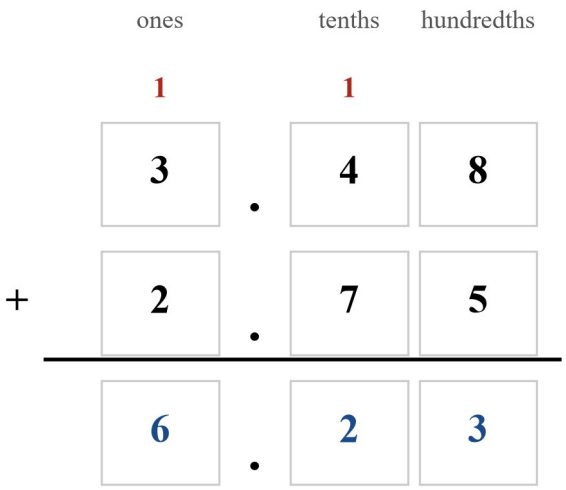

$$12.345 = 10 + 2 + 0.3 + 0.04 + 0.005$$

10 of any place make 1 of the place to its left.

*Place value chart for 12.345 with columns for tens, ones, tenths, hundredths and thousandths, showing the value of each digit*

**Line up the decimal points.** The decimal point sits between the ones column and the tenths column. So lining up the points is what lines up the places: write one number under the other with the points in a straight line, and ones, tenths and hundredths fall into the same columns by themselves. Where a number has no digit in a place, a zero fills the gap: $3.5 = 3.50$, and $3 = 3.00$. Writing the zeros does not change the number; it just makes every place visible.

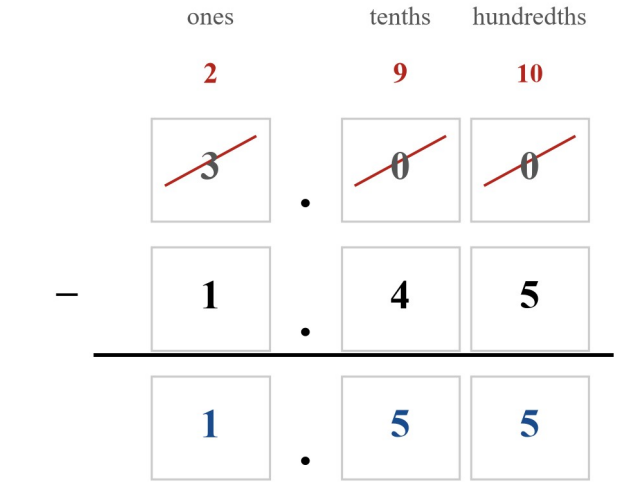
**Adding in columns.** With the points lined up, add column by column from the right, exactly as with whole numbers. When a column makes 10 or more, rename: 10 in the hundredths column make 1 in the tenths column, and 10 in the tenths column make 1 in the ones column. In the figure, the hundredths give $8+5=13$, so 3 is written and 1 is carried; the tenths give $4+7+1=12$, so 2 is written and 1 one is carried; the ones give $3+2+1=6$. So $3.48+2.75=6.23$.




The decimal points line up, so ones meet ones, tenths meet tenths and hundredths meet hundredths.

*Column addition of 3.48 and 2.75 with ones, tenths and hundredths lined up, giving 6.23 with renaming marks above the tenths and ones columns*

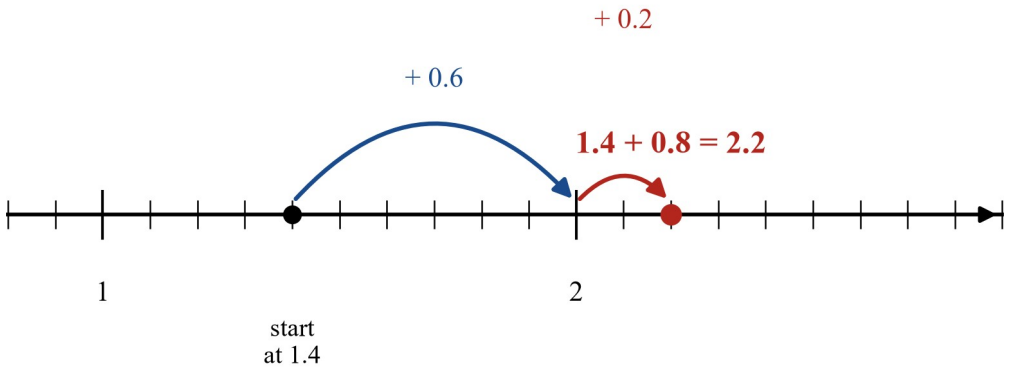
**Subtracting in columns.** Subtract the same way, renaming when a column is too small. To find $3 - 1.45$, first write 3 as $3.00$ so every place is visible. Then rename: 3 ones become 2 ones and 10 tenths, and 1 of those tenths becomes 10 hundredths, so the top number reads 2 ones, 9 tenths and 10 hundredths. Now every column can subtract: $10 - 5 = 5$, $9 - 4 = 5$, $2 - 1 = 1$, giving $3.00 - 1.45 = 1.55$.



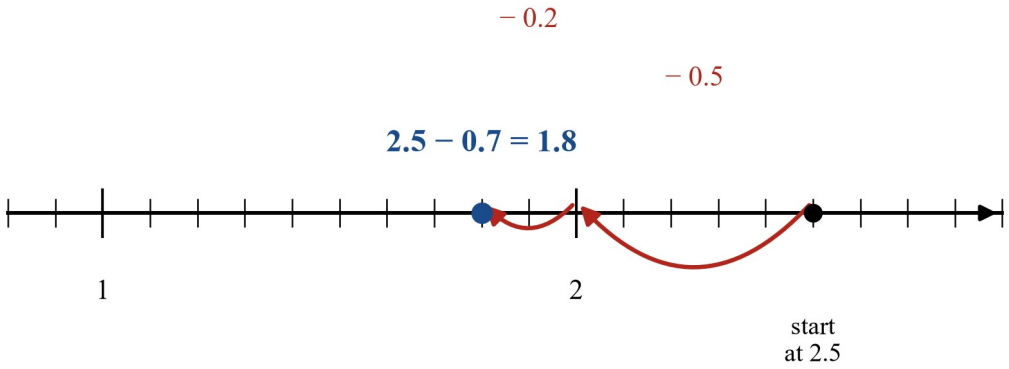

Rename: 3 ones = 2 ones and 10 tenths, then 1 of those tenths = 10 hundredths. Now each column can subtract.

*Column subtraction of 1.45 from 3.00 showing the renaming across zeros, 2 ones, 9 tenths and 10 hundredths, giving 1.55*

**Mental strategies: partition and bridge.** The same place-value thinking gives quick mental methods. To add $1.4 + 0.8$, split the $0.8$ into $0.6 + 0.2$: jump $0.6$ to bridge to the next whole number, 2, then jump $0.2$ more to land on $2.2$. To subtract $2.5 - 0.7$, split the $0.7$ into $0.5 + 0.2$: jump back $0.5$ to the whole number 2, then back $0.2$ more to land on $1.8$. Basic facts do the work — $15 - 7 = 8$ tells you $2.5 - 0.7$ ends in 8 tenths — and place value tells you where you are.

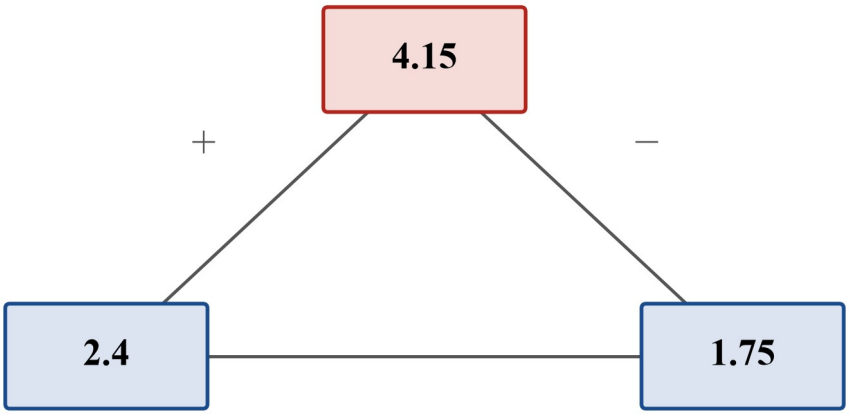



*Number line from 0.8 to 2.9 showing 1.4 plus 0.8 by jumping 0.6 to 2 and then 0.2 more to 2.2*




*Number line from 0.8 to 2.9 showing 2.5 take away 0.7 by jumping back 0.5 to 2 and then 0.2 more to 1.8*

**The inverse relationship.** Addition and subtraction undo each other, and decimals are no different. One fact such as $2.4 + 1.75 = 4.15$ brings three more with it: $1.75 + 2.4 = 4.15$, $4.15 - 2.4 = 1.75$ and $4.15 - 1.75 = 2.4$. Use the inverse to check your working: if $3.00 - 1.45 = 1.55$ is right, then $1.55 + 1.45$ must get back to $3.00$ — and it does.



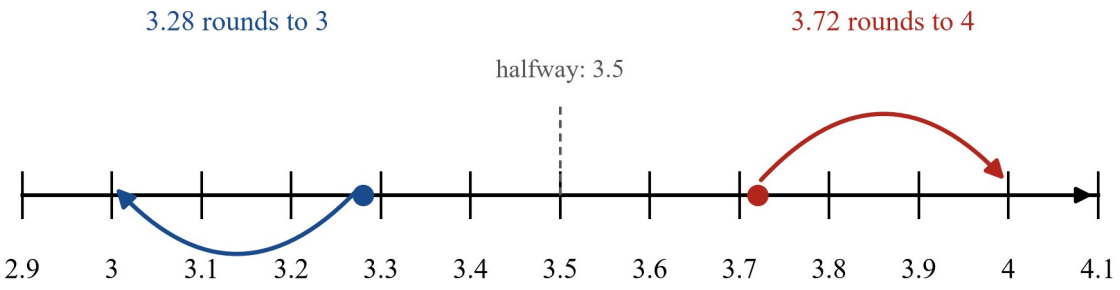

Four facts from one family:

$2.4 + 1.75 = 4.15$ $\quad$ $1.75 + 2.4 = 4.15$

$4.15 - 2.4 = 1.75$ $\quad$ $4.15 - 1.75 = 2.4$

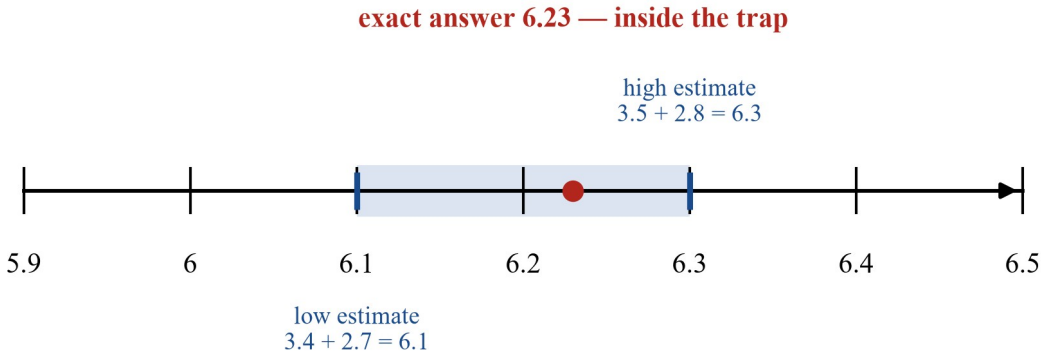
*Fact family triangle for 2.4, 1.75 and 4.15 with the four facts 2.4 + 1.75 = 4.15, 1.75 + 2.4 = 4.15, 4.15 − 2.4 = 1.75 and 4.15 − 1.75 = 2.4*

**Round to check your answer.** After you calculate, round each number to the nearest whole and add or subtract in your head. 3.72 rounds to 4 and 3.28 rounds to 3, because 3.5 is the halfway mark and decimals past it round up. If your exact answer is nowhere near your estimate, something has gone wrong — go back and check your renaming.



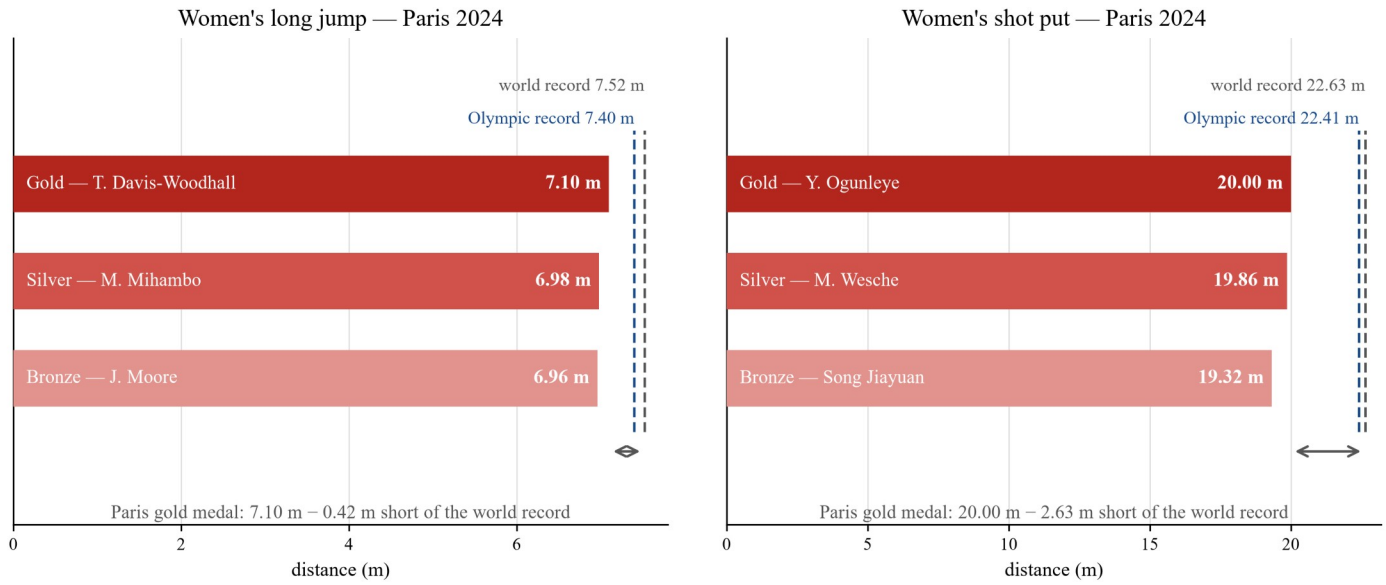

*Number line from 2.9 to 4.1 with 3.5 marked halfway, showing 3.72 rounding up to 4 and 3.28 rounding down to 3*

**Trap the exact answer.** For a closer check, make two estimates. Round every number **down** to 1 decimal place for a **low estimate**, and **up** to 1 decimal place for a **high estimate**. For $3.48 + 2.75$: the low estimate is $3.4 + 2.7 = 6.1$ and the high estimate is $3.5 + 2.8 = 6.3$, so the exact answer must sit between 6.1 and 6.3. It does: 6.23. Any answer outside the trap is wrong.




*Number line from 5.9 to 6.5 with the exact answer 6.23 sitting inside the shaded band between the low estimate 6.1 and the high estimate 6.3*

**Decimals and metric measurement.** Metres are a natural home for decimals, because centimetres are hundredths of a metre and millimetres are thousandths: 7.10 m is 7 m and 10 cm, and 1.245 m is 1 m and 245 mm. Adding and subtracting these measurements is exactly the column work above. The figure shows the women's long jump and shot put at the Paris 2024 Olympic Games against the standing world and Olympic records — all of it additive work with decimals to two places.




*Bar charts of the women's long jump and shot put at the Paris 2024 Olympic Games, showing the gold, silver and bronze marks against the standing world record and Olympic record in each event*

Source: World Athletics, Paris 2024 Olympic Games — women's long jump and shot put results, and world record lists, 2024. Retrieved 20 August 2026.

**When is a calculator appropriate?** The content description says digital tools may be used *where appropriate* — that is a permission, and part of the skill is deciding when. For decimals to hundredths, your mental and column methods are quick and trustworthy, and they keep your place-value sense sharp. When the decimals run beyond hundredths — thousandths and ten-thousandths, as in $1.0 - 0.0035$ or $2.345 + 1.4999$ — a calculator is a sensible choice. Even then, estimate first: $2.345 + 1.4999$ is about $2.3 + 1.5 = 3.8$, so a display reading $3.8449$ is reasonable, while $38.449$ would fail the check at a glance.

**Words for this subtopic**, with what they mean here:

| Term | Meaning here |
|---|---|
| **decimal point** | the dot between the ones column and the tenths column |
| **place value** | the value a digit has because of its column: ones, tenths, hundredths, … |
| **rename** | to swap 1 in the ones column for 10 in the tenths column, or 1 in the tenths column for 10 in the hundredths column, without changing the number |
| **partition** | to split a number into parts that are easier to add or subtract |
| **inverse** | the opposite operation: subtraction undoes addition, and addition undoes subtraction |
| **estimate** | a quick, close-enough answer, usually worked out in your head |
| **reasonable** | sensible — an answer that agrees with your estimate |

## Worked examples

### *Example 1 — with help*

Find $5.67 + 2.86$ using columns, then check that your answer is reasonable.

| Working | Comment |
|---|---|
| Write $5.67$ over $2.86$ with the decimal points in a line. | Equal places now sit in the same column. |

| Working | Comment |
|---|---|
| Hundredths: $7 + 6 = 13$. Write 3, carry 1. | 13 hundredths renames to 1 in the tenths column and 3 in the hundredths column. |
| Tenths: $6 + 8 + 1 = 15$. Write 5, carry 1 one. | Do not forget the 1 you carried. |
| Ones: $5 + 2 + 1 = 8$. The answer is $8.53$. | 10 tenths made 1 extra one. |
| Check: $6 + 3 = 9$. | $5.67 \to 6$ and $2.86 \to 3$; $8.53$ is close to 9, so it is reasonable. ✓ |

### *Example 2 — with help*

At the Paris 2024 Olympic Games the women's long jump gold medal was $7.10$ m, and the standing world record is $7.52$ m. How much further is the world record? Repeat for the shot put, where the gold medal was $20.00$ m and the world record is $22.63$ m.

Source: World Athletics, Paris 2024 Olympic Games — women's long jump and shot put results, and world record lists, 2024. Retrieved 20 August 2026.

| Working | Comment |
|---|---|
| Long jump: $7.52 - 7.10 = 0.42$ | Points lined up; hundredths $2 - 0 = 2$, tenths $5 - 1 = 4$, ones $7 - 7 = 0$. |
| The world record is $0.42$ m further. | $0.42$ m is 42 cm — about half a metre. |
| Shot put: $22.63 - 20.00 = 2.63$ | The same column work, with a larger whole part. |
| The world record is $2.63$ m further. | Check with the inverse: $20.00 + 2.63 = 22.63$. ✓ |

Estimate check: $7.5 - 7 = 0.5$, close to $0.42$; $23 - 20 = 3$, close to $2.63$. Both answers are reasonable. ✓

### *Example 3 — on your own*

Find $3 - 1.45$. Check your answer twice: once with the inverse, once with an estimate.

Write 3 as $3.00$. Rename: 3 ones become 2 ones and 10 tenths, then 1 of those tenths becomes 10 hundredths, so the top number reads 2, 9, 10. Now subtract: $10 - 5 = 5$, $9 - 4 = 5$, $2 - 1 = 1$. The answer is $1.55$.

Inverse check: $1.55 + 1.45 = 3.00$. ✓ Estimate check: $3 - 1.5 = 1.5$, and $1.55$ is close to $1.5$. ✓

### *Example 4 — on your own*

Decide how to calculate each: in your head, in columns, or with a calculator. Then calculate, and check with an estimate. (a) $4.6 + 2.7$ (b) $3.208 + 4.4957$ (c) $2.0 - 0.0064$

(a) Friendly tenths — do it in your head: $4.6 + 2 = 6.6$, then $6.6 + 0.7 = 7.3$. Estimate: $5 + 3 = 8$, and $7.3$ is close. ✓

(b) Four decimal places — a calculator is appropriate: $3.208 + 4.4957 = 7.7037$. Estimate: $3.2 + 4.5 = 7.7$, so the display is reasonable. ✓

(c) Ten-thousandths — a calculator is appropriate: $2.0 - 0.0064 = 1.9936$. Estimate: taking a tiny amount from 2 leaves just under 2, and $1.9936$ is just under 2. ✓

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## Practice questions

### *With help*

**Q1.** Add in your head by bridging through the next whole number. Use a number line if you like. (a) $1.4 + 0.8$ (b) $2.6 + 0.7$ (c) $0.9 + 0.5$ (d) $3.8 + 0.6$

**Q2.** Add using columns. Line up the decimal points first. (a) $3.48 + 2.75$ (b) $5.62 + 1.89$ (c) $0.75 + 2.48$ (d) $12.36 + 5.87$

**Q3.** Subtract using columns. Rename where you need to, and fill empty places with zeros first. (a) $3 - 1.45$ (b) $5.2 - 2.68$ (c) $8.03 - 3.57$

**Q4.** Each answer was found by a Year 6 student. Round to the nearest whole to check it. If an answer is not reasonable, find the correct one. (a) $6.21 + 3.87 = 10.08$ (b) $9.42 - 3.76 = 6.66$ (c) $4.38 + 2.91 = 7.29$

**Q5.** Here is one fact: $2.4 + 1.75 = 4.15$. (a) Write the three other facts in this family. (b) Use the inverse to check that $4.15 - 1.75 = 2.4$.

**Q6.** The long jump record at Zara's school is $4.85$ m. At sports day, Zara jumps $5.12$ m. (a) How much further is Zara's jump than the old record? (b) Check your answer with the inverse. (c) The Paris 2024 Olympic gold medal in the women's long jump was $7.10$ m. How much further is that than Zara's jump?

Source: World Athletics, Paris 2024 Olympic Games — women's long jump results, 2024. Retrieved 20 August 2026.

### *On your own*

**Q7.** Add or subtract in your head by bridging through a whole number. (a) $3.7 + 0.6$ (b) $5.2 - 0.8$ (c) $2.9 + 1.4$ (d) $6.3 - 0.9$

**Q8.** Add using columns. (a) $7.58 + 6.74$ (b) $0.96 + 1.28 + 2.57$ (c) $15.4 + 2.87$

**Q9.** Subtract using columns. (a) $7 - 2.36$ (b) $10.4 - 6.75$ (c) $9.02 - 4.68$

**Q10.** Each answer was found by a Year 6 student. Round to the nearest whole to check it. If an answer is not reasonable, find the correct one. (a) $12.42 + 5.87 = 18.29$ (b) $7.91 - 2.48 = 4.43$ (c) $3.65 + 4.72 = 8.37$

**Q11.** A shelf board is $2.4$ m long. A carpenter cuts off $1.75$ m for a shelf. (a) How long is the leftover piece? (b) Check your answer with the inverse.

**Q12.** Millimetres are thousandths of a metre. One metal rod is $1.245$ m long and a second is $0.86$ m long. (a) Write the length of the second rod using three decimal places. (b) The rods are joined end to end. Find the total length. (c) How much longer is the first rod than the second?

**Q13.** Use the Paris 2024 results in the figure. (a) The Olympic record in the women's long jump is $7.40$ m and the gold medal was $7.10$ m. How much further is the Olympic record? (b) In the women's shot put, the gold medal was $20.00$ m and the bronze was $19.32$ m. How much further was the gold medal? (c) Which gap is larger: the long jump gold medal to the long jump world record, or the shot put gold medal to the shot put world record? By how much?

Source: World Athletics, Paris 2024 Olympic Games — women's long jump and shot put results, and world record lists, 2024. Retrieved 20 August 2026.

**Q14.** Decide how to calculate each: in your head, in columns, or with a calculator. Then calculate, and check with an estimate. (a) $6.5 - 2.8$ (b) $4.125 + 3.4987$ (c) $5 - 0.0072$

## Answers

**Q1.** (a) 2.2; (b) 3.3; (c) 1.4; (d) 4.4. **Q2.** (a) 6.23; (b) 7.51; (c) 3.23; (d) 18.23. **Q3.** (a) 1.55; (b) 2.52; (c) 4.46. **Q4.** (a) reasonable; (b) not reasonable — 5.66; (c) reasonable. **Q5.** (a) $1.75 + 2.4 = 4.15$, $4.15 - 2.4 = 1.75$, $4.15 - 1.75 = 2.4$; (b) $2.4 + 1.75 = 4.15$, so the subtraction is correct. **Q6.** (a) 0.27 m; (b) $4.85 + 0.27 = 5.12$; (c) 1.98 m. **Q7.** (a) 4.3; (b) 4.4; (c) 4.3; (d) 5.4. **Q8.** (a) 14.32; (b) 4.81; (c) 18.27. **Q9.** (a) 4.64; (b) 3.65; (c) 4.34. **Q10.** (a) reasonable; (b) not reasonable — 5.43; (c) reasonable. **Q11.** (a) 0.65 m; (b) $1.75 + 0.65 = 2.4$. **Q12.** (a) 0.860 m; (b) 2.105 m; (c) 0.385 m. **Q13.** (a) 0.30 m; (b) 0.68 m; (c) the shot put gap, 2.63 m against 0.42 m — larger by 2.21 m. **Q14.** (a) in your head, 3.7; (b) calculator, 7.6237; (c) calculator, 4.9928.

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## Worked solutions

**Q1.** (a) $1.4 + 0.6 = 2$, then $2 + 0.2 = 2.2$. (b) $2.6 + 0.4 = 3$, then $3 + 0.3 = 3.3$. (c) $0.9 + 0.1 = 1$, then $1 + 0.4 = 1.4$. (d) $3.8 + 0.2 = 4$, then $4 + 0.4 = 4.4$.

**Q2.** (a) Hundredths $8 + 5 = 13$: write 3, carry 1. Tenths $4 + 7 + 1 = 12$: write 2, carry 1. Ones $3 + 2 + 1 = 6$. So 6.23. (b) $5.62 + 1.89$: $2 + 9 = 11$, $6 + 8 + 1 = 15$, $5 + 1 + 1 = 7$: so 7.51. (c) $0.75 + 2.48$: $5 + 8 = 13$, $7 + 4 + 1 = 12$, $0 + 2 + 1 = 3$: so 3.23. (d) $12.36 + 5.87$: $6 + 7 = 13$, $3 + 8 + 1 = 12$, $2 + 5 + 1 = 8$, bring down the 1: so 18.23.

**Q3.** (a) Write 3.00; rename to 2 ones, 9 tenths, 10 hundredths: $10 - 5 = 5$, $9 - 4 = 5$, $2 - 1 = 1$: so 1.55. (b) Write 5.20 ; $10 - 8 = 2$, $11 - 6 = 5$, $4 - 2 = 2$: so 2.52. (c) $13 - 7 = 6$, $9 - 5 = 4$, $7 - 3 = 4$: so 4.46.

**Q4.** (a) $6 + 4 = 10$, and 10.08 is close to 10: reasonable. (b) $9 - 4 = 5$, but 6.66 is more than a whole away from 5: not reasonable. Correct: $9.42 - 3.76 = 5.66$. (c) $4 + 3 = 7$, and 7.29 is close to 7: reasonable.

**Q5.** (a) $1.75 + 2.4 = 4.15$; $4.15 - 2.4 = 1.75$; $4.15 - 1.75 = 2.4$. (b) Adding back: $2.4 + 1.75 = 4.15$, which returns the whole, so $4.15 - 1.75 = 2.4$ is correct.

**Q6.** (a) $5.12 - 4.85 = 0.27$ m. (b) $4.85 + 0.27 = 5.12$, back to Zara's jump. ✓ (c) $7.10 - 5.12 = 1.98$ m.

**Q7.** (a) $3.7 + 0.3 = 4$, then $4 + 0.3 = 4.3$. (b) $5.2 - 0.2 = 5$, then $5 - 0.6 = 4.4$. (c) $2.9 + 0.1 = 3$, then $3 + 1.3 = 4.3$. (d) $6.3 - 0.3 = 6$, then $6 - 0.9 = 5.4$.

**Q8.** (a) $8 + 4 = 12$, $5 + 7 + 1 = 13$, $7 + 6 + 1 = 14$: so 14.32. (b) $0.96 + 1.28 = 2.24$, then $2.24 + 2.57 = 4.81$. (c) Write 15.40: $0 + 7 = 7$, $4 + 8 = 12$, $5 + 2 + 1 = 8$, bring down the 1: so 18.27.

**Q9.** (a) Write 7.00; rename to 6 ones, 9 tenths, 10 hundredths: $10 - 6 = 4$, $9 - 3 = 6$, $6 - 2 = 4$: so 4.64. (b) Write 10.40; rename to 9 ones, 13 tenths, 10 hundredths: $10 - 5 = 5$, $13 - 7 = 6$, $9 - 6 = 3$: so 3.65. (c) $12 - 8 = 4$, $9 - 6 = 3$, $8 - 4 = 4$: so 4.34.

**Q10.** (a) $12 + 6 = 18$, and 18.29 is close to 18: reasonable. (b) $8 - 2 = 6$, but 4.43 is a long way from 6: not reasonable. Correct: $7.91 - 2.48 = 5.43$. (c) $4 + 5 = 9$, and 8.37 is close to 9: reasonable.

**Q11.** (a) $2.40 - 1.75 = 0.65$ m. (b) $1.75 + 0.65 = 2.40$, back to the whole board. ✓

**Q12.** (a) $0.86 = 0.860$ m. (b) $1.245 + 0.860 = 2.105$ m. (c) $1.245 - 0.860 = 0.385$ m. Check: $0.860 + 0.385 = 1.245$. ✓

**Q13.** (a) $7.40 - 7.10 = 0.30$ m. (b) $20.00 - 19.32 = 0.68$ m. (c) Long jump gap: $7.52 - 7.10 = 0.42$ m. Shot put gap: $22.63 - 20.00 = 2.63$ m. The shot put gap is larger, by $2.63 - 0.42 = 2.21$ m.

**Q14.** (a) In your head: $6.5 - 2 = 4.5$, then $4.5 - 0.8 = 3.7$. Estimate $6.5 - 3 = 3.5$, close. ✓ (b) Four decimal places, so a calculator is appropriate: $4.125 + 3.4987 = 7.6237$. Estimate $4.1 + 3.5 = 7.6$, close. ✓ (c) Ten-thousandths, so a calculator is appropriate: $5 - 0.0072 = 4.9928$. Estimate: just under 5. ✓

## Multiplying and dividing decimals by powers of 10

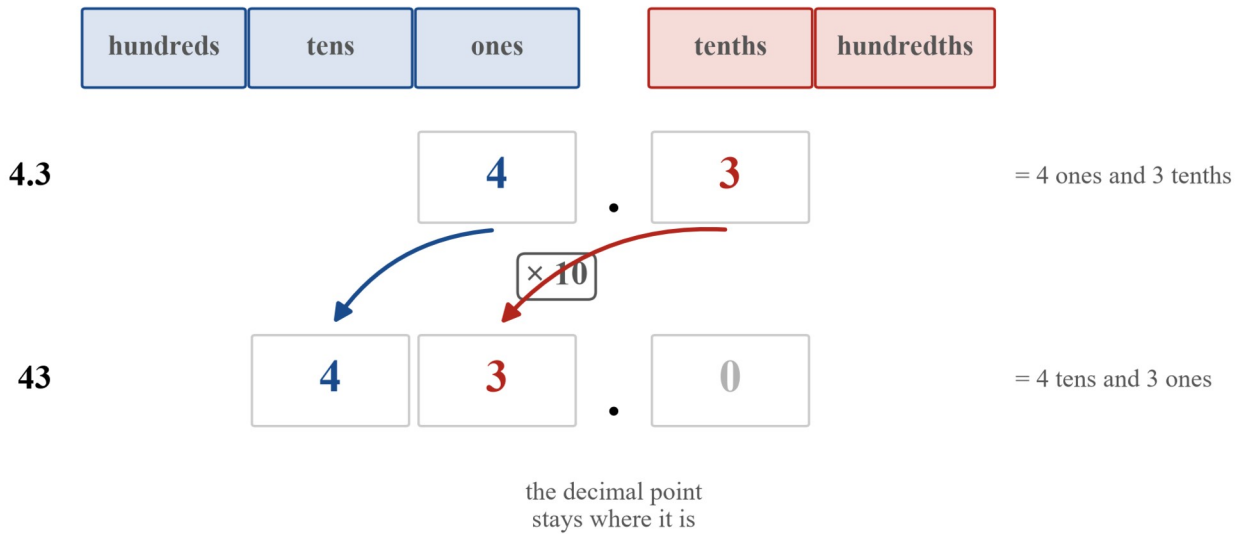
> **Content description VC2M6N06:** multiply and divide decimals by multiples of powers of 10 without a calculator, applying knowledge of place value and proficiency with multiplication facts, using estimation and rounding to check the reasonableness of answers

*Multiply* 4.3 *by* 10 *and the answer is* 43 *— the same two digits, in new columns. That is the whole trick of this subtopic. The digits do the moving, the decimal point stays exactly where it is, and once you can see that,* $\times 1000$ *and* $\div 100$ *are just more of the same.*

### Theory

**Place value does the work.** The number 4.3 is 4 ones and 3 tenths, while 43 is 4 tens and 3 ones: the same digits in different columns. In our place-value system every column is worth 10 times the column to its right, so moving a digit one column to the left makes it worth 10 times as much, and one column to the right makes it worth 10 times less. Multiplying and dividing by 10, 100 and 1000 is exactly that digit-moving — and nothing else.

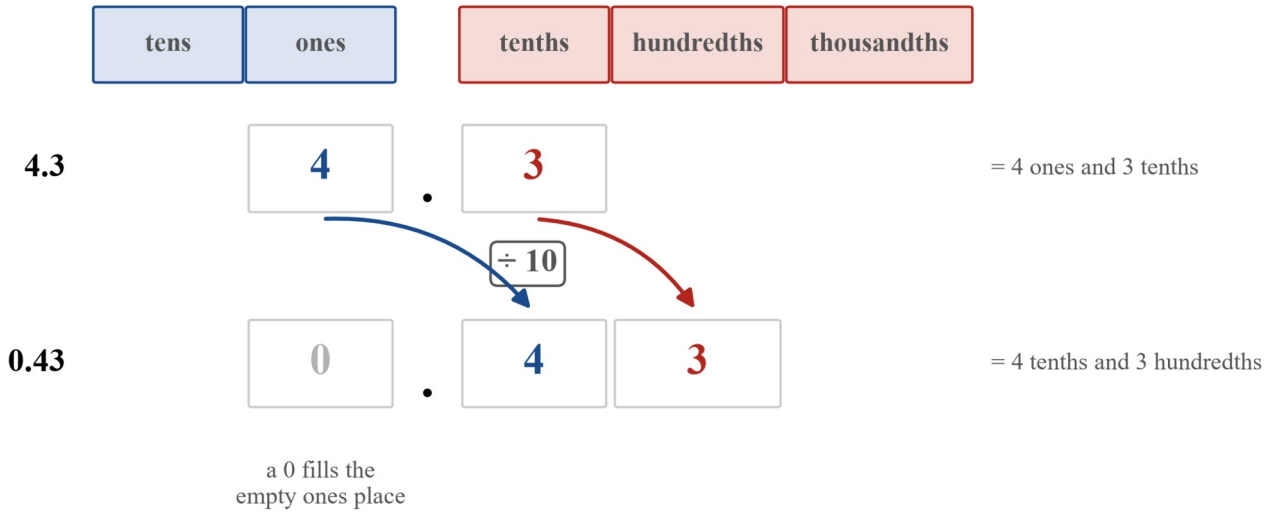
**Multiplying by 10: every digit shifts one place to the left.** In the figure, $4.3 \times 10 = 43$. The 4 begins in the ones column and ends in the tens column; the 3 begins in the tenths column and ends in the ones column. Every digit is now worth 10 times what it was, which is exactly what multiplying by 10 means. Notice the decimal point: it has not moved at all. It sits between the ones and tenths columns in both rows, because that is its job — it always marks the boundary between the ones and the tenths.




4.3 × 10 = 43 — every digit shifts one place to the left, so each digit is worth 10 times as much.

*Place value chart showing 4.3 multiplied by 10 equals 43, with the 4 and the 3 each shifting one column to the left while the decimal point stays fixed between the ones and tenths columns*

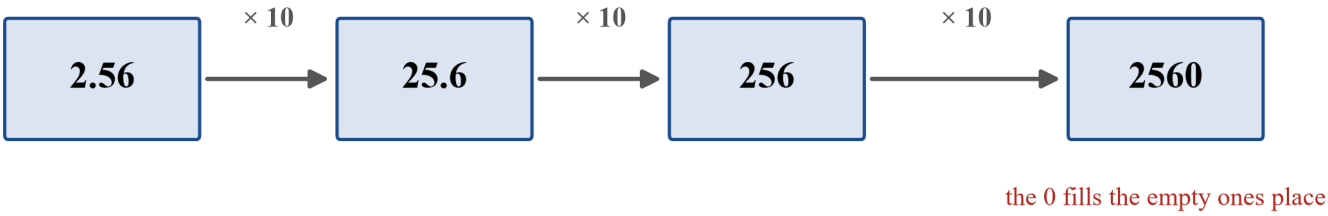
**Dividing by 10: every digit shifts one place to the right.** So $4.3 \div 10 = 0.43$: the 4 lands in the tenths column and the 3 in the hundredths column, each worth 10 times less than it was. The ones column is left empty, and a 0 fills it so we can see the point in its usual place. That 0 in 0.43 is a placeholder — it carries no value, it just keeps every other digit in its place.




4.3 ÷ 10 = 0.43 — every digit shifts one place to the right, so each digit is worth one tenth as much.

*Place value chart showing 4.3 divided by 10 equals 0.43, with the 4 and the 3 each shifting one column to the right and a 0 filling the empty ones place*

**Larger jumps: ×100 and ×1000.** Since $100 = 10 \times 10$ and $1000 = 10 \times 10 \times 10$, multiplying by 100 shifts every digit two places left, and multiplying by 1000 shifts every digit three places left. The figure follows 2.56: one shift gives 25.6, two shifts give 256, three shifts give 2560 — so $2.56 \times 100 = 256$ and $2.56 \times 1000 = 2560$. Where a shift leaves an empty column on the whole-number side, a zero fills it: that is the only zero that ever gets "added", and it is added as a placeholder, not stuck on the end of the number.

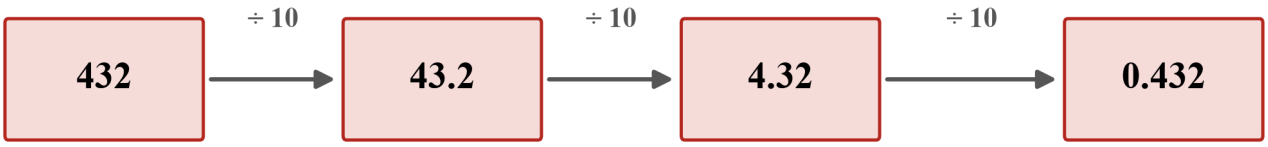



× 100 = two of these shifts: 2.56 × 100 = 256

× 1000 = three of these shifts: 2.56 × 1000 = 2560

*Chain of boxes showing 2.56 times 10 equals 25.6, times 10 equals 256 and times 10 equals 2560, with the notes that times 100 is two of these shifts and times 1000 is three*

**Dividing by 100 and 1000.** The same jumps, to the right: $432 \div 10 = 43.2$, then $432 \div 100 = 4.32$ (two shifts) and $432 \div 1000 = 0.432$ (three shifts), with zeros filling any empty columns so the point stays visible. Dividing makes a number smaller — 0.432 is far smaller than 432 — so if a "divide by 100" answer comes out larger than you started, the digits have shifted the wrong way.

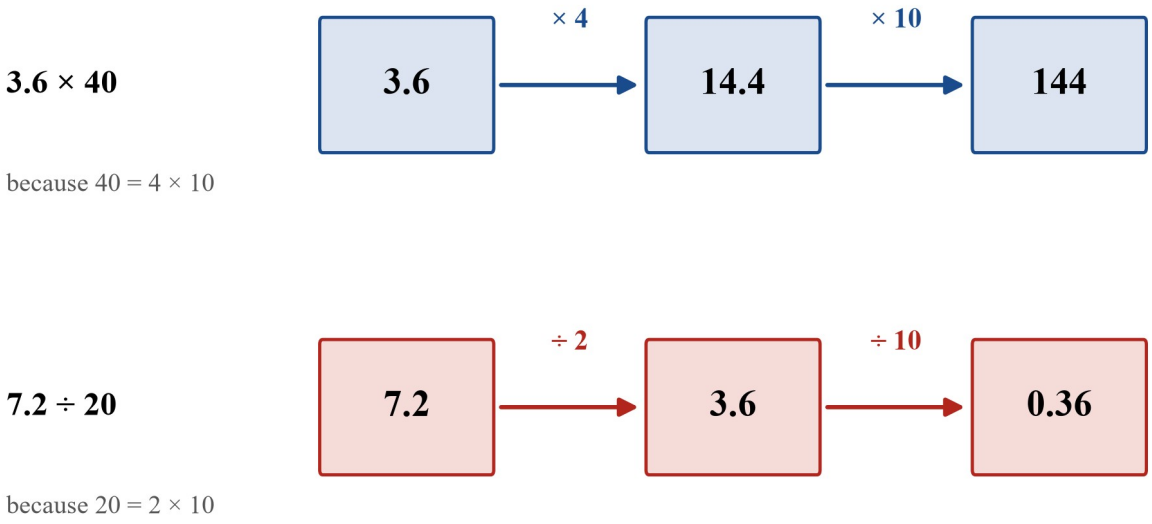



÷ 100 = two of these shifts: 432 ÷ 100 = 4.32

÷ 1000 = three of these shifts: 432 ÷ 1000 = 0.432

*Chain of boxes showing 432 divided by 10 equals 43.2, divided by 10 equals 4.32 and divided by 10 equals 0.432, with the notes that divided by 100 is two of these shifts and divided by 1000 is three*

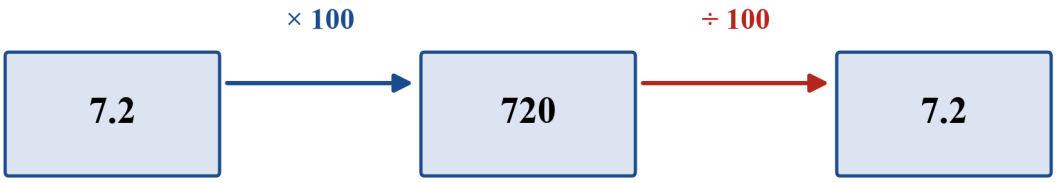
**Multiples of powers of 10.** The content description says *multiples* of powers of 10, so numbers like 20, 50 and 300 are in scope too. Split the multiple into its single digit and its power of 10: $40 = 4 \times 10$, so $3.6 \times 40 = 3.6 \times 4 \times 10 = 14.4 \times 10 = 144$. Division splits the same way: $20 = 2 \times 10$, so $7.2 \div 20 = 7.2 \div 2 \div 10 = 3.6 \div 10 = 0.36$. The single-digit step is basic-fact work you already know; the power-of-10 step is a shift.




Split the multiple into its single digit and its power of 10, then do two easy steps.

*Two-step flows: 3.6 times 4 equals 14.4 then times 10 equals 144 for 3.6 times 40, and 7.2 divided by 2 equals 3.6 then divided by 10 equals 0.36 for 7.2 divided by 20*

**Multiplication and division undo each other.** Multiplying by 100 and then dividing by 100 gets back to where you started, and that inverse link finds missing numbers: if $\square \times 100 = 83.2$, then $\square = 83.2 \div 100 = 0.832$.

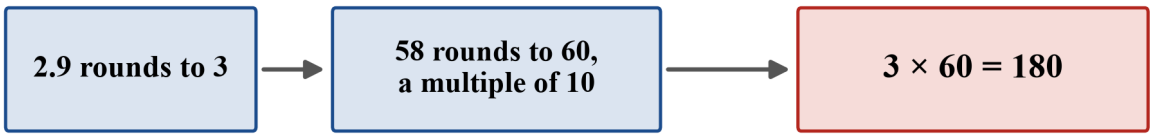



Multiplying by 100 and then dividing by 100 gets back to where you started.

Use it to find a missing number: □ × 100 = 83.2 undoes to 83.2 ÷ 100 = 0.832, so □ = 0.832.

*Flow showing 7.2 times 100 equals 720 and 720 divided by 100 returns to 7.2, with the missing-number example: box times 100 equals 83.2 undoes to 83.2 divided by 100 equals 0.832*

**Estimate, then check.** After any exact answer, round and redo it in your head: $6.27 \times 100 = 627$ passes the check because $6 \times 100 = 600$ and 627 is close to 600, while 62.7 or 6270 would fail it at a glance. When a question only asks *about how many*, the estimate is the answer: round each number to something friendly — a multiple of 10 where you can — and multiply in your head.



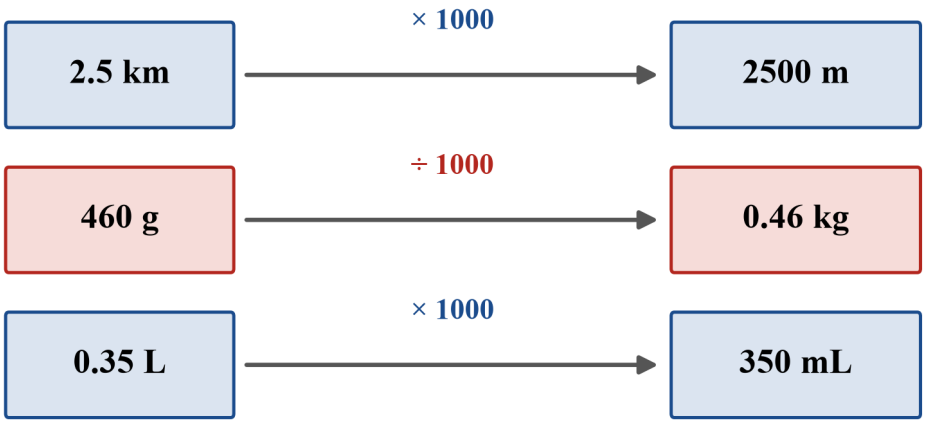

**so 2.9 × 58 is about 180**

The question asks about how many — so an estimate is enough, and no exact working is needed.

Check: the exact answer would be close to 180, not 18 or 1800.

*Estimation flow: 2.9 rounds to 3 and 58 rounds to 60, a multiple of 10, so 3 times 60 equals 180 and 2.9 times 58 is about 180*

**Decimals and metric measurement.** The metric system runs on powers of 10: 1 km is 1000 m, 1 kg is 1000 g, 1 L is 1000 mL, and 1 m is 100 cm. So changing units is multiplying or dividing by a power of 10 — $2.5 \text{ km} = 2500 \text{ m}$ is just $2.5 \times 1000$. Subtopic 5A puts these same steps to work across the full set of metric units; everything it needs is in this figure.




Every step here is a ×10, ×100 or ×1000 — the same skills as the rest of this subtopic. Subtopic 5A puts them to work on the full set of metric units.

*Metric conversions as powers of 10: 2.5 km times 1000 equals 2500 m, 460 g divided by 1000 equals 0.46 kg, and 0.35 L times 1000 equals 350 mL*

**No calculator needed.** This subtopic is calculator-free by design: every shift here is quick mental work, and doing it yourself is what keeps your place-value sense sharp. If a question in this subtopic ever feels like calculator work, the digits are not shifting — go back and look for the shift.

**Words for this subtopic**, with what they mean here:

| Term | Meaning here |
|---|---|
| **place value** | the value a digit has because of its column: ones, tenths, hundredths, … |
| **power of 10** | 10, 100, 1000, … — each is 10 times the one before |
| **multiple** | a whole number times a number: 40 is a multiple of 10 because $40 = 4 \times 10$ |
| **shift** | to move a digit one or more columns left or right in the place-value chart |
| **placeholder** | a 0 written in an empty column to keep the other digits in their places, as in 0.43 |
| **inverse** | the operation that undoes another: division undoes multiplication, and multiplication undoes division |
| **estimate** | a quick, close-enough answer, usually worked out in your head |
| **reasonable** | sensible — an answer that agrees with your estimate |

## Worked examples

### *Example 1 — with help*

Complete each line, then explain in words what happened to the digits.

| Working | Comment |
|---|---|
| $6.27 \times 10 = 62.7$ | Every digit shifts one place left: the 2 leaves the tenths column for the ones column. |
| $6.27 \times 100 = 627$ | Two shifts left; every column fills, so no placeholder is |

| Working | Comment |
|---|---|
| | needed. |
| $6.27 \times 1000 = 6270$ | Three shifts left; the ones column is left empty, so a 0 fills it. |

Check: $6 \times 1000 = 6000$, and $6270$ is close to $6000$, so it is reasonable. ✓

### *Example 2 — with help*

A tank holds $84.6$ L. Find $84.6 \div 10$ and $84.6 \div 100$, and say what each answer would mean if the tank were shared out.

| Working | Comment |
|---|---|
| $84.6 \div 10 = 8.46$ | Every digit shifts one place right. |
| $84.6 \div 100 = 0.846$ | Two shifts right; a 0 fills the empty ones place. |

Dividing makes the number smaller, and both answers are smaller than $84.6$. ✓ Sharing $84.6$ L ten ways gives $8.46$ L each; a hundred ways gives $0.846$ L each.

### *Example 3 — on your own*

One crate of milk holds $3.6$ L. How many litres do 40 crates hold?

Split 40 into $4 \times 10$. First $3.6 \times 4 = 14.4$ (basic facts: $36 \times 4 = 144$, so $3.6 \times 4 = 14.4$). Then $14.4 \times 10 = 144$, the digits shifting one place left. So 40 crates hold $144$ L.

Estimate check: $4 \times 40 = 160$, and $144$ is close to $160$. ✓

### *Example 4 — on your own*

A delivery is 58 boxes, and each box weighs about $2.9$ kg. About how many kilograms is the delivery?

The question asks *about how many*, so an estimate is enough. $2.9$ rounds to $3$; $58$ rounds to $60$, a multiple of 10. Then $3 \times 60 = 180$, so the delivery is about $180$ kg.

Check: the exact answer would be close to 180 — not 18 and not 1800 — so the estimate is reasonable. ✓

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## Practice questions

### *With help*

**Q1.** Multiply in your head. Each part is the same number times 10, times 100 and times 1000. (a) $4.7 \times 10$; $4.7 \times 100$; $4.7 \times 1000$ (b) $0.83 \times 10$; $0.83 \times 100$; $0.83 \times 1000$ (c) $12.05 \times 10$; $12.05 \times 100$; $12.05 \times 1000$ (d) $36 \times 10$; $36 \times 100$; $36 \times 1000$

**Q2.** Divide in your head. Each part is the same number divided by 10, by 100 and by 1000. (a) $274 \div 10$; $274 \div 100$; $274 \div 1000$ (b) $9 \div 10$; $9 \div 100$; $9 \div 1000$ (c) $3050 \div 10$; $3050 \div 100$; $3050 \div 1000$

**Q3.** Split the multiple into its single digit and its power of 10, then calculate. (a) $2.4 \times 20$ (b) $1.5 \times 30$ (c) $0.7 \times 50$ (d) $4.25 \times 200$ (e) $8.4 \div 20$ (f) $9.6 \div 40$ (g) $75 \div 300$ (h) $6.3 \div 30$

**Q4.** Find the missing number. (a) $4.05 \times \square = 405$ (b) $\square \times 10 = 426$ (c) $90 \div \square = 0.9$ (d) $3.08 \times \square = 308$ (e) $\square \times 100 = 205$ (f) $62 \div \square = 0.62$

**Q5.** Jordan writes $6.4 \times 10 = 6.40$. Is Jordan correct? Explain using place value, and give the correct answer if it is wrong.

**Q6.** The population of Victoria was 7 121 900 people at 31 December 2025.

Source: Australian Bureau of Statistics, *National, state and territory population*, December 2025 release. Retrieved 19 August 2026.

(a) Find the population times 10.
(b) Find the population divided by 10.
(c) Find the population times 100.
(d) Find the population divided by 100. What fraction of the population is this answer?

### *On your own*

**Q7.** Quick shifts — answer in your head. (a) $15.08 \times 10$ (b) $4.6 \times 10$ (c) $305.2 \div 100$ (d) $7 \div 100$ (e) $2.006 \times 100$ (f) $603 \div 10$

**Q8.** Fill in the missing number. Remember which way the digits shift. (a) $3.8$ km = ▢ m (b) $250$ mL = ▢ L (c) $0.45$ kg = ▢ g (d) $8$ cm = ▢ m

**Q9.** Follow the chain and fill in each answer. Then give the single step that does both shifts at once. (a) Start at $0.64$; multiply by 10; multiply by 10 again. (b) Start at $81.2$; divide by 10; divide by 10 again.

**Q10.** Estimate only — no exact working needed. Round to a multiple of 10 or 100 first. (a) $4.2 \times 198$ (b) $3.1 \times 72$ (c) $9.8 \times 41$

**Q11.** Tia says $18.6 \div 10 = 1.86$. Milo says $7.2 \times 10 = 7.2$. Who is correct? Explain the mistake in the other answer using place value.

**Q12.** Fill in the missing number. (a) $1.42$ m = ▢ cm (b) $23.7$ mm = ▢ cm (c) $0.01$ L = ▢ mL (d) 895 c = ▢ in dollars

**Q13.** "To multiply by 10, just add a zero." Explain why this trick seems to work for $45 \times 10$ but fails for $4.5 \times 10$.

**Q14.** Find the missing number, then make your own. (a) $▢ \times 100 = 425$ (b) $▢ \div 100 = 0.93$ (c) $7.04 \times ▢ = 704$ (d) Make up your own missing-number puzzle using $\times 10$, $\times 100$, $\div 10$ or $\div 100$, and swap it with a partner.

## Answers

**Q1.** (a) 47; 470; 4700. (b) 8.3; 83; 830. (c) 120.5; 1205; 12 050. (d) 360; 3600; 36 000. **Q2.** (a) 27.4; 2.74; 0.274. (b) 0.9; 0.09; 0.009. (c) 305; 30.5; 3.05. **Q3.** (a) 48; (b) 45; (c) 35; (d) 850; (e) 0.42; (f) 0.24; (g) 0.25; (h) 0.21. **Q4.** (a) 100; (b) 42.6; (c) 100; (d) 100; (e) 2.05; (f) 100. **Q5.** Not correct; 64. **Q6.** (a) 71 219 000; (b) 712 190; (c) 712 190 000; (d) 71 219 — one part in 100 of the population. **Q7.** (a) 150.8; (b) 46; (c) 3.052; (d) 0.07; (e) 200.6; (f) 60.3. **Q8.** (a) 3800; (b) 0.25; (c) 450; (d) 0.08. **Q9.** (a) 6.4, 64; $\times 100$. (b) 8.12, 0.812; $\div 100$. **Q10.** (a) about 800; (b) about 210; (c) about 400. **Q11.** Tia; Milo's should be 72. **Q12.** (a) 142; (b) 2.37; (c) 10; (d) \$8.95. **Q13.** See worked solutions. **Q14.** (a) 4.25; (b) 93; (c) 100; (d) answers will vary.

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## Worked solutions

**Q1.** Each digit shifts left: one place for $\times 10$, two for $\times 100$, three for $\times 1000$, with zeros filling any empty columns. (a) 47; 470; 4700. (b) 8.3; 83; 830. (c) 120.5; 1205; 12 050. (d) 360; 3600; 36 000.

**Q2.** Each digit shifts right: one place for $\div 10$, two for $\div 100$, three for $\div 1000$, with zeros filling any empty columns. (a) 27.4; 2.74; 0.274. (b) 0.9; 0.09; 0.009. (c) 305; 30.5; 3.05.

**Q3.** (a) $2.4 \times 2 = 4.8$, then $4.8 \times 10 = 48$. (b) $1.5 \times 3 = 4.5$, then $4.5 \times 10 = 45$. (c) $0.7 \times 5 = 3.5$, then $3.5 \times 10 = 35$. (d) $4.25 \times 2 = 8.5$, then $8.5 \times 100 = 850$. (e) $8.4 \div 2 = 4.2$, then $4.2 \div 10 = 0.42$. (f) $9.6 \div 4 = 2.4$, then $2.4 \div 10 = 0.24$. (g) $75 \div 3 = 25$, then $25 \div 100 = 0.25$. (h) $6.3 \div 3 = 2.1$, then $2.1 \div 10 = 0.21$.

**Q4.** (a) $4.05 \rightarrow 405$ is two shifts left, so $\square = 100$. (b) $426 \div 10 = 42.6$. (c) $90 \rightarrow 0.9$ is two shifts right, so $\square = 100$. (d) $3.08 \rightarrow 308$ is two shifts left, so $\square = 100$. (e) $205 \div 100 = 2.05$. (f) $62 \rightarrow 0.62$ is two shifts right, so $\square = 100$.

**Q5.** Not correct. 6.40 is the same number as 6.4 — the extra 0 is a placeholder, so nothing has been multiplied. Multiplying by 10 shifts every digit one place left: 6 ones become 6 tens and 4 tenths become 4 ones, giving 64.

**Q6.** (a) $7\,121\,900 \times 10 = 71\,219\,000$. (b) $7\,121\,900 \div 10 = 712\,190$. (c) $7\,121\,900 \times 100 = 712\,190\,000$. (d) $7\,121\,900 \div 100 = 71\,219$; dividing by 100 gives one part in 100 of the population.

**Q7.** (a) One shift left: 150.8. (b) One shift left: 46. (c) Two shifts right: 3.052. (d) Two shifts right: 0.07. (e) Two shifts left: 200.6. (f) One shift right: 60.3.

**Q8.** (a) km to m is $\times 1000$: 3800 m. (b) mL to L is $\div 1000$: 0.25 L. (c) kg to g is $\times 1000$: 450 g. (d) cm to m is $\div 100$: 0.08 m.

**Q9.** (a) $0.64 \rightarrow 6.4 \rightarrow 64$; two left-shifts is one $\times 100$ step. (b) $81.2 \rightarrow 8.12 \rightarrow 0.812$; two right-shifts is one $\div 100$ step.

**Q10.** (a) $4 \times 200 = 800$, so about 800. (b) $3 \times 70 = 210$, so about 210. (c) $10 \times 40 = 400$, so about 400. Each estimate is a multiple-of-10 product done in the head; the exact answer would be close to the estimate.

**Q11.** Tia is correct: dividing by 10 shifts every digit one place right, so $18.6 \rightarrow 1.86$. Milo is wrong: multiplying by 10 must make the number 10 times larger, so the digits shift one place left and $7.2 \times 10 = 72$, not 7.2. Writing 7.20 would only add a placeholder — the value would not change.

**Q12.** (a) m to cm is $\times 100$: 142 cm. (b) mm to cm is $\div 10$: 2.37 cm. (c) L to mL is $\times 1000$: 10 mL. (d) cents to dollars is $\div 100$: \$8.95.

**Q13.** For $45 \times 10 = 450$, writing a 0 after the 45 happens to give the right answer, because every digit of 45 shifts one place left (4 tens become 4 hundreds, 5 ones become 5 tens) and the new 0 fills the ones place that the 5 left. For $4.5 \times 10$, "adding a zero" gives 4.50, which is the same number as 4.5 — no digit has moved, so nothing has been multiplied. The correct answer shifts the digits: 4 ones become 4 tens and 5 tenths become 5 ones, giving 45. The trick only ever "works" for whole numbers, because the ones place is the last column a left-shift leaves empty.

**Q14.** (a) $425 \div 100 = 4.25$. (b) $0.93 \times 100 = 93$. (c) $7.04 \rightarrow 704$ is two shifts left, so $\square = 100$. (d) Sample: $\square \times 10 = 8.06$, answer 0.806 — any puzzle whose missing number follows a shift is acceptable.

## What comes next

Subtopic 2E puts these same shifts to work on percentages — 10% of a number is the number divided by 10, and 1% is the number divided by 100, so $7\,121\,900 \div 100 = 71\,219$ is both "divided by 100" and "1% of the population". Then subtopic 5A takes the $\times 1000$ and $\div 1000$ steps into metric conversion across the full set of units — the reason 2D is taught before 5A.

## Finding a fraction, decimal or percentage of a quantity

**Content description VC2M6N07:** solve problems that require finding a familiar fraction, decimal or percentage of a quantity, including percentage discounts, choosing efficient calculation strategies with and without digital tools

*Half of a pizza, 25% off a game, 0.5 of a litre of juice — these are all the same kind of question. Each one asks for a part of a quantity. By the end of this subtopic you will have quick, sure ways to find that part, whether it is given as a fraction, a decimal or a percentage.*

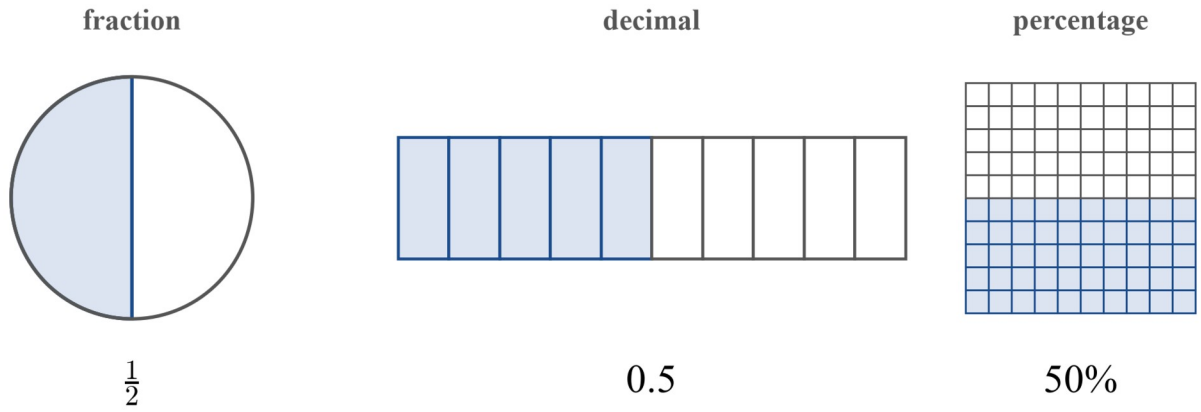
### Theory

#### *Three ways to name the same part*

Last year you learned that **100% is the whole of something**, and that familiar percentages, fractions and decimals can name the same amount. Half of a quantity can be written three ways:

$$\frac{1}{2} = 0.5 = 50\,\%$$

They look different but they name exactly the same part. Here are the ones you already know, plus a few new friends.




Three ways to name the same part: $\frac{1}{2} = 0.5 = 50\%$

*Three models of the same amount: a circle with one half shaded, a strip of ten parts with five parts shaded, and a hundred square with fifty squares shaded, named as one half, 0.5 and 50 percent*

| Fraction | Decimal | Percentage |
|---|---|---|
| $\frac{1}{2}$ | 0.5 | 50% |
| $\frac{1}{4}$ | 0.25 | 25% |
| $\frac{3}{4}$ | 0.75 | 75% |
| $\frac{1}{5}$ | 0.2 | 20% |
| $\frac{1}{10}$ | 0.1 | 10% |
| $\frac{1}{8}$ | 0.125 | 12.5% |

| Fraction | Decimal | Percentage |
|---|---|---|
| $\frac{1}{3}$ | 0.333… | $33\frac{1}{3}\%$ |
| $\frac{2}{3}$ | 0.666… | $66\frac{2}{3}\%$ |
| $\frac{1}{100}$ | 0.01 | 1% |

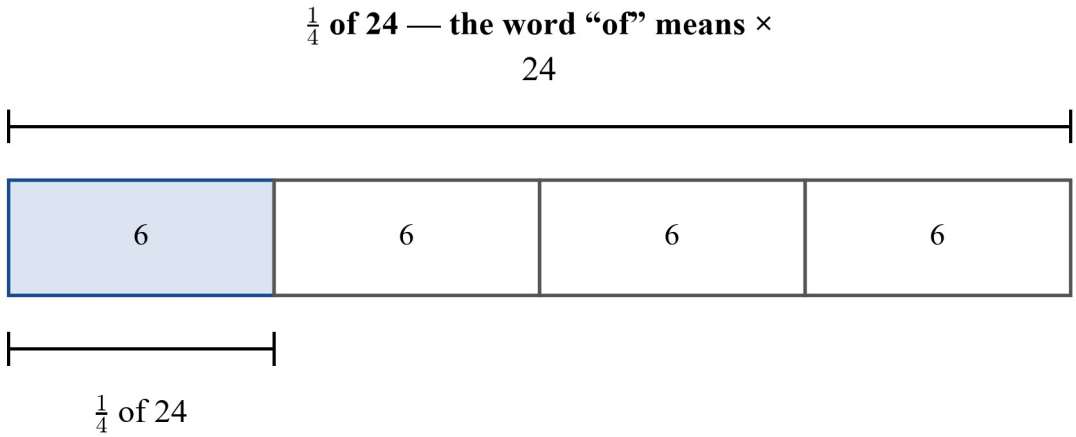
The new ones to remember are **12.5%**, $33\frac{1}{3}$**%** and $66\frac{2}{3}$**%**. Keep this table handy — it does a lot of the work in this subtopic.

### *"Of" means ×*

In maths, the word **of** next to a quantity usually means **multiply**:

$$\frac{1}{4} \times 24 = 24 \div 4 = 6, \text{so } \frac{1}{4} \text{ of } 24 = 6.$$

Writing the situation as a number sentence first — like $\frac{1}{4} \times 24$ — keeps the question clear before you work anything out.




*A bar of 24 split into four equal parts of 6, with one part shaded, showing that one quarter of 24 is 24 divided by 4, which is 6*

### *Unit fractions: divide by the bottom number*

A **unit fraction** has 1 on top: $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{8}, \frac{1}{10}$. Finding one is easy — **divide by the number on the bottom**:

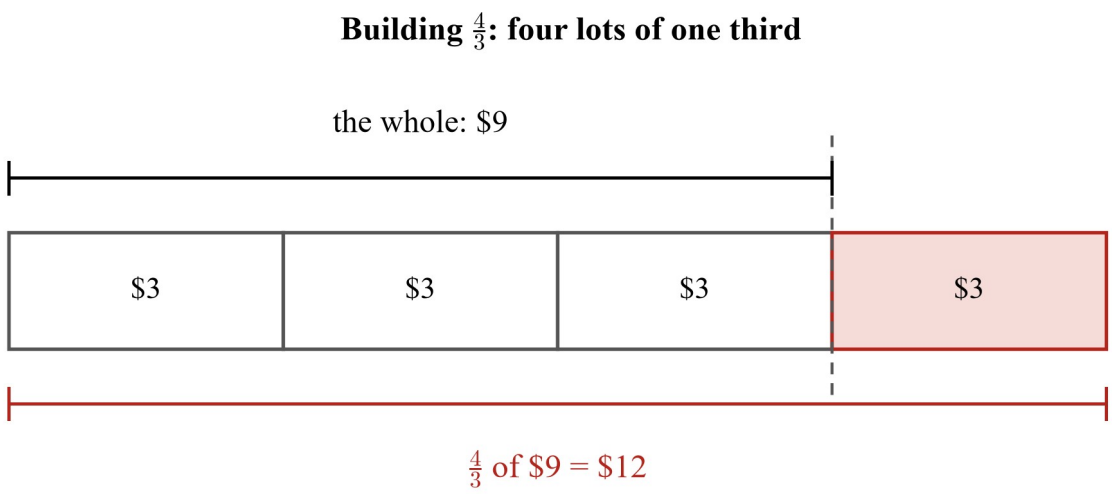
$\frac{1}{3}$ of a quantity = the quantity ÷ 3

Once you have the unit fraction, you can build the others by multiplying:

- $\frac{2}{3}$ of a quantity = 2 × (one third of it)

- $\frac{4}{3}$ of a quantity = 4 × (one third of it)

Notice that $\frac{4}{3}$ is **more than one whole**: $\frac{4}{3}$ of \$9 is \$12, which is more than \$9. Fractions greater than 1 give answers greater than the quantity you started with.




$\frac{4}{3}$ is more than one whole: \$12 is more than the \$9 you started with.

*A bar of 9 dollars split into three equal parts of 3 dollars, with a fourth part added past the end of the bar, showing that four thirds of 9 dollars is 12 dollars, more than the whole 9 dollars*

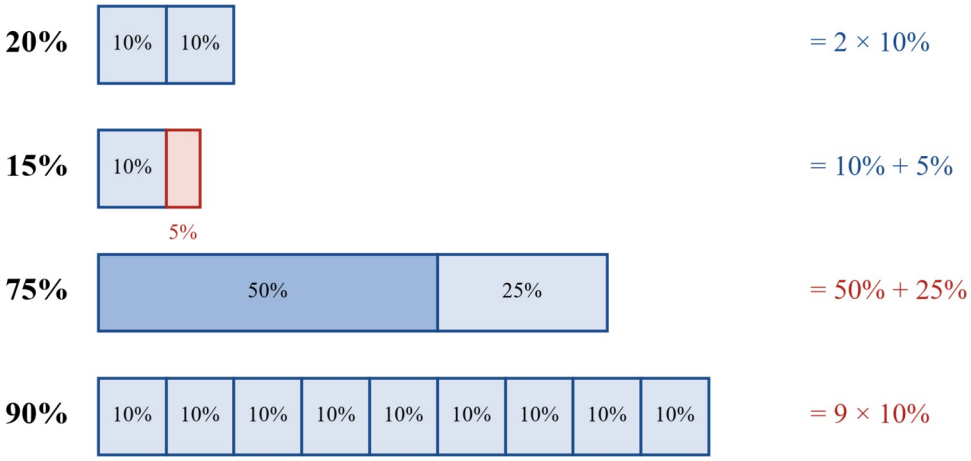
### *Percentages: build them from the big ones you know*

Five percentages unlock nearly everything: **50%, 25%, 10%, 5% and 1%**.

- **50%** = half → divide by 2
- **25%** = a quarter → divide by 4
- **10%** → divide by 10
- **5%** = half of 10%
- **1%** → divide by 100

Every other familiar percentage is built from these:

- 20% = 2 × 10%
- 30% = 3 × 10%
- 15% = 10% + 5%
- 75% = 50% + 25%
- 90% = 9 × 10% (or 100% − 10%)




Every familiar percentage is built from five blocks: 50%, 25%, 10%, 5% and 1%.

*Rows of blocks building percentages from the big blocks: 20 percent as two 10 percent blocks, 15 percent as a 10 percent block plus a 5 percent block, 75 percent as a 50 percent block plus a 25 percent block, and 90 percent as nine 10 percent blocks*

Because **per cent** means **for each 100**, 1% is 1 out of every 100, so $1\% = \frac{1}{100} = 0.01$, and $10\% = \frac{10}{100} = \frac{1}{10} = 0.1$.

### *Decimals of a quantity*

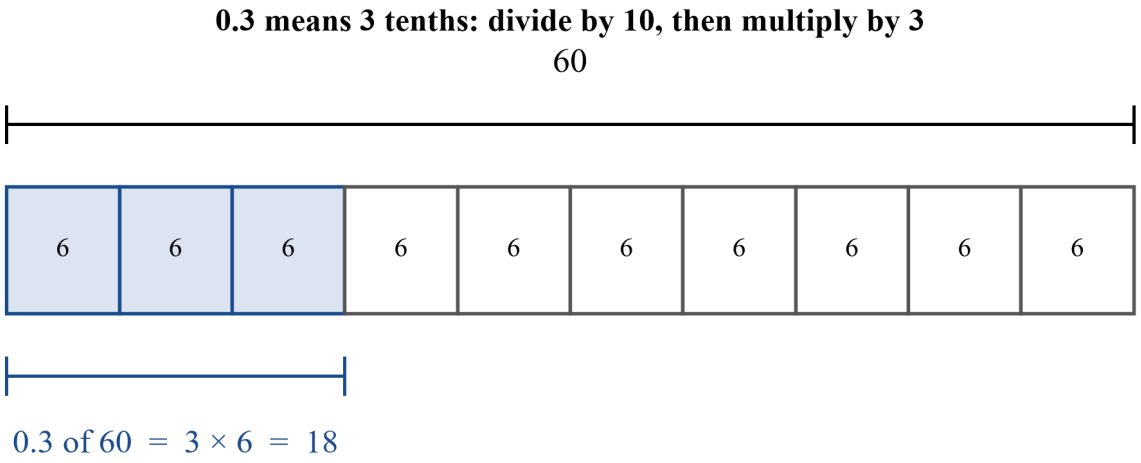
Decimals work the same way. The decimal tells you which fraction to use:

- **0.5** of a quantity = half of it
- **0.25** of a quantity = a quarter of it
- **0.1** of a quantity = $\frac{1}{10}$ of it

For a decimal in tenths, divide by 10 and then multiply. For example, to find **0.3 of 60**:

$$60 \div 10 = 6, 3 \times 6 = 18, \text{so } 0.3 \times 60 = 18.$$

That is the same as finding 30% of 60, because 0.3 = 30%.




60 ÷ 10 = 6, then 3 × 6 = 18, so 0.3 × 60 = 18 (the same as 30% of 60).

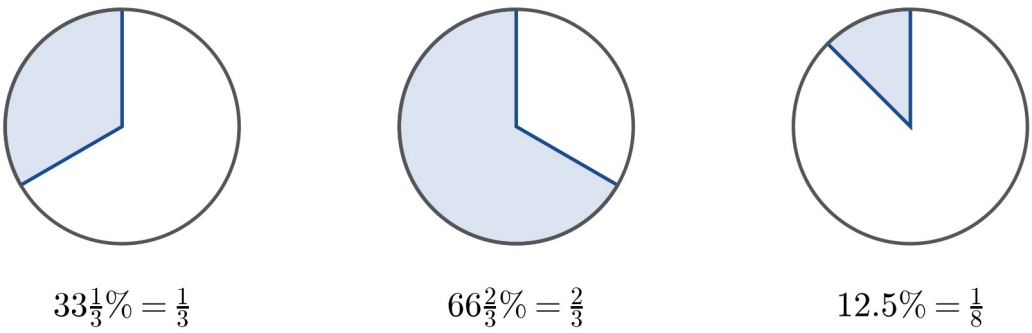
*A bar of 60 split into ten equal parts of 6, with three parts shaded, showing that 0.3 of 60 is 3 times 6, which is 18*

### *Friendships to remember*

Some percentages are really fractions in disguise:

- $33\frac{1}{3}\% = \frac{1}{3}$ — so $33\frac{1}{3}\%$ of a quantity is the quantity ÷ 3
- $66\frac{2}{3}\% = \frac{2}{3}$ — so find one third, then double it
- $12.5\% = \frac{1}{8}$ — so the quantity ÷ 8

When you see one of these, use the fraction. It is nearly always the fastest way.




These percentages are really fractions in disguise — when you see one, use the fraction.

*Three circles, one with one third shaded, one with two thirds shaded and one split into eight parts with one part shaded, matched with the percentages 33 and one third percent, 66 and two thirds percent and 12.5 percent*

### *Discounts*

A **discount** is an amount taken off the full price. Shops often give discounts as percentages: a **10% discount**, a **25% discount**, or a big **50% discount** — which is a half-price sale.

Two steps answer every discount question:

1. **Find the discount.** The discount is that percentage **of the full price**.
2. **Find the sale price.** sale price = full price − discount.

*Example in words:* a $40 toy with 25% off. The discount is 25% of $40, which is $10. The sale price is $40 − $10 = $30.


*A bar of 40 dollars split into four equal parts of 10 dollars, with one part marked as the 25 percent discount of 10 dollars and three parts marked as the sale price of 30 dollars*

### *Choosing how to work it out*

The same question can be done several ways. Part of the skill is **choosing an efficient way** — one that gets you to a correct answer without extra work.

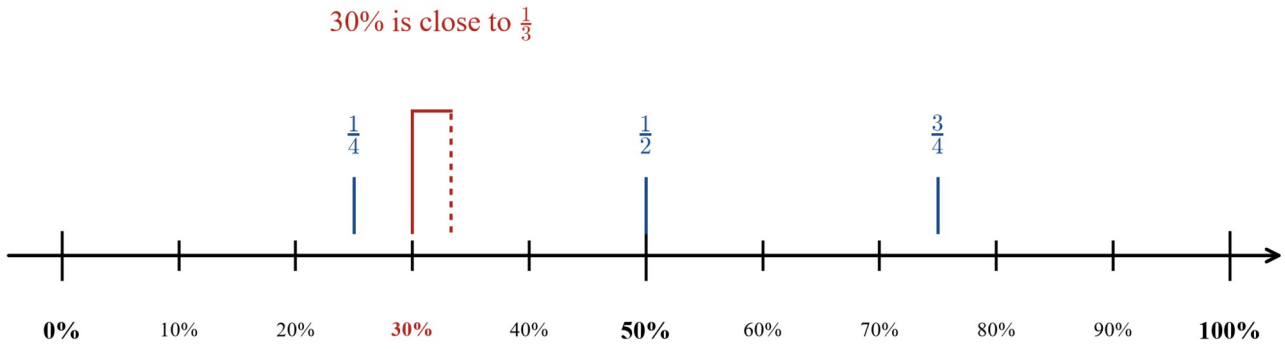
- **In your head** — when the numbers are friendly: 50% of 96, 25% of 40, $\frac{1}{3}$ of 27. Use the big building blocks.
- **On paper** — when there are a few steps, like 15% of $84 (find 10%, then 5%, then add).
- **With a calculator** — when the numbers are not friendly, or when money has cents. To find 25% of 36, key in `0.25 × 36 =`.
- **With a spreadsheet** — when the same calculation is needed for a whole list, like the discount on every item in a sale. Put the rule in one cell and fill it down the column.

You will practise **both** ways in this subtopic: some questions are best done by hand, and some are marked *digital tools*, where a calculator or spreadsheet is welcome.

### *Check as you go*

Before you start, get a rough idea of the answer. 30% is close to $\frac{1}{3}$; 25% is a quarter; 50% is a half. If your exact answer is far from your rough one, stop and check. And always ask: *does this answer make sense in the question?* A

discount makes a price smaller, $\frac{4}{3}$ of a quantity gives more than you started with, and a percentage of a quantity never gives more than the 100% whole unless the fraction is greater than 1.




Quick checks: 25% is one quarter, 50% is one half, 75% is three quarters.

*A number line from 0 percent to 100 percent with one quarter marked at 25 percent, one half at 50 percent and three quarters at 75 percent, and 30 percent marked close to one third*

### *Words of this subtopic*

| Word | What it means here | Other words you might see |
|---|---|---|
| **quantity** | the amount you are taking a part of | amount, number, total |
| **unit fraction** | a fraction with 1 on top, like $\frac{1}{4}$ | — |
| **discount** | an amount taken off the full price | money off, reduction |
| **sale price** | the price after the discount is taken off | new price |
| **equivalent** | naming the same amount in a different form | equal in value |
| **digital tool** | a calculator, a spreadsheet, or any other technology that does calculations for you | technology |

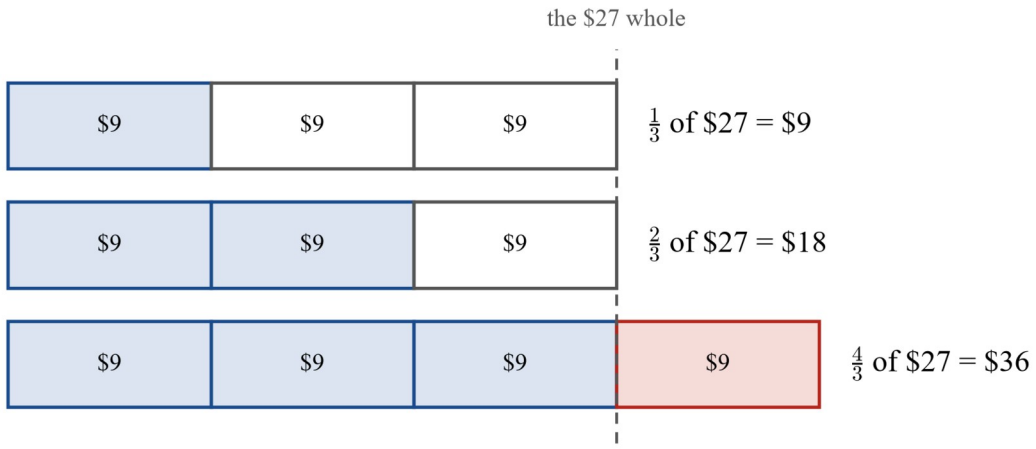
## Worked examples

### *Example 1 — with help*

Find $\frac{1}{3}$ of \$27. Then use your answer to find $\frac{2}{3}$ of \$27 and $\frac{4}{3}$ of \$27.

| Working | Comment |
|---|---|
| $27 \div 3 = 9$, so $\frac{1}{3}$ of \$27 is **\$9**. | To find one third, divide by 3. |
| $2 \times 9 = 18$, so $\frac{2}{3}$ of \$27 is **\$18**. | Two thirds is 2 lots of one third. |
| $4 \times 9 = 36$, so $\frac{4}{3}$ of \$27 is **\$36**. | Four thirds is 4 lots of one third — more than the \$27 you started with. |

$\therefore \frac{1}{3}$ of \$27 = \$9, $\frac{2}{3}$ of \$27 = \$18 and $\frac{4}{3}$ of \$27 = \$36.




One third of \$27 is \$9 — two thirds is 2 lots of \$9, four thirds is 4 lots of \$9.

*Bars split into thirds of 27 dollars, showing one third as 9 dollars, two thirds as 18 dollars and four thirds as 36 dollars, one third past the whole*

### *Example 2 — with help*

A roll of ribbon is 90 m long. Priya uses 30% of it. How much ribbon does she use?

| Working | Comment |
|---|---|
| 10% of 90 m = $90 \div 10 = 9$ m. | Start with the 10% building block. |
| 30% = 3 × 10%, so $3 \times 9 = 27$ m. | Build 30% from three 10% blocks. |

$30\% = 0.3$, so this is the same as finding $0.3 \times 90$.

∴ Priya uses **27 m** of ribbon.

### *Example 3 — with help*

A game normally costs \$36. A shop has it for sale with **25% off**. Find the discount and the sale price.

| Working | Comment |
|---|---|
| 25% of \$36: $36 \div 4 = 9$. | 25% = $\frac{1}{4}$, so divide by 4. (The decimal way is $0.25 \times 36 = 9$ — the same answer.) |
| The discount is **\$9**. | The discount is 25% **of the full price**. |
| Sale price: $36 - 9 = 27$. | sale price = full price − discount. |

∴ The discount is \$9 and the sale price is **\$27**.

### *Example 4 — with help*

A bottle holds 2 L of juice. A glass holds 0.3 of the bottle. How many litres does the glass hold?

| Working | Comment |
|---|---|
| 0.3 means 3 tenths, so divide by 10 first: $2 \div 10 = 0.2$. | 0.1 of 2 L is 0.2 L. |
| Now multiply by 3: $3 \times 0.2 = 0.6$. | 0.3 is 3 tenths. |

∴ The glass holds **0.6 L** (which is 600 mL).

### *Example 5 — on your own*

A school has 64 students in Year 6. Exactly 12.5% of them ride their bike to school. How many students is that?

12.5% = $\frac{1}{8}$, so the question is really asking for $\frac{1}{8}$ of 64:

$$64 \div 8 = 8$$

∴ **8 students** ride their bike to school.

### *Example 6 — on your own*

Find 15% of \$84.

Build 15% from 10% and 5%:

$$10\,\%\text{ of }84 = 84 \div 10 = 8.40$$

$$5\,\%\text{ of }84 = \text{half of }8.40 = 4.20$$

$$15\,\%\text{ of }84 = 8.40 + 4.20 = 12.60$$

∴ 15% of \$84 is **\$12.60**.

### *Example 7 — on your own*

A movie is 2 hours long. Nao has watched $\frac{5}{8}$ of it. How many minutes has she watched?

Change 2 hours to 120 minutes, then divide by 8 and multiply by 5:

$$120 \div 8 = 15,\ 5 \times 15 = 75$$

∴ Nao has watched **75 minutes**.

### *Example 8 — on your own (digital-tool path)*

An online toy sale gives **10% off every item**. Three items cost \$15, \$28 and \$45. Find the discount and the sale price for each item **using a spreadsheet or a calculator**.

In a spreadsheet, put the full prices in one column. In the discount column use the rule **discount = 0.10 × price** (because 10% = 0.10), and in the sale price column use **sale price = price − discount**. Fill each rule down the column:

| Item price | Discount = 0.10 × price | Sale price |
|---:|---:|---:|
| \$15 | \$1.50 | \$13.50 |
| \$28 | \$2.80 | \$25.20 |
| \$45 | \$4.50 | \$40.50 |

| | A | B | C |
|---|---|---|---|
| 1 | **Item price** | **Discount = 0.10 × price** | **Sale price** |
| 2 | \$15 | \$1.50 | \$13.50 |
| 3 | \$28 | \$2.80 | \$25.20 |
| 4 | \$45 | \$4.50 | \$40.50 |


Put each rule in one cell — discount = 0.10 × price, sale price = price − discount — then fill it down the column.

*A spreadsheet with the prices 15, 28 and 45 dollars in one column, the rule discount is 0.10 times the price filled down the next column, and the sale prices 13.50, 25.20 and 40.50 dollars in the last column*

With a calculator instead: key `0.10 × 15 =` to get the \$1.50 discount, then `15 − 1.50 =` for the sale price, and repeat for each item.

∴ The sale prices are **\$13.50**, **\$25.20** and **\$40.50**.

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## Practice questions

*Do the questions in this section without a calculator unless they are marked **digital tools** — those are the ones where a calculator or spreadsheet is part of the skill.*

### *With help*

**Q1.** Copy and complete the table. Three ways to name the same part.

| Fraction | Decimal | Percentage |
|---|---|---|
| $\frac{1}{2}$ | 0.5 | 50% |
| $\frac{1}{4}$ | ▢ | ▢ |
| ▢ | 0.75 | ▢ |
| $\frac{1}{5}$ | ▢ | ▢ |
| ▢ | ▢ | 10% |
| $\frac{1}{8}$ | ▢ | ▢ |

**Q2.** Find each unit fraction. *Divide by the number on the bottom.*

a. $\frac{1}{4}$ of 24

b. $\frac{1}{3}$ of 42

c. $\frac{1}{5}$ of 35

d. $\frac{1}{8}$ of 56

e. $\frac{1}{10}$ of 90

f. $\frac{1}{100}$ of 500

**Q3.** Use the unit fraction to build the others.

a. $\frac{1}{3}$ of 18 = 6, so $\frac{2}{3}$ of 18 = ▢

b. $\frac{1}{3}$ of 18 = 6, so $\frac{4}{3}$ of 18 = ▢

c. $\frac{1}{4}$ of 40 = 10, so $\frac{3}{4}$ of 40 = ▢

d. $\frac{1}{4}$ of 40 = 10, so $\frac{5}{4}$ of 40 = ▢

**Q4.** Build from 10%. *First find 10% by dividing by 10.*

a. 10% of 70
b. 20% of 70
c. 30% of 70
d. 40% of 70

**Q5.** Build from smaller blocks.

a. 10% of 300 = ▢
b. 5% of 300 = ▢ *(half of 10%)*
c. 15% of 300 = ▢ *(10% + 5%)*
d. 1% of 300 = ▢
e. 3% of 300 = ▢
f. 11% of 300 = ▢ *(10% + 1%)*

**Q6.** Make each percentage from the big blocks. Fill in the blanks.

a. 15% = 10% + ▢%
b. 25% = ▢ × 5%
c. 75% = 50% + ▢%
d. 45% = ▢ × 10% + 5%
e. 90% = ▢ × 10%
f. 20% = ▢ × 10%

**Q7.** A shop takes **10% off** every item. Copy and complete the table.

| Full price | Discount (10%) | Sale price |
|---|---|---|
| $30 | ▢ | ▢ |
| $50 | ▢ | ▢ |
| $18 | ▢ | ▢ |
| $75 | ▢ | ▢ |

**Q8.** Find each decimal of 24.

a. 0.5 of 24
b. 0.25 of 24

c. 0.1 of 24
d. 0.75 of 24

**Q9.** Write each situation as a number sentence, then solve it.

a. $\frac{2}{3}$ of 21
b. 25% of 48
c. 30% of 60

**Q10.** Calculator keys. *(You may use a calculator.)*

a. To find 25% of 36 you can key in `0.25 × 36 =`. What does the display show?
b. Write the keys you would use to find 50% of 84, and give the answer.
c. In words, what does the calculation `0.1 × 46` find?

### *On your own*

**Q11.** Find each amount.

a. $\frac{3}{5}$ of 35 apples
b. $\frac{5}{8}$ of 48 m of rope
c. $\frac{2}{3}$ of \$45
d. $\frac{3}{4}$ of 60 minutes
e. $\frac{2}{5}$ of 45 players
f. $\frac{1}{4}$ of 500 mL
g. $\frac{3}{5}$ of 25 kg of flour

**Q12.** Fractions greater than 1.

a. $\frac{4}{3}$ of 12
b. $\frac{5}{4}$ of 24
c. $\frac{3}{2}$ of 50
d. Is $\frac{5}{3}$ of 9 more than 9 or less than 9? Explain how you know.

**Q13.** Find each percentage.

a. 30% of 70
b. 20% of 85
c. 15% of 60
d. 75% of 240
e. 45% of 200
f. 5% of \$90

**Q14.** Use the friendships.

a. 12.5% of 48

b. $33\frac{1}{3}$% of 27

c. $66\frac{2}{3}$% of 36

d. 12.5% of 200

**Q15.** Find each decimal.

a. 0.2 of 35
b. 0.75 of 40
c. 0.05 of 200
d. 0.4 of 15
e. 0.1 of 128

**Q16.** A clothing store has **25% off** everything. Copy and complete the table.

| Full price | Discount (25%) | Sale price |
|---|---|---|
| $24 | ▢ | ▢ |
| $32 | ▢ | ▢ |
| $56 | ▢ | ▢ |
| $18 | ▢ | ▢ |

**Q17.** Half-price sale — everything is **50% off**.

a. A movie ticket, normally $16
b. A pizza, normally $14
c. A game, normally $49
d. 50% off has another name. What is it?

**Q18.** Without working anything out exactly, say which is larger in each pair. Then check by finding both.

a. 30% of 50, or $\frac{1}{2}$ of 35

b. 25% of 80, or 10% of 150

**Q19.** Write each situation as a number sentence, then answer it **in terms of the situation**.

a. A box holds 32 chocolates. One quarter of them are eaten. How many are eaten?
b. 40 students go to camp. 30% of them travel by bus. How many travel by bus?
c. A 500 mL bottle of water is one fifth full. How many millilitres are in the bottle?

**Q20.** *Digital tools.* An online toy sale gives **10% off** everything.

a. Use a calculator or a spreadsheet to find the sale price of items that cost $15, $28 and $45.
b. Instead of finding the discount and subtracting it, you can multiply the price by 0.90 to get the sale price directly. Why does that work?

**Q21.** Mia saves $\frac{2}{5}$ of her $45 pocket money each week.

a. How much does she save each week?
b. One week she spends half of that week's savings on a book. How much does the book cost?
c. How much of that week's savings does she have left?

**Q22.** True or false? Correct each false statement.

a. 10% of 90 is 9.
b. 0.5 of 48 is 9.6.
c. With 25% off \$20, the sale price is \$5.
d. $\frac{2}{3}$ of 12 is 8.
e. 12.5% = $\frac{1}{8}$.

### *Maths in real life*

**Q23.** The population of Victoria was 7 121 900 people at 31 December 2025.

Source: Australian Bureau of Statistics, *National, state and territory population*, December 2025 release. Retrieved 19 August 2026.

a. Find 10% of this population.
b. Find 1% of this population.
c. Find 50% of this population.
d. Find 25% of this population.

**Q24.** The Year 6 class runs a stall at the school fete. Cakes cost \$4, cookies cost \$2 and drinks cost \$3. After 2 pm, everything is **25% off**.

a. Find the discount, and the sale price, on a cake.
b. Find the discount, and the sale price, on a cookie.
c. Find the discount, and the sale price, on a drink.
d. Sam buys one cake, one cookie and one drink after 2 pm. He pays with a \$10 note. How much change does he get?

**Q25.** In Australia, shops add an extra 10% tax to most prices. A bike shop sells a bike for \$280 before the tax is added.

a. Find the amount of tax on the bike.
b. Find the total price of the bike with the tax added.

### *Choosing your strategy*

**Q26.** Match each item on the left with the item on the right that names the same amount.

i. $33\frac{1}{3}\%$ · ii. 0.2 · iii. $\frac{3}{4}$ · iv. 12.5% · v. $\frac{2}{3}$

a. 75% · b. $\frac{1}{8}$ · c. $\frac{1}{3}$ · d. 20% · e. $66\frac{2}{3}\%$

**Q27.** Work out each amount, then write the four amounts in order from smallest to largest.

25% of 40 · $\frac{1}{2}$ of 30 · 10% of 90 · $\frac{3}{4}$ of 16

**Q28.** For each calculation, choose: **head**, **paper**, **calculator** or **spreadsheet**. Give a reason for each choice, then find the answer.

a. 50% of 96
b. 15% of \$84
c. 10% of 7 121 900 *(digital tools permitted)*
d. 12.5% of 37

**Q29.** Make your own. Write a discount question for a partner to solve: choose a full price and a discount of 10%, 25% or 50%. Work out the answer yourself so you can mark their work.

## Answers

**Q1.** $\frac{1}{4} = 0.25 = 25\%$; $0.75 = \frac{3}{4} = 75\%$; $\frac{1}{5} = 0.2 = 20\%$; $10\% = \frac{1}{10} = 0.1$; $\frac{1}{8} = 0.125 = 12.5\%$.

**Q2.** a. 6 b. 14 c. 7 d. 7 e. 9 f. 5.

**Q3.** a. 12 b. 24 c. 30 d. 50.

**Q4.** a. 7 b. 14 c. 21 d. 28.

**Q5.** a. 30 b. 15 c. 45 d. 3 e. 9 f. 33.

**Q6.** a. 5 b. 5 c. 25 d. 4 e. 9 f. 2.

**Q7.** \$30 → \$3, \$27; \$50 → \$5, \$45; \$18 → \$1.80, \$16.20; \$75 → \$7.50, \$67.50.

**Q8.** a. 12 b. 6 c. 2.4 d. 18.

**Q9.** a. $\frac{2}{3} \times 21 = 14$; b. $0.25 \times 48 = 12$ (or $48 \div 4$); c. $0.3 \times 60 = 18$.

**Q10.** a. 9; b. `0.5 × 84 =`, answer 42; c. 10% of 46 ($\frac{1}{10}$ of 46), which is 4.6.

**Q11.** a. 21 apples b. 30 m c. \$30 d. 45 minutes e. 18 players f. 125 mL g. 15 kg.

**Q12.** a. 16 b. 30 c. 75 d. More than 9, because $\frac{5}{3}$ is greater than 1 ($\frac{5}{3}$ of 9 is 15).

**Q13.** a. 21 b. 17 c. 9 d. 180 e. 90 f. \$4.50.

**Q14.** a. 6 b. 9 c. 24 d. 25.

**Q15.** a. 7 b. 30 c. 10 d. 6 e. 12.8.

**Q16.** \$24 → \$6, \$18; \$32 → \$8, \$24; \$56 → \$14, \$42; \$18 → \$4.50, \$13.50.

**Q17.** a. \$8 b. \$7 c. \$24.50 d. Half price.

**Q18.** a. $\frac{1}{2}$ of 35 (check: 30% of 50 = 15, $\frac{1}{2}$ of 35 = 17.5); b. 25% of 80 (check: 25% of 80 = 20, 10% of 150 = 15).

**Q19.** a. $\frac{1}{4} \times 32 = 8$: 8 chocolates are eaten. b. $0.3 \times 40 = 12$: 12 students travel by bus. c. $500 \div 5 = 100$: there are 100 mL in the bottle.

**Q20.** a. \$13.50, \$25.20, \$40.50; b. 100% − 10% = 90%, and 90% = 0.90, so 0.90 × price finds the sale price in one step.

**Q21.** a. \$18; b. \$9; c. \$9.

**Q22.** a. True; b. False — 0.5 of 48 is 24; c. False — \$5 is the discount; the sale price is \$15; d. True; e. True.

**Q23.** a. 712 190 people; b. 71 219 people; c. 3 560 950 people; d. 1 780 475 people.

**Q24.** a. \$1 off, sale price \$3; b. 50c off, sale price \$1.50; c. 75c off, sale price \$2.25; d. Sale total \$6.75, change \$3.25.

**Q25.** a. \$28; b. \$308.

**Q26.** i–c, ii–d, iii–a, iv–b, v–e.

**Q27.** 25% of 40 = 10; $\frac{1}{2}$ of 30 = 15; 10% of 90 = 9; $\frac{3}{4}$ of 16 = 12. Order: 10% of 90 (9), 25% of 40 (10), $\frac{3}{4}$ of 16 (12), $\frac{1}{2}$ of 30 (15).

**Q28.** Sample choices: a. head — 50% is a half, so 48; b. paper — 10% + 5% gives \$8.40 + \$4.20 = \$12.60; c. calculator or spreadsheet — the number is big: 712 190; d. calculator — 37 ÷ 8 does not give a whole-number answer: 4.625.

**Q29.** Answers will vary. Check: the discount must be 10%, 25% or 50% of the full price, and the sale price must be the full price with that discount taken away.

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## All the working

**Q1.** $\frac{1}{4}$ = 0.25 = 25%. 0.75 is three quarters, so it is $\frac{3}{4}$ = 75%. $\frac{1}{5}$ = 0.2 = 20%. 10% is 10 out of 100, which is $\frac{1}{10}$ = 0.1. $\frac{1}{8}$ = 0.125 = 12.5%.

**Q2.** Divide by the bottom number: a. $24 \div 4 = 6$; b. $42 \div 3 = 14$; c. $35 \div 5 = 7$; d. $56 \div 8 = 7$; e. $90 \div 10 = 9$; f. $500 \div 100 = 5$.

∴ a. 6 b. 14 c. 7 d. 7 e. 9 f. 5.

**Q3.** Multiply the unit fraction's answer: a. $2 \times 6 = 12$; b. $4 \times 6 = 24$; c. $3 \times 10 = 30$; d. $5 \times 10 = 50$.

∴ a. 12 b. 24 c. 30 d. 50.

**Q4.** 10% of $70 = 70 \div 10 = 7$. Then 20% = $2 \times 7 = 14$, 30% = $3 \times 7 = 21$, 40% = $4 \times 7 = 28$.

∴ a. 7 b. 14 c. 21 d. 28.

**Q5.** 10% of $300 = 300 \div 10 = 30$. 5% is half of 10%: $30 \div 2 = 15$. 15% = 10% + 5% = $30 + 15 = 45$. 1% of $300 = 300 \div 100 = 3$. 3% = $3 \times 3 = 9$. 11% = 10% + 1% = $30 + 3 = 33$.

∴ a. 30 b. 15 c. 45 d. 3 e. 9 f. 33.

**Q6.** a. 15% = 10% + **5**%; b. 25% = **5** × 5%; c. 75% = 50% + **25**%; d. 45% = **4** × 10% + 5%; e. 90% = **9** × 10%; f. 20% = **2** × 10%.

**Q7.** 10% means divide by 10, then subtract. \$30: discount $30 \div 10 = 3$, sale price $30 - 3 = 27$. \$50: discount 5, sale price 45. \$18: discount 1.80, sale price $18 - 1.80 = 16.20$. \$75: discount 7.50, sale price $75 - 7.50 = 67.50$.

∴ \$3, \$27; \$5, \$45; \$1.80, \$16.20; \$7.50, \$67.50.

**Q8.** 0.5 = half: $24 \div 2 = 12$. 0.25 = quarter: $24 \div 4 = 6$. 0.1 means ÷ 10: $24 \div 10 = 2.4$. 0.75 = three quarters: $6 \times 3 = 18$.

∴ a. 12 b. 6 c. 2.4 d. 18.

**Q9.** a. $\frac{2}{3} \times 21$: $21 \div 3 = 7$, $2 \times 7 = 14$. b. 25% of 48: $0.25 \times 48 = 48 \div 4 = 12$. c. 30% of 60: $0.3 \times 60 = 60 \div 10 \times 3 = 18$.

∴ a. 14 b. 12 c. 18.

**Q10.** a. `0.25 × 36 =` shows **9**. b. `0.5 × 84 =` shows **42**. c. `0.1 × 46` finds $\frac{1}{10}$ of 46 — that is, 10% of 46 — which is 4.6.

**Q11.** a. $35 \div 5 = 7$, $3 \times 7 = 21$ apples. b. $48 \div 8 = 6$, $5 \times 6 = 30$ m. c. $45 \div 3 = 15$, $2 \times 15 = 30$: \$30. d. $60 \div 4 = 15$, $3 \times 15 = 45$ minutes. e. $45 \div 5 = 9$, $2 \times 9 = 18$ players. f. $500 \div 4 = 125$ mL. g. $25 \div 5 = 5$, $3 \times 5 = 15$ kg.

∴ a. 21 apples b. 30 m c. \$30 d. 45 minutes e. 18 players f. 125 mL g. 15 kg.

**Q12.** a. $12 \div 3 = 4$, $4 \times 4 = 16$. b. $24 \div 4 = 6$, $5 \times 6 = 30$. c. $50 \div 2 = 25$, $3 \times 25 = 75$. d. $\frac{5}{3}$ is greater than 1 (5 thirds is more than 3 thirds), so $\frac{5}{3}$ of 9 is more than 9: $9 \div 3 = 3$, $5 \times 3 = 15$.

∴ a. 16 b. 30 c. 75 d. more than 9 (it is 15).

**Q13.** a. 30% of 70: $70 \div 10 = 7$, $3 \times 7 = 21$. b. 20% of 85: $85 \div 10 = 8.5$, $2 \times 8.5 = 17$. c. 15% of 60: 10% is 6, 5% is 3, so $6 + 3 = 9$. d. 75% of 240: $240 \div 4 = 60$, $3 \times 60 = 180$. e. 45% of 200: 4 × 10% = 80, plus 5% = 10, so $80 + 10 = 90$. f. 5% of \$90: 10% is \$9, half of that is \$4.50.

∴ a. 21 b. 17 c. 9 d. 180 e. 90 f. \$4.50.

**Q14.** a. 12.5% = $\frac{1}{8}$: $48 \div 8 = 6$. b. $33\frac{1}{3}\% = \frac{1}{3}$: $27 \div 3 = 9$. c. $66\frac{2}{3}\% = \frac{2}{3}$: $36 \div 3 = 12$, $2 \times 12 = 24$. d. $200 \div 8 = 25$.

∴ a. 6 b. 9 c. 24 d. 25.

**Q15.** a. 0.2 = $\frac{1}{5}$: $35 \div 5 = 7$. b. 0.75 = $\frac{3}{4}$: $40 \div 4 = 10$, $3 \times 10 = 30$. c. 0.05 = 5%: 10% of 200 is 20, half of that is 10. d. 0.4 = $\frac{4}{10}$: $15 \div 10 = 1.5$, $4 \times 1.5 = 6$. e. 0.1 means ÷ 10: $128 \div 10 = 12.8$.

∴ a. 7 b. 30 c. 10 d. 6 e. 12.8.

**Q16.** 25% = quarter: divide by 4, then subtract. \$24: discount 6, sale price $24 - 6 = 18$. \$32: discount 8, sale price 24. \$56: discount 14, sale price 42. \$18: discount 4.50, sale price $18 - 4.50 = 13.50$.

∴ \$6, \$18; \$8, \$24; \$14, \$42; \$4.50, \$13.50.

**Q17.** 50% off means half price: a. $16 \div 2 = 8$; b. $14 \div 2 = 7$; c. $49 \div 2 = 24.50$; d. 50% off is a **half-price** sale.

**Q18.** a. 30% is close to $\frac{1}{3}$, and $\frac{1}{3}$ of 50 is about 17, while $\frac{1}{2}$ of 35 is also about 17 — close call. Check exactly: 30% of 50 = 15; $\frac{1}{2}$ of 35 = 17.5. So $\frac{1}{2}$ of 35 is larger. b. 25% of 80 is about a quarter of 80 = 20; 10% of 150 = 15. So 25% of 80 is larger.

∴ a. $\frac{1}{2}$ of 35 b. 25% of 80.

**Q19.** a. $\frac{1}{4} \times 32 = 8$: **8 chocolates** are eaten. b. $0.3 \times 40$: $40 \div 10 = 4$, $3 \times 4 = 12$: **12 students** travel by bus.
c. $500 \div 5 = 100$: the bottle has **100 mL** of water.

**Q20.** a. 10% off: discount = 0.10 × price. \$15 → \$1.50 off, sale price \$13.50; \$28 → \$2.80 off, sale price \$25.20; \$45 → \$4.50 off, sale price \$40.50. b. The full price is 100%. Taking 10% off leaves 100% − 10% = 90% of the price, and 90% = 0.90, so multiplying the price by 0.90 gives the sale price in one step.

∴ a. \$13.50, \$25.20, \$40.50; b. because 100% − 10% = 90% = 0.90.

**Q21.** a. $\frac{2}{5}$ of \$45: $45 \div 5 = 9$, $2 \times 9 = 18$: Mia saves **\$18**. b. Half of \$18 is \$9: the book costs **\$9**. c. $18 - 9 = 9$: she has **\$9** left.

**Q22.** a. $90 \div 10 = 9$: **true**. b. 0.5 of 48 is $48 \div 2 = 24$, not 9.6: **false**. c. The discount is 25% of \$20 = \$5; the sale price is $20 - 5 = 15$: **false** (\$5 is the discount, not the sale price). d. $12 \div 3 = 4$, $2 \times 4 = 8$: **true**. e. $1 \div 8 = 0.125 = 12.5\%$: **true**.

**Q23.** The population is 7 121 900. a. 10%: $7\,121\,900 \div 10 = 712\,190$ people. b. 1%: $7\,121\,900 \div 100 = 71\,219$ people. c. 50%: $7\,121\,900 \div 2 = 3\,560\,950$ people. d. 25%: $3\,560\,950 \div 2 = 1\,780\,475$ people.

∴ a. 712 190 b. 71 219 c. 3 560 950 d. 1 780 475 people.

**Q24.** 25% off = a quarter off. a. Cake \$4: $4 \div 4 = 1$, so \$1 off and the sale price is $4 - 1 = 3$. b. Cookie \$2: $2 \div 4 = 0.50$, so 50c off and the sale price is \$1.50. c. Drink \$3: $3 \div 4 = 0.75$, so 75c off and the sale price is \$2.25. d. Sale total: $3 + 1.50 + 2.25 = 6.75$. Change from \$10: $10 - 6.75 = 3.25$.

∴ a. \$1 off, \$3; b. 50c off, \$1.50; c. 75c off, \$2.25; d. \$3.25 change.

**Q25.** a. The tax is 10% of \$280: $280 \div 10 = 28$: the tax is **\$28**. b. Total price: $280 + 28 = 308$: **\$308**.

**Q26.** $33\frac{1}{3}\% = \frac{1}{3}$ (c). 0.2 = 20% (d). $\frac{3}{4} = 75\%$ (a). $12.5\% = \frac{1}{8}$ (b). $\frac{2}{3} = 66\frac{2}{3}\%$ (e).

∴ i–c, ii–d, iii–a, iv–b, v–e.

**Q27.** 25% of 40 = $40 \div 4 = 10$. $\frac{1}{2}$ of 30 = 15. 10% of 90 = 9. $\frac{3}{4}$ of 16: $16 \div 4 = 4$, $3 \times 4 = 12$. From smallest to largest: 9, 10, 12, 15.

∴ 10% of 90, 25% of 40, $\frac{3}{4}$ of 16, $\frac{1}{2}$ of 30.

**Q28.** Sample answers — the reason must match the choice. a. **Head**: 50% is a half, so $96 \div 2 = 48$. b. **Paper**: 15% = 10% + 5%: 10% of \$84 = \$8.40, 5% = \$4.20, total \$12.60. c. **Calculator or spreadsheet**: 7 121 900 is a big number; divide by 10 to get 712 190. d. **Calculator**: 12.5% = $\frac{1}{8}$, and 37 ÷ 8 does not give a whole-number answer: $37 \div 8 = 4.625$.

**Q29.** Answers will vary. Example: *A book costs \$26. A shop has it with 25% off. Find the discount and the sale price.* Check: $26 \div 4 = 6.50$, so the discount is \$6.50 and the sale price is $26 - 6.50 = 19.50$. Mark your partner's work against your own solution.

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## What comes next

That closes Chapter 2. Next, Chapter 3 takes these same skills into estimation and money: in **3A** you will learn to approximate an answer before you calculate it, and in **3B** you will use fractions, decimals and percentages to plan budgets and savings, and to explain the choices you made (VC2M6N08, VC2M6N09).

In Year 7, percentages turn around: instead of finding a percentage **of** a quantity, you will express one quantity **as** a percentage of another, and you will meet ratios (VC2M7N07, VC2M7N09). Everything in this subtopic is the ground that work stands on.

## Test

**Chapter test T2 — Fractions, decimals and percentages**

**Content descriptions assessed** (for diagnostic marking against the Level 6 achievement standard): VC2M6N03 (2A) · VC2M6N05 (2B) · VC2M6N04 (2C) · VC2M6N06 (2D) · VC2M6N07 (2E)

> This is a school-designed paper. It is not a VCAA instrument. Achievement in the Victorian Curriculum is reported against the Level 6 achievement standard, not against a mark on this paper.

| | |
|---|---|
| **Time** | 30 minutes — 5 minutes reading time, then about 1 minute per mark |
| **Total** | **25 marks** |
| **Questions** | 17 — answer every question |
| **Equipment** | Pen or pencil. **No calculator** on Questions 1–16. A calculator is permitted **only** on Question 17, the 2E digital-tool item. The Questions 11–14 items on multiplying and dividing by powers of 10 are calculator-free because the content description says *without a calculator*. |

| Subtopic | Content description | Marks | Questions |
|---|---|---|---|
| 2A Equivalent fractions | VC2M6N03 | 5 | 1–4 |
| 2B Adding and subtracting fractions | VC2M6N05 | 5 | 5–7 |
| 2C Adding and subtracting decimals | VC2M6N04 | 5 | 8–10 |
| 2D Multiplying and dividing decimals by powers of 10 | VC2M6N06 | 5 | 11–14 |
| 2E Finding a fraction, decimal or percentage of a quantity | VC2M6N07 | 5 | 15–17 |

Show your working wherever a question asks for it — marks are given for the working, not just the final answer.

### Questions 1–4 · 2A Equivalent fractions (5 marks)

**Q1.** Fill in the missing number. *(1 mark)*

$$\frac{2}{3} = \frac{?}{12}$$

**Q2.** Order $\frac{2}{3}$, $\frac{1}{4}$, $\frac{5}{6}$ and $\frac{1}{2}$ from smallest to biggest, and **justify** your order. *(2 marks: 1 for the order, 1 for the reason)*

**Q3.** On a number line from 0 to 1, which of these fractions sits **between** $\frac{1}{3}$ and $\frac{1}{2}$? *(1 mark)*

- A. $\frac{1}{4}$
- B. $\frac{5}{12}$
- C. $\frac{2}{3}$

- D. $\frac{3}{4}$

**Q4.** Which is greater, $\frac{3}{8}$ or $\frac{1}{2}$? Give your reason in one sentence. *(1 mark)*

### Questions 5–7 · 2B Adding and subtracting fractions (5 marks)

*No calculator for these questions.*

**Q5.** Find $\frac{5}{6} - \frac{3}{4}$. Give your answer in simplest form. Show your working. *(2 marks: 1 for renaming with a common denominator, 1 for the answer)*

**Q6.** Lani is making playdough. She uses $1\frac{1}{2}$ cups of flour, then adds $\frac{3}{4}$ of a cup more. How much flour does she use altogether? Show your working. *(2 marks: 1 for the renaming, 1 for the answer as a mixed numeral)*

**Q7.** Find $\frac{4}{9} + \frac{2}{9}$. Give your answer in simplest form. *(1 mark)*

### Questions 8–10 · 2C Adding and subtracting decimals (5 marks)

*No calculator for these questions.*

**Q8.** Work out each calculation using columns. Line up the decimal points first. *(1 mark each)*

(a) $7.36 + 4.95$

(b) $9 - 3.65$

**Q9.** Work out in your head, by bridging through a whole number:

$$5.8 + 1.6$$

*(1 mark)*

**Q10.** Zac says $8.24 - 3.87 = 5.63$. Round each number to the nearest whole to check his answer. Is Zac's answer reasonable? If it is not, find the correct answer. *(2 marks: 1 for the check and the judgement, 1 for the correct answer)*

### Questions 11–14 · 2D Multiplying and dividing decimals by powers of 10 (5 marks)

**No calculator for these questions** — the content description says *without a calculator*. Do them in your head.

**Q11.** *(1 mark each)*

(a) $7.05 \times 100$

(b) $63.2 \div 10$

**Q12.** Find $2.7 \times 30$. Show how you split 30 to make the calculation easy. *(1 mark)*

**Q13.** Fill in the box: $0.95$ L = $\square$ mL. *(1 mark)*

**Q14.** Rani says $6.13 \times 10 = 6.130$, "because you just add a zero". Use place value to explain why Rani is wrong, and give the correct answer. *(1 mark)*

### Questions 15–17 · 2E Finding a fraction, decimal or percentage of a quantity (5 marks)

**Q15.** Without a calculator, find *(1 mark each)*:

(a) $\frac{3}{8}$ of 40

(b) 0.4 of 35

**Q16.** A toy shop has **25% off** a skateboard that costs $60. Find the discount and the sale price. Show your working. *(2 marks: 1 for the discount, 1 for the sale price)*

**Q17.** *Digital-tool item — you may use a calculator.* Find 12.5% of $36. *(1 mark)*

**Total: 25 marks**

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## Solutions

For self-checking: the compact answer key comes first, then the fully worked solutions with the mark breakdown for each question.

### Answer key

| Q | Answer | Marks |
|---|---|---|
| 1 | 8 | 1 |
| 2 | $\frac{1}{4} < \frac{1}{2} < \frac{2}{3} < \frac{5}{6}$, justified in twelfths | 2 |
| 3 | B ($\frac{5}{12}$) | 1 |
| 4 | $\frac{1}{2}$, because $\frac{1}{2} = \frac{4}{8}$ | 1 |
| 5 | $\frac{1}{12}$ | 2 |
| 6 | $2\frac{1}{4}$ cups | 2 |
| 7 | $\frac{2}{3}$ | 1 |
| 8 | (a) 12.31; (b) 5.35 | 2 |
| 9 | 7.4 | 1 |
| 10 | Not reasonable; the correct answer is 4.37 | 2 |
| 11 | (a) 705; (b) 6.32 | 2 |
| 12 | 81 | 1 |
| 13 | 950 | 1 |
| 14 | Digits shift one place left; 61.3 | 1 |
| 15 | (a) 15; (b) 14 | 2 |
| 16 | Discount \$15; sale price \$45 | 2 |
| 17 | \$4.50 | 1 |
| | **Total** | **25** |

### Worked solutions

**Q1.** Multiply the top and the bottom by 4: $\frac{2 \times 4}{3 \times 4} = \frac{8}{12}$. The missing number is **8**. Equivalent fractions name the same amount.

**Q2.** Write every fraction in twelfths, because 12 is a multiple of 3, 4, 6 and 2:

$$\frac{2}{3} = \frac{8}{12}, \frac{1}{4} = \frac{3}{12}, \frac{5}{6} = \frac{10}{12}, \frac{1}{2} = \frac{6}{12}$$

The top numbers give $3 < 6 < 8 < 10$, so

$$\frac{1}{4} < \frac{1}{2} < \frac{2}{3} < \frac{5}{6}$$

*1 mark for the correct order; 1 mark for the justification — the fractions named in the same parts, then the top numbers compared.*

**Q3. B.** In twelfths, $\frac{1}{3}=\frac{4}{12}$ and $\frac{1}{2}=\frac{6}{12}$, so the point between them must count 5 twelfths: $\frac{5}{12}$. The others fail: $\frac{1}{4}=\frac{3}{12}$ sits to the left of $\frac{1}{3}$, and $\frac{2}{3}=\frac{8}{12}$ and $\frac{3}{4}=\frac{9}{12}$ both sit to the right of $\frac{1}{2}$.

**Q4. $\frac{1}{2}$ is greater.** Half of 8 is 4, so $\frac{1}{2}=\frac{4}{8}$, and 4 eighths is more than 3 eighths. This is a benchmark check against $\frac{1}{2}$.

**Q5.** The lowest common denominator of 6 and 4 is 12. Rename both fractions:

$$\frac{5}{6}=\frac{10}{12}\text{(top and bottom} \times 2), \frac{3}{4}=\frac{9}{12}\text{(top and bottom} \times 3)$$

Then subtract the tops and keep the denominator:

$$\frac{10}{12}-\frac{9}{12}=\frac{1}{12}$$

$\frac{1}{12}$ is already in simplest form. *1 mark for renaming both fractions with the common denominator; 1 mark for the answer.*

**Q6.** Rename the fraction parts so they match — quarters: $1\frac{1}{2}=1\frac{2}{4}$. Then

$$1\frac{2}{4}+\frac{3}{4}=1\frac{5}{4}$$

The fraction part is worth more than one whole, so trade it in: $\frac{5}{4}=1\frac{1}{4}$, giving $1\frac{5}{4}=2\frac{1}{4}$. Lani uses $2\frac{1}{4}$ **cups** of flour altogether. *1 mark for the renaming; 1 mark for the answer as a mixed numeral.*

**Q7.** Same denominators, so add the tops and keep the denominator:

$$\frac{4+2}{9}=\frac{6}{9}=\frac{2}{3}$$

(divide top and bottom by 3 for simplest form).

**Q8.** (a) $7.36+4.95$, points lined up. Hundredths: $6+5=11$, write 1, carry 1. Tenths: $3+9+1=13$, write 3, carry 1. Ones: $7+4+1=12$. Answer **12.31**.

(b) Write 9 as $9.00$ and rename: 9 ones become 8 ones and 10 tenths, and 1 of those tenths becomes 10 hundredths. Hundredths: $10-5=5$. Tenths: $9-6=3$. Ones: $8-3=5$. Answer **5.35**.

*1 mark each. Check:* $12.31$ *is close to* $7+5=12$*, and* $5.35$ *is close to* $9-4=5$ *— both reasonable.*

**Q9.** Bridge through 6: $5.8+0.2=6$, then $6+1.4=7.4$. Answer **7.4**.

**Q10.** Round each number to the nearest whole: $8.24 \to 8$ and $3.87 \to 4$, so the answer should be near $8-4=4$. Zac's 5.63 is more than a whole away from 4, so it is **not reasonable**. Correct working: $8.24-3.87=4.37$. *1 mark for the check and the judgement; 1 mark for the correct answer.*

**Q11.** (a) $7.05 \times 100$: every digit shifts two places left — the 7 lands in the hundreds column — and the empty ones column is filled with a 0 placeholder: **705**. (b) $63.2 \div 10$: every digit shifts one place right: **6.32**. *1 mark each.*

**Q12.** Split $30 = 3 \times 10$. First $2.7 \times 3 = 8.1$ (basic facts: $27 \times 3 = 81$), then $8.1 \times 10 = 81$, the digits shifting one place left. Answer **81**.

**Q13.** 1 L = 1000 mL, so multiply by 1000 — every digit shifts three places left: $0.95 \times 1000 = 950$. The box is **950**.

**Q14.** Multiplying by 10 shifts **every digit one place to the left**, so each digit becomes worth 10 times as much: the 6 moves from the ones column to the tens column, the 1 from the tenths column to the ones column, and the 3 from the hundredths column to the tenths column. That gives **61.3**. Writing 6.130 only adds a placeholder 0 in the thousandths column — 6.130 is the same number as 6.13, so nothing has been multiplied. *1 mark for a place-value explanation and the correct answer.*

**Q15.** (a) $\frac{3}{8}$ of 40: divide by the bottom number, then multiply — $40 \div 8 = 5$, then $3 \times 5 = 15$. Answer **15**.

(b) 0.4 is 4 tenths, so divide by 10 first, then multiply by 4: $35 \div 10 = 3.5$, then $4 \times 3.5 = 14$. Answer **14**. (This is the same as finding 40% of 35.) *1 mark each.*

**Q16.** The discount is 25% **of the full price**. Since 25% = $\frac{1}{4}$, divide by 4:

$$\$60 \div 4 = \$15$$

The discount is **$15**. Then sale price = full price − discount:

$$\$60 - \$15 = \$45$$

The sale price is **$45**. *1 mark for the discount; 1 mark for the sale price.* (Check: the discount makes the price smaller, so $45 < $60. ✓)

**Q17.** 12.5% = $\frac{1}{8}$, so $36 \div 8 = 4.50$. With a calculator instead, key `0.125 × 36 =`. The answer is **$4.50**.