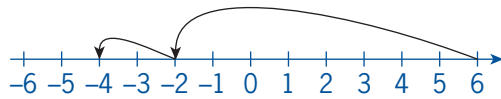


You can **add** and **subtract** integers by counting **moves** along a number line.

To work out  $6 - 8 - 2$  start at 6. count back 8 moves (to  $-2$ ) and then 2 to  $-4$ .

$$6 - 8 = -2 \text{ and } -2 - 2 = -4 \text{ so } 6 - 8 - 2 = -4$$



$-6$  is 12 smaller than 6.  
Count the moves from  $-6$  to 6.  
You make 12 moves.

- Negative numbers are smaller than 0 | Positive numbers are larger than 0

Addition, subtraction, multiplication and division are all mathematical operations.

Operation	Instruction
Add	Total, altogether, sum
Subtract	Difference between, minus
Multiply	Lots of, times
Divide	Share, how many in

**EXAMINER'S TIP:**  
Read the question carefully and look for the key words.  
Think about the answer. If it is not sensible, have you used the right operation?

EXAMPLE

Sue, Liam and Jack share the cost of a meal equally.  
The meal costs £24.60.  
How much do they each pay?

$$£24.60 \div 3 = £8.20$$

Your calculator shows 8.2  
Remember to put in the 0 and £ sign.

When you **multiply** or **divide** a number by 10, 100, 1000... the digits do not change.

**a**  $90 \times 100 = 9000$

		9	0
9	0	0	0

**b**  $3 \div 10 = 0.3$

3	.	0	
0	.	3	

Learn the rules for multiplying and dividing with **directed** (negative and positive) **numbers**.

× or ÷	-	+
-	+	-
+	-	+

Examples  
**3a**  $2 \times -3 = -6$   
**3b**  $-15 \div -3 = 5$   
**3c**  $15 \times -2 \div 5 = -6$

**EXAMINER'S TIP:**  
As a check, count the number of lines to make the signs on the numbers.  
If this is even, the answer is +  
If it is odd, the answer is -  
**3a** only 1 line (odd) answer -  
**3b** 2 lines (even) answer +  
**3c** only 1 line (odd) answer -

EXAMPLE

The sum of three integers is 5. Two of the integers are negative.  
Write down two different sets of integers that obey these rules

14, -3 and -6 **and** 20, -12 and -3

There are many different possible answers.

## Exercise N1

- 1 Work out    **a**  $12 \div -6$     **b**  $-32 \times 2 \times -2$     **c**  $-21 - 8$     **d**  $-21 + 8$
- 2 Draw a number line. Use your number line to explain why  
**a** the answer to question **1c** is smaller than  $-21$   
**b** the answer to question **1d** is larger than  $-21$ .
- 3 Explain how you know these answers are wrong just by looking at them.  
**a**  $123 \times -2 = 246$     **b**  $25 \div -5 = 5$     **c**  $-8 \times -5 \times -2 = 80$     **d**  $10 \times -2 = 20$
- 4 Finn buys 24 large loaves to make sandwiches. Each loaf has 18 slices, including the end crusts, which he cannot use. He needs 2 slices to make a sandwich. How many sandwiches can he make?
- 5 Carla flies from London to Rome at Christmas. The temperature in Rome is  $14^{\circ}\text{C}$  and the temperature in London is  $-5^{\circ}\text{C}$ . How much hotter is Rome than London?

- 6 Harry sees this advert.  
**a** How much money does he save if he buys 3 Choc Stars?  
**b** Because they melt quickly he sells one to Ali for 95p and one to Rita for 95p. How much has his Choc Star cost him?

**Choc Star**  
 £1.23 each or 3 for £2.80



- 7 This table shows the average heights, in mm, of boys and girls in the UK.  
**a** How many mm do boys grow, on average, between the ages of 11 years and 18 years?  
**b** How many mm does the average boy grow in height in 1 year?  
**c** How many mm does the average girl grow in height in 1 year?  
**d** Explain what your answers tell you and why this might not be the whole story.

Age	Height	
	Girls	Boys
11	1440	1430
12	1500	1490
13	1550	1550
14	1590	1630
15	1610	1690
16	1620	1730
17	1620	1750
18	1620	1760

- 8 Here is a puzzle.  
 Three negative integers have a sum of  $-10$ .  
 The largest integer is 3 more than the smallest one.  
 When the numbers are multiplied together the answer is  $-30$ .  
 What are the three integers?
- 9 There are 12 inches in a foot and 3 feet in a yard.  
 The distance round a circle is roughly three times the distance across it.  
**a** How many inches is it round the centre circle of a football field if the distance across the circle is 20 yards?  
**b** What is the distance in feet?

You can use the same rules for decimals as you do for integers.

- When you multiply or divide a **decimal** number by 10, 100, 1000... the digits do not change.
- When you **multiply** a decimal number move the digits **left** the same number of columns as there are **zeros** in the multiplier.

## Example

a  $23 \times 1000 = 23\,000$

b  $2.9 \times 100 = 290$

			2	3	.
2	3	0	0	0	.

		2	.	9
2	9	0		

When you **divide** a decimal number move the digits **right** the same

Number of columns as there are zeros in the divider.

## Example

a  $41 \div 100 = 0.41$

b  $0.3 \div 10 = 0.03$

4	1	.		
		.	4	1

	0	.	3	
	0	.	0	3

### EXAMINER'S TIP:

There is an invisible decimal point at the end of every whole number. Use zeros to fill columns between a digit and the decimal point.

Rules for multiplying and dividing by a positive number between 0 and 1

×	The answer is smaller than the original number.	$25 \times 0.5 = 12.5$	25 halves make 12.5
÷	The answer is larger than the original number.	$25 \div 0.5 = 50$	There are 50 halves in 25

## Example

- a Steve pays 15.27p a unit for his electricity. He uses 418 units. What is his bill, in pounds?

$$15.27\text{p} \times 418 = 6382.86\text{p}$$

His bill is £63.83

You are working in pence. Keep writing pence until you change to £. Round to nearest penny. He does **not** have a bill of £6382.86!

- b Mia has a bag containing 2.4 kg of flour. She has a recipe for 15 small cakes that uses 430 g of flour. Mia makes 45 cakes. How many grams of flour are left in the bag?

$$45 \div 15 = 3 \text{ (she makes 3 lots of cakes)}$$

$$3 \times 450 \text{ g} = 1350 \text{ g}$$

$$2400 - 1350 = 1050 \text{ g}$$

1050 g of flour are left in the bag.

The answer is to be in grams so work in grams. There are 1000 g in 1 kg, so  $2.4\text{ kg} \times 1000 = 2400 \text{ g}$



- c** How can you tell these answers are wrong, just by looking at them?
- i**  $23.5 \times 10 = 23.50$       **ii**  $104.6 \div 100 = 10460$
- i** The digits have not moved at all.  
**ii** 10460 is bigger than 104.6 – it should be smaller.
- d** Work out    **a**  $13.26 \div 100$       **b**  $145\,269 \times 10\,000\,000$
- a** 0.1326                      **b** 145269000000

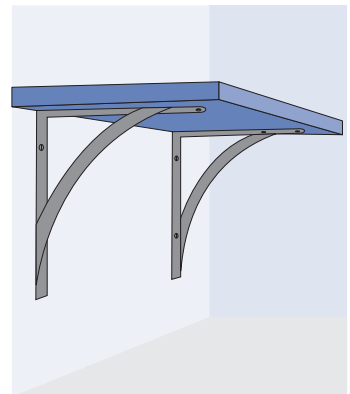
In **i** a 0 has been added after the decimal point – this makes no difference to the values of the digits.

In part **a** write 0 in front of the decimal point to show the point clearly.

**EXAMINER'S TIP**  
 Your calculator will say  $1.45269 \times 10^{12}$ . It is easier just to move the digits 7 places (because of 7 zeros in 10 million)

## Exercise N2

- 1** Work out
- a**  $2 \div 1000$       **b**  $2\,348\,392 \times 10\,000$       **c**  $0.00348 \times 10\,000\,000$
- 2** There are 12 inches in a foot and 3 feet in a yard. There are 1760 yards in 1 mile.
- a** How many inches are there in 1 mile?  
**b** How many yards are there in 2.6 miles?  
**c** Brett's pace is 0.9 yards long. How many paces does Brett take when he walks for a mile?
- 3** Explain how you know these answers are wrong just by looking at them.
- a**  $123 \times 0.4 = 492$       **b**  $16 \div 0.5 = 8$       **c**  $48 \times 0.5 = 0.24$
- 4** Explain how you know these answers are wrong just by looking at them.
- a**  $2.3 \times 100 = 2.300$       **b**  $1.4 \times 10 = 0.14$   
**c**  $0.5 \times 1000 = 600$       **d**  $8 \div 100 = 0.8$
- 5** Kobe pays a monthly contract of £25 for his mobile phone. He makes 200 calls in the month. How much is each call costing him on average?
- 6** Here are some facts about metric lengths.
- There are 1000 millimetres (mm) in 1 metre (m)  
 100 centimetres (cm) in 1 metre  
 1000 metres in 1 kilometre (km)
- a** A shelf is 4.2 metres long. How many millimetres is this?  
**b** Paula walks 1.06 kilometres to school. How many metres is this?  
**c** A shelf is 140 mm wide. A shelf bracket is 0.1 m wide. Can the bracket be used to hold up the shelf?  
**d** The head teacher wants to take a picture of all the pupils lined up, shoulder to shoulder, along the school drive. There are 430 pupils in the school. The average width of a pupil across the shoulders is 380 mm. The drive is 150 m long. Can the photograph be taken in a single line?



## Overmatter exercise N2

7 This formula can be used to change between miles and kilometres.

distance in miles  $\longrightarrow$   $\boxed{\times 1.6}$   $\longrightarrow$  Distance in kilometres

Change    **a** 14 miles into kilometres                      **b** 32 kilometres into miles.

8 A bag contains 1.8 kilograms of sugar.

Gemma uses 560 grams of the sugar to make a cake and 196 g to fill her sugar bowl.

How much sugar is left in the bag?

There are 100 grams in 1 kilogram.

9 Imani earns 2 loyalty points every time she spends £1 at Supersave. She can exchange 100 loyalty points for £0.50. Imani cashes in all her loyalty points at Christmas and receives £46. How much money has she spent to earn these points?

10 Alan buys a petrol car that emits 0.11 kg of carbon every kilometre.

How many kilometres has he driven if the car has emitted 1 tonne of carbon?

There are 1000 kg in 1 tonne.



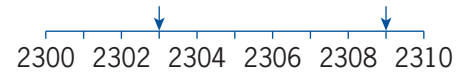
You can **round** a number to the nearest ten or the nearest hundred or thousand.

EXAMPLE

Round these numbers to the nearest ten.

**a** 2309                      **a** 2309 = 2310 to the nearest ten

**b** 2303                      **b** 2303 = 2300 to the nearest ten



When you round to the nearest ten look at the units digit. If it is 5 or more, round up. If it is less than 5 round down.

EXAMPLE

Round 2309

**a** to the nearest hundred    **b** to the nearest thousand

**a** 2309 = 2300 (to nearest 100)

**b** 2309 = 2000 (to nearest 1000)

Look at the place value of the digit following the one you are rounding. If it is 5 or more round up. If it is less than 5 round down.

You can round decimal numbers.

EXAMPLE

Round 63.64 to

**a** the nearest whole number    **b** one decimal place.

**a** 63.64 = 64 (to nearest whole number)

**b** 63.64 = 63.6 (1 dp)

'significant' means important

You can round using **significant figures** (sf).

For example 19 783 = 19 800 to 3 sf

Put two zeros to keep the digits in the correct columns.

- The most significant figure is the one with the largest place value.

EXAMPLE

Copy these numbers and underline the most significant figure in each.

**a** 302451.6    **b** 0.000612    **c** 2.208    **d** 0.01387

**a** 302451.6    **b** 0.000612    **c** 2.208    **d** 0.01387

The zeros at the start of a decimal number are **not** significant figures.

When you round using significant figures start at the left-hand side of the number at the first non-zero digit.

Round 0.097 62 to **a** 3 sf **b** 2 sf **c** 1 sf

- a**  $0.09762 = 0.0976$  to 3 sf  
**b**  $0.09762 = 0.098$  to 2 sf  
**c**  $0.09762 = 0.1$  to 1 sf

In part **c** the 9 is followed by a 7 so you must round up. When you round up 0.09 you get 0.1

## Exercise N3

- Write each of these numbers in words.
 

**a** 11 384      **b** 2010 345      **c** 45 000 20      **d** 23 444 012
- Write each of these numbers in figures.
 

**a** twelve thousand, six hundred and nine  
**b** fifty million, one hundred and twenty thousand and seven  
**c** one hundred and forty-two point two  
**d** fifteen million, nine hundred and five thousand and fifty-three
- Copy each number and underline the digit in the decimal place indicated.
 

**a** 12.376 (second dp)                      **b** 0.00469 (first dp)  
**c** 25.0936 (third dp)                      **d** 3.5398 (second dp)
- Round the numbers in question 3 correct to the decimal place indicated.
- Copy each number and underline the first significant figure.
 

**a** 12.376      **b** 0.00469      **c** 25.0936      **d** 3.5398
- Round each number as indicated.
 

<b>a</b> 140 298	the nearest hundred.	<b>b</b> 34 718	1 sf
<b>c</b> 0.58 076	1 dp	<b>d</b> 17.099	1 dp
<b>e</b> 45 970	1 sf	<b>f</b> 1.97 304	2 dp
<b>g</b> 2.619	1 sf	<b>h</b> 0.00 284	1 sf
<b>i</b> 825.774	2 dp	<b>j</b> 16.99	1 dp
- Calculate
 

**a**  $13 \times 0.13$  correct to 1 dp                      **b**  $4.56 \times 4.56$  correct to the nearest whole number  
**c**  $1 \div 7$  correct to 2 dp                      **d**  $12.3 \div 1.6$  correct to 1 dp
- Barry bought 16 litres of fuel at 119.9p a litre.  
How much did he pay for this fuel? (Round to the nearest penny.)
- Chen buys 33 bags of potatoes at 86 p a bag. He makes them into chips.  
Each bag of potatoes makes 7 portions of chips.
 

**a** How much does Chen pay for the potatoes?  
**b** How many portions of chips does he make?  
**c** What is the cost of the potatoes per portion of chips? (Round to the nearest penny.)  
**d** How much should he charge for a portion of chips if he wants to make a profit of 8p per portion?  
**e** How much profit does he make if he sells all the chips he makes?

Look at the digit in the next decimal place when you round.

- A **multiple** is any number in that number's multiplication table.  
Multiples of 5 are  $1 \times 5, 2 \times 5, 3 \times 5, \dots$  that is 5, 10, 15, ...
- A **common multiple** of two (or more) numbers is a multiple of both numbers, for example 28 is a common multiple of 4 and 7.
- The **least common multiple (LCM)** of two (or more) numbers is the lowest number that they both divide into, for example the LCM of 4 and 7 is 28.

## Example

Find the LCM of 12 and 15.

Multiples of 12... 12, 24, 36, 48, **60**, 72, 84....

Multiples of 15... 15, 30, 45, **60**, ...

The least common multiple of 12 and 15 is 60.

- A **factor** divides exactly into a number.  
1, 2, 3, 4 and 6 are all factors of 12.
- The **highest common factor (HCF)** of two (or more) numbers is the highest number that divides into both of them, for example the HCF of 12 and 18 is 6.

## Example

Find the HCF of 42 and 90

First write each number as the product of prime factors.

$42 = 2 \times 3 \times 7$  and  $90 = 2 \times 3 \times 3 \times 5$

The HCF of 42 and 90 =  $2 \times 3 = 6$

- A **prime number** has only two factors, the number itself and 1.  
Learn this list of the first ten prime numbers. 2, 3, 5, 7, 11, 13, 17, 19, 23, 29

Test to see if a number is prime by dividing it by 2 then 3 then 5 ...

If you get a whole number at any point, the number is not prime.

- A **prime factor** is a factor of a number that is also prime.  
3 is a factor of 12 and it is prime so 3 is a prime factor of 12.

You can write a number as the **product** of its prime factors, for example  $24 = 2 \times 2 \times 2 \times 3 = 2^3 \times 3$

Notice that 1 is not a prime number (it does not have two factors).

2 and 3 are common factors so the HCF is  $2 \times 3$

2 and 3 are prime factors of 12

## Example

Write 60 as the product of its prime factors.

$$60 = 3 \times 20$$

$$20 = 4 \times 5$$

$$4 = 2 \times 2$$

$$60 = 2 \times 2 \times 3 \times 5 = 2^2 \times 3 \times 5$$

Think of any two whole numbers that multiply to give 20. If one is prime put a ring round it and repeat the process with the other number until you have only primes.

## Exercise N4

1 Write the first five multiples of each number.

- a 6      b 8      c 17  
d 23      e 51      f 242

2 Find all the factors of each number.

- a 16      b 21      c 36  
d 43      e 120      f 552

3 Find all the prime numbers between 30 and 50.

4 Work out whether each number is prime or not. Show your working.

- a 27      b 83      c 123  
d 117      e 215      f 401

5 Write each number as the product of its prime factors

- a 30      b 72      c 98  
d 130      e 166      f 1024

6 Find the least common multiple of

- a 12 and 30      b 16 and 24      c 22 and 12  
d 6, 15 and 20      e 9, 12 and 15




7 Find the highest common factor of each set of numbers in question 6.

8 Two model cars start together at 9 o'clock on a track.


One takes 10 minutes to complete the track and the other takes 12 minutes.

At what time will they next pass each other on the starting line?


You will need to practise with your own calculator as they do not all have the same keys.


- The **square** key is usually 
- The **cube** key is usually 
- Enter a number, press the key and then 

2 and 3 are prime factors of 12

- The **square root** key is usually 
- If you have to **square root a whole calculation** then you may have to put brackets round the calculation first.
- To find  $\sqrt{64-21}$  you enter  $\sqrt{64-21} =$  and the answer is 6.5574...

If you leave out the bracket you may get -13, which is wrong. You may have to round the answer.

- The **cube root** key is usually  Use this like the square root key.

- The **reciprocal** of a number is  $1 \div$  the number.
- The key is 

If you have a **calculation written as a fraction**, put brackets round the top and bottom of the fraction and remember that a fraction is a division.

To find  $\frac{23.4-6.27}{1.2 \times 2}$

write this  $\frac{(23.4-6.27)}{(1.2 \times 2)}$  and enter  $(23.4 - 6.27) \div (1.2 \times 2) =$

The answer is 7.1375

If you leave out the bracket you may get 12.95, which is wrong.

EXAMPLE

- Calculate the cost of one ticket if 15 cost £18.

$$18 \div 15 = 1.2 = \text{£}1.20$$

**EXAMINER'S TIP:**

Never write 1.2 for money, always £1.20

EXAMPLE

- Bryony makes a solid cube by joining lots of 1 cm cubes together. The cube is 6 cm along each edge. How many cubes has she used?

$$6^3 = 216 \text{ cubes}$$

**EXAMINER'S TIP:**

$6^3$  is tidier than  $6 \times 6 \times 6$

## Exercise N5

1 Use your calculator to work out the following. Round to 1dp if the answer is not exact.

a  $2.5^2$

b  $\sqrt{625}$

c  $1.4^3 - 1.4^2$

d  $\sqrt[3]{1331}$

e  $\frac{(2.6+1.9)}{1.5}$

f  $\frac{4.6^2 - 2}{(5.1+2.3-3.4)}$

g  $\sqrt[3]{6.1^2 - 0.81}$

h  $\frac{\sqrt{2.5 \times 4}}{5^2}$

i  $\frac{4.5^3 + 1.3^2}{1.4 - 2}$

2 Calculate the **reciprocal** of these numbers.

a 5

b 0.2

c 12

d 100

e 18

f 0.08

What do you notice about the answers to **a** and **b**?

3 Darren buys 6 rolls of loft insulation.

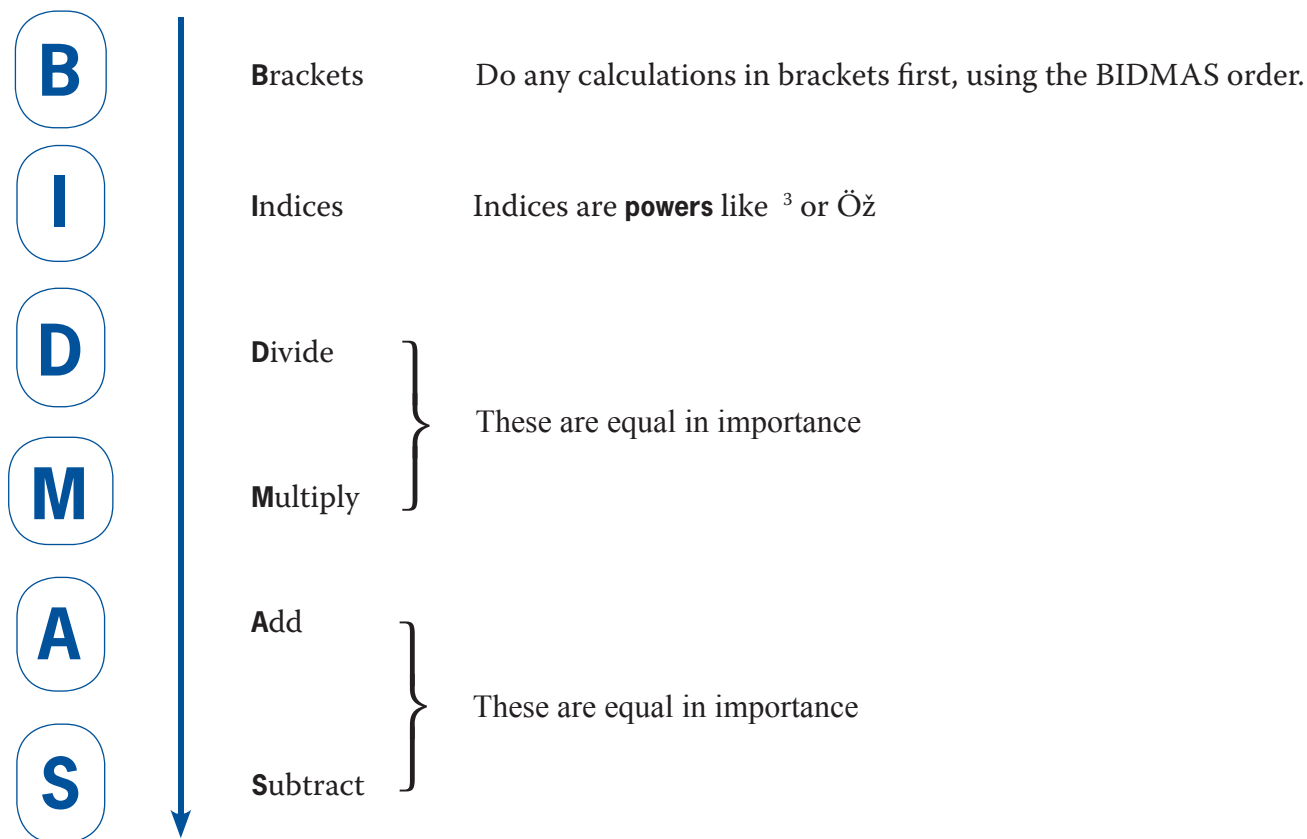
Each roll is a 5m length of insulation and is 400mm wide.

He pays £77.94 for all six rolls.

a What is the cost of 1 m of loft insulation?

b How much does it cost to insulate  $4\text{m}^2$  of the loft?

BIDMAS tells you the order in which to do a calculation. All scientific calculators use these rules BUT you still need to check your answers in case of “slips”.



If all the signs are equal in value, then work from left to right.

- When a calculation is a fraction, it is the same as division  
so  $\frac{5}{8}$  is the same as  $5 \div 8$

When a calculation is like  $\frac{12+6}{5-3}$  you must put brackets in when you use

the calculator so this becomes  $(12 + 6) \div (5 - 3) = 9$

Try it on your calculator without brackets and you will get 10.2 ×  
[larger and clearly a “wrong” cross]

You may be given a calculation and asked to put brackets in to make the answer correct.  
Write the calculation in the working space and try brackets in different places to get the answer.

Only write the brackets in the **answer space** when you have got it right.

$$6 \times 5 - 1 + 3 = 27$$

The answer to the calculation without using brackets is 32.

Try  $6 \times 5 - (1 + 3) \times$  The answer is 26 ..... **try it yourself**

Try  $6 \times (5 - 1) + 3 \checkmark$  This is right ( $6 \times 4 + 3 = 27$ )

- 1 Calculate **a**  $3.4 + 1.2 \times 5$  **b**  $(5 - 1.2)^2$  **c**  $\frac{(14.3 + 4^2)}{(5 + 3)}$   
 2 Put brackets in this calculation to give the answer  
 $15 - 2 \times 7 + 3 = -5$

- 1 **a**  $3.4 + 1.2 \times 5 = 3.4 + 6 = 9.4$   
**b**  $(5 - 1.2)^2 = 3.8^2 = 14.44$   
**c**  $\frac{(14.3 - 4^2)}{(5 + 3)} = \frac{-2.3}{8} = -0.2875$  or  $-0.29$  to 2dp

- 2 Try  $(15 - 2) \times 7 + 3$  The answer is 94  
 Try  $15 - 2 \times (7 + 3)$  The answer is  $-5$  so this is correct

**EXAMINER'S TIP:**

$5 - 1.2$  is in a bracket so is done first

**EXAMINER'S TIP:**

When you enter this in your calculator, type  $(14.3 - 4^{\boxed{x^2}}) \div (5 + 3)$

**EXAMINER'S TIP:**

There is no point trying  $15 - (2 \times 7) + 3$  because this is the same order of operations as in the question.

## Exercise N6

- 1 Use your calculator to work out the following.
- a**  $2.1 + 5.8 \times 3$       **b**  $4.2 - 2.6 \div 2$       **c**  $(1 + 4.3) \times 3 - 6.1$   
**d**  $4 - 2 \times (3.4 + 1.2)$       **e**  $3 - (2 \times 1.4 + 1)$       **f**  $12 + 2(3.3 \times 4) - 2$
- 2 Do a rough calculation to check the answers to question 1.  
 Part **a** is done for you.
- a**  $2 + 6 \times 3$   
 $= 2 + 18$   
 $= 20$
- 3 Use your calculator to work out the following. Give the answer to 1dp where necessary.
- a**  $\frac{3 \times 5}{1 + 2}$       **b**  $\frac{(1.3 + 2 \times 3.7)}{1.3 + 0.2}$       **c**  $\frac{3 \times 5.2 - 4.5}{3.2 - 2}$   
**d**  $\frac{(10.2 - 3.1 \times 2.4)}{2.2 + 1.6}$       **e**  $\frac{3^2 \times 5}{1 + 2^2}$       **f**  $\sqrt{(12.3 + 4.7)}$   
**g**  $\frac{\sqrt{18.8 - 9.8} + 9.6}{1 + 2}$       **h**  $\frac{(6 + 8)^2}{2.5^2 - 1.5^2}$
- 4 Put brackets in the appropriate place in each calculation to give the answer.
- a**  $1 + 2 \times 3 = 9$       **b**  $1 + 2 \times 3 - 4 = -1$       **c**  $10 - 3 + 2 \times 5 = -15$   
**d**  $10 - 3 + 2 \times 5 = 45$       **e**  $10 - 3 + 2 \times 5 = -3$       **f**  $14 + 5 \times 2^2 = 76$   
**g**  $14 + 5 \times 2^2 = 114$       **h**  $12 - 2 + 5 \times 2 + 1 = 1$

## Overmatter exercise N6

5



Sally says:  
Add 12 and 3, double the answer  
and then divide the result by 10.  
What is the answer?

- a What is the answer to Sally's calculation?
  - b Write the calculation in the form of a fraction and remember to include brackets.
- 6 Sarah the electrician, charges a "call out" fee of £25 and then £15 for each half hour she works. Owen calls Sarah to mend his immersion heater. The job takes 90 minutes. Owen works out what he thinks he will pay like this,  $(£25 + £15) \times 3 = £120$
- a Is Owen right?
  - b What calculation should Owen have done?
  - c What was Owen's real bill?



A ratio **compares the size** of two or more amounts.

A family has six pet animals.

Four animals are dogs (D) and two animals are cats (C) so  $D : C = 4 : 2$ .

There are twice as many dogs as cats, so the ratio can also be written  $D : C = 2 : 1$ .

- Amounts must be in the same units to write a ratio.

If  $A = 1\text{kg}$  and  $B = 500\text{g}$   $A : B$  is not  $1 : 500$ .  
Change  $A$  to  $1000\text{g}$  and  $A : B = 1000 : 500$ .  
(This means that  $A$  is twice as big as  $B$ )

- A ratio does not have any units because it compares relative amounts.

### EXAMINER'S TIP

$A : B = 3\text{ kg} : 2\text{ kg}$  ×  
But  $A : B = 3 : 2$  ✓

$A : B = 3 : 2$  means, for every three shares of  $B$  there are two shares of  $A$ .

So,  $A$  is  $1\frac{1}{2}$  times as big as  $B$  ( $3 = 2 \times 1\frac{1}{2}$ ).

You can **simplify** a ratio by dividing each "share" by a common factor.

You can multiply each "share" by the same number without changing the meaning of the ratio.

$2 : 1 = 6 : 3$  ( $\times 3$ ) but the first number is still twice as big as the second one.

You can write a ratio in the form **1 : n**.

Divide all the "shares" by the "share" that is to become 1.

You can change a ratio to a fraction in two ways.

Write one "share" as a fraction of the whole amount (all the "shares").

- Add up all the shares. This is the denominator.
- Write the one "share" is the numerator.

$P : B = 5 : 7$   
 $P$  is  $\frac{5}{12}$  of all the shares. ( $5 + 7 = 12$ )

delete highlighted - explained in hint boxes

Write one "share" as a fraction of another "share".

- The one "share" is the numerator.
- Write the second "share" is the denominator.

$P : B = 5 : 7$  then  $P$  is  $\frac{5}{7}$  of  $B$

Divide by 2.  
This is like cancelling fractions.  
Always check that there are no more common factors to divide by.

### EXAMPLE

- Simplify  $F : G : H = 4 : 6 : 10$
  - Simplify  $H : J = 1.4 : 0.9$
- Write  $P : Q = 4 : 5$  in the form 1 to  $n$ . better to make this 1c?

- $F : G : H = 2 : 3 : 5$
  - $H : J = 14 : 9$
- $P : Q = 1 : 1.25$

Multiply by 10 so there are no decimals

$P$  has to be 1, so divide both "shares" by 4

EXAMPLE

3 Sue, Terry and Unity are left some money.  
They divide it between them in the ratio  $S : T : U = 2 : 3 : 5$   
What fraction does Sue have of the whole amount?

There are  $2 + 3 + 5 = 10$  shares  
S has  $\frac{2}{10}$  or  $\frac{1}{5}$  of all the "shares".

### EXAMINER'S TIP

Always check that you have cancelled the fractions as far as possible and there are no other common factors.

EXAMPLE

4 What fraction is Sue's share of Unity's share?

Sue has 2 shares and Unity has 5.  
S has  $\frac{2}{5}$  of Unity's share.

2 and 5 have no common factors so cannot be cancelled.

## Exercise N7

Questions like this may appear in your examination paper. However, you will not be asked lots of similar questions on the same topic.

A single part of one of questions 1 to 7 could form a single examination question.

1 Write each ratio as simply as possible.

a  $P : Q = 10 : 15$

b  $G : M = 12 : 9$

c  $R : P = 24 : 36$

d  $K : J = 3.6 : 1.2$

e  $A : B : C = 20 : 30 : 40$

f  $A : G : P = 45 : 18 : 54$

g  $R : U : F = 2.4 : 0.6 : 1.8$

h  $J : K = 1.5 : 2$

i  $S : H : G = 12 : 1.5 : 4$

j  $P : S = 5 : 0.5$

2 Write each ratio in the form  $1 : n$ .

a  $S : T = 3 : 12$

b  $G : H = 10 : 5$

c  $F : K = 1.2 : 1.8$

d  $J : G = 240 : 600$

e  $L : K = 9 : 1.8$

f  $P : M = 20 : 4.4$

3 Write each ratio in the form  $n : 1$ .

a  $K : P = 25 : 20$

b  $H : S = 1 : 2.5$

c  $G : Y = 24 : 19.2$

d  $B : G = 14.2 : 8.52$

e  $S : Y = 3 : 0.5$

f  $M : T = 4.2 : 4.8$

4 In each case write the ratio  $A : B$ , giving your answer in its simplest form.

a

b

c

d

e

f

g

h

i

a  $A = 5 \text{ kg}$     $B = 12 \text{ kg}$

b  $A = 5 \text{ kg}$     $B = 1500 \text{ g}$

c  $A = 12 \text{ minutes}$     $B = 1 \text{ hour}$

d  $A = £10$     $B = 50 \text{ p}$

e  $A = 3 \text{ days}$     $B = 3 \text{ weeks}$

f  $A = 25 \text{ cm}$     $B = 1.2 \text{ m}$

## Overmatter exercise N7

5 In each case write the ratio  $A : B : C$ , giving your answer in the simplest form.

- a  $A = £2$      $B = 75p$      $C = £1.50$     b  $A = 4$  litres     $B = 6$  litres     $C = 500$  millilitres  
c  $A = 10$  cm     $B = 0.2$  m     $C = 1$  m    d  $A = 40$  mm     $B = 2$  cm     $C = 1$  m  
e  $A = £24$      $B = 5p$      $C = £5.50$     f  $A = 5$  hours     $B = 20$  minutes     $C = 1\frac{1}{2}$  hours

- 6 a  $S : R = 2 : 5$ . What fraction is  $S$  of  $R$ ?  
b  $G : K : P = 1 : 3 : 4$ . What fraction is  $P$  of the total?  
c  $M : V = 9 : 5$ . What fraction is  $V$  of  $M$ ?  
d  $A : H : Y = 3 : 2 : 6$ . What fraction is  $A$  of  $Y$ ?  
e  $G : H : T = 1 : 2 : 5$ . What fraction is  $H$  of  $T$ ?  
f  $P : G : X = 4 : 6 : 5$ . What fraction is  $P$  of the total?



You should be able to use ratios to find the solutions to problems.

To share an amount in a ratio Share £2000 in the ratio 2:3

- Add up all the “shares” of the ratio.  $2 + 3 = 5$
- Divide the amount by the total number of shares  $2000 \div 5 = 400$
- Multiply each share by the given ratio  $400 \times 2 = 800$   
 $400 \times 3 = 1200$

EXAMPLE

**1** Divide 2.4 kg in the ratio M : N = 3 : 5.

- 
- $3 + 5 = 8$ . (Add all the shares)
  - $2.4 \text{ kg} \div 8 = 0.3 \text{ kg}$ . (Find the value of 1 share)
  - M =  $3 \times 0.3 \text{ kg} = 0.9 \text{ kg}$  and
  - N =  $5 \times 0.3 \text{ kg} = 1.5 \text{ kg}$ .

**EXAMINER'S TIP:**

Check that all the weights add up to the whole amount (2.4 kg).  
( $0.9 + 1.5 = 2.4$  ✓)

To find the original amount when you know one share

- Add up all the “shares”
- Divide the known value by the size of **its** “share”.
- Multiply these two amount together

**EXAMINER'S NOTE:**

This could be where ingredients are mixed in a ratio. You will know the weight of one of the ingredients and the ratio. You have to find the weight of the others.

You can also find the size of each of the other shares. After the second step, just multiply the weight of one “share” by the number of each other “share”.

EXAMPLE

**2** Peter uses his phone to make texts and calls.  
The ratio of the number of calls to the number of texts is 7 : 5  
He sends 140 texts, how many calls does he make?

- 
- $7 + 5 = 12$ . (Add all the shares)
  - 1 share =  $140 \div 5 = 28$  (Find the value of 1 share)
  - Number of calls =  $28 \times 7 = 196$  (Calls has **7** shares)

EXAMPLE

**3** A recipe uses Flour, Sugar and Butter in the ratio 5 : 3 : 2 by weight. 75 g of Sugar is used.

- a What weight of each ingredient is used?
- b What is the total weight of the mixture?

- 
- $5 + 3 + 2 = 12$ . (Add all the shares)
  - 1 share =  $75 \text{ g} \div 3 = 25 \text{ g}$  (Find the value of 1 share)
  - Amount of Flour  $5 \times 25 \text{ g} = 125 \text{ g}$ . (Flour has **5** shares)
  - Amount of Butter  $2 \times 25 \text{ g} = 50 \text{ g}$  (Butter has **2** shares)
  - Total weight =  $25 \text{ g} \times 10 = 250 \text{ g}$

**EXAMINER'S TIP:**

Check that 1 share  $\times 10$  (total number of shares) = 250g.  $25 \text{ g} \times 10 = 250 \text{ g}$  ✓

## Exercise N8

- In each case, share the amount in the ratio given.
  - £25 in the ratio  $A : B = 1 : 4$
  - 200 g in the ratio  $A : B = 7 : 3$
  - 2.8 kg in the ratio  $A : B = 3 : 5$
  - 3 hours in the ratio  $A : B : C = 5 : 3 : 1$
- Find the original amount when  $A = 4.5$  kg and  $A : B = 5 : 4$
  - Find  $G$  when  $A = £6.40$  and  $A : G = 5 : 8$
  - Find  $P$  when  $S = 30p$  and  $P : S = 12 : 5$
  - Find  $W$  and  $X$  when  $Z = 4$  litres and  $W : X : Z = 1 : 15 : 8$
- John and Andrew take part in a sponsored walk.
  - The amounts they raise are in the ratio  $J : A = 4 : 5$ .  
John raises £48.60.
    - How much does Andrew raise?
    - How much do they raise altogether?
  - The amount they raise is  $\frac{3}{40}$  of the total amount raised.  
How much is raised altogether?
- Paula's garden is divided into lawn (L), flowers (F), paths (P) and vegetables (V) in the ratio  
 $L : F : P : V = 10 : 6 : 3 : 8$ .  
The area of the lawn is 45 m<sup>2</sup>.
  - What area is planted with vegetables?
  - What fraction of the garden is flowers?
- A wholemeal biscuit weighs 12.5 g and contains the following nutrients.
  - What is the weight of the "other" nutrients?
  - What is the ratio of carbohydrate to fat?
  - What is the ratio fat to fibre?
  - Explain what your answer to part (ii) tells you about the amounts of fat : fibre in these biscuits.
  - The maker of the biscuits claims, "Less than  $\frac{1}{10}$  of our biscuit is fat. Explain whether this is true.

Carbohydrate	7.0 g
Fat	1.2 g
Fibre	1.8 g
Other	
- Connor uses his car for work (W) and pleasure (P). The ratio of the miles he drives is  $W : P = 4 : 3$ .  
One month he drives 1470 miles.
  - How many miles does he drive for pleasure?

Connor spends £160.80 buying fuel for all his driving that month.  
He claims 40p a mile from his company for the miles that he drives for work.

  - Does the money he claims cover the cost of the petrol he buys?

## Overmatter exercise N8

- 7 Shades of pink paint can be made by mixing red (R) and white (W) paint in these ratios by volume.

Name	Sunset	Rose	Pale	Hint
Ratio R : W	5 : 3	5 : 2	6 : 1	25 : 3

The more white is used, the paler the colour.

- i Which ratio makes the darkest pink?
- ii If Gretta wants 3 litres of “Sunset”, what volume of red and what volume of white paint will she need to mix?
- iii Alan mixes 1.2 litres of red with 200 ml of white. Which shade has he made?
- iv Karen wants to mix “Hint” and has 600 ml of white.  
If she uses all of this, with the correct amount of red to make the paint, what volume of “Hint” has she made?

