Number/Algebra: Decimal place values

A decimal number (or **decimal**) contains a **decimal point**. In any decimal:

- the **whole-number part** is to the *left* of the decimal point.
- the **fraction part** is to the *right* of the decimal point.

The number of digits to the right of the decimal point is called the number of **decimal places**, e.g. the decimal 19.673 has 3 decimal places.

Decimals are written using a base 10 **place-value system**. In a decimal:

- for each place you move left, the place value is multiplied by 10
- for each place you move right, the place value is divided by 10

×10 ÷10

					•	0.1	0.01	0.001
Ten thousands	Thousands	Hundreds	Tens	Ones	Decimal point	Tenths	Hundredths	Thousandths
10 000	1 000	100	10	1	•	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1\,000}$

Place, face and total values of a decimal

For each digit in a decimal:

- **face value** is the numerical value of the digit;
- **place value** is the value of the *place* the digit occupies;
- **total value** is what the digit is worth when its face value and place value are multiplied.

Example: Below are the face, place and total values for the decimal number 24.837.

Digit	Face value	Place value	Total value
2	2	10	$2 \times 10 = 20$
4	4	1	$4 \times 1 = 4$
8	8	$\frac{1}{10}$	$8 \times \frac{1}{10} = \frac{8}{10}$
3	3	$\frac{1}{100}$	$3 \times \frac{1}{100} = \frac{3}{100}$
7	7	$\frac{1}{1\,000}$	$7 \times \frac{1}{1\,000} = \frac{7}{1\,000}$

Practising decimal place values

1. Give the face (F), place (P) and total (T) values of the following highlighted decimal numbers.

a. 54.789 F = P = T =

b. 2 134.85 F = P = T =

c. 7.789 F = P = T =

d. 8 256.112 F = P = T =

e. 43.6 F = P = T =

f. 1.034 F = P = T =

g. 7.15 F = P = T =

2. Fill in the tables for the following numbers (FV = Face value, PV = Place value and TV = total value).

a. 17.532

Digit	FV	PV	TV
1			
7			
5			
3			
2			

b. 34.176

Digit	FV	PV	TV
3			
4			
1			
7			
6			

c. 5 073.024

Digit	FV	PV	TV
5			
7			
3			
2			
4			

b. 1 304.87

Digit	FV	PV	TV
1			
3			
4			
8			
7			

3. Pointless numbers!

The first column of the table alongside has numbers which have lost their decimal points.

Rewrite these numbers *with* decimal points so that the given digit has the place value specified.

The first one has been done for you.

	Number	Digit	Place value	New number
*	8137	7	hundredths	81.37
a.	52790	0	thousandths	
b.	92689	6	tenths	
c.	1234	4	hundredths	
d.	738462	6	hundredths	
e.	3567	5	tenths	
f.	58361	1	tenths	
g.	30924	9	ones	
h.	400693	3	thousandths	
i.	510021	2	hundredths	

Number/Algebra: Addition and subtraction of decimals

When adding or subtracting decimals, line up places carefully in columns.

Start at the place furthest right and rename where necessary.

Example: Find 17.583 + 3.072. The working is shown in steps.

thousandths	→	hundredths	→	tenths	→	Ones	→	Tens
17.583		^{1}17.583		^{1}17.583		$^{1\ 1}$17.583		$^{1\ 1}$17.583
+ 3.072		+ 3.072		+ 3.072		+ 3.072		+ 3.072
5		55		.655		0.655		20.655
3 + 2 = 5 (record).		8 + 7 = 15. Rename as 1 tenth (transfer) 5 hundredths (record).		5 + 0 + 1 = 6 (record). Insert decimal point in answer.		7 + 3 = 10. Rename as 1 ten (transfer) 0 ones (record).		1 + 1 = 2 (record).

By calculator: press 1 7 . 5 8 3 + 3 . 0 7 2 = to get 20.655.

Practising addition and subtraction of decimals

1. Work out answers to the following decimal additions and subtractions.

a.	b.	c.	d.	e.	f.
246.97	472.16	876.89	521.627	25.712	7 331.3
+ 45.6	− 65.45	+ 12.9	− 232.43	+ 3.123	− 147.2

Solve the following word problems by setting your sums out in working form, as shown above. Remember to line up your decimal points.

2. Jenny has $14.50 in her purse. Her mum gives her $20.00 and her Nana gives her $27.75 towards buying some new jeans.

   a. How much money does she have in total?

   +
   $

   b. The jeans that Jenny wants cost $99.95. How much more money will Jenny need before she can buy her jeans?

   −
   $

   c. How much money would Jenny need in total if she wanted to buy her jeans and a top for $42.75?

   +
   $

3. John is going on holiday. He has two bags. One weighs 27.24 kg and the other weighs 18.97 kg.

   a. How much do his bags weigh in total?

   b. John's bags are only allowed to weigh 40 kg in total. Are John's bags over or under the airlines weight restrictions?

   By how much? kg

Working space

Ken bought 3 cakes at $1.65 each. To work out the total price, multiply $1.65 by 3.

hundredths → tenths → Ones → decimal point

$$\begin{array}{r} {}^{1}1.65 \\ \times\ 3 \\ \hline 5 \end{array} \qquad \begin{array}{r} {}^{1\ 1}1.65 \\ \times\ 3 \\ \hline 95 \end{array} \qquad \begin{array}{r} {}^{1\ 1}1.65 \\ \times\ 3 \\ \hline 4\ 95 \end{array} \qquad \begin{array}{r} {}^{1\ 1}1.65 \\ \times\ 3 \\ \hline 4.95 \end{array}$$

$3 \times 5 = 15$; Record 5; Transfer 1

$3 \times 6 + 1 = 19$; Record 9; Transfer 1

$3 \times 1 + 1 = 4$ (record)

decimal places in answer match decimal places in question

The cakes cost $4.95

By calculator: press 1 . 6 5 × 3 = to get 4.95.

Using a calculator, these patterns were found for multiplications by 10, 100, 1 000.

$47.\overset{\curvearrowright}{8}32 \times 10 = 478.32$ × 10 moves decimal point 1 place right

$47.\overset{\curvearrowright}{8}\overset{\curvearrowright}{3}2 \times 100 = 4783.2$ × 100 moves decimal point 2 places right

$47.\overset{\curvearrowright}{8}\overset{\curvearrowright}{3}\overset{\curvearrowright}{2} \times 1\,000 = 47\,832$ × 1 000 moves decimal point 3 places right

Add extra zeros as place holders if necessary.

If the decimal point moves to the end of the number it does not need to be shown.

Examples:

$15.4 \times 100 = 15.\overset{\curvearrowright}{4}\overset{\curvearrowright}{0} \times 100 = 1\,540$ decimal point moves 2 places right, need one 0 place holder

$3.1 \times 1\,000 = 3.\overset{\curvearrowright}{1}\overset{\curvearrowright}{0}\overset{\curvearrowright}{0} \times 1\,000 = 3\,100$ decimal point moves 3 places right, need two 0's

Practising multiplying decimals by whole numbers

1. Estimate (round to the nearest whole number) then work out answers to these multiplications.

* $\begin{array}{r} {}^{1}4.{}^{2}26 \\ \times\ 4 \\ \hline 17.04 \end{array} \rightarrow \begin{array}{r} \text{Estimate} \\ 4 \\ \times\ 4 \\ \hline 16 \end{array}$

a. $7.43 \rightarrow \quad \times\ 5 \quad \times\ 5$

b. $9.03 \rightarrow \quad \times\ 8 \quad \times\ 8$

c. $12.7 \rightarrow \quad \times\ 6 \quad \times\ 6$

2. Work out these multiplications, then use a calculator to check.

* $\begin{array}{r} {}^{1}{}^{1}19.543 \\ \times\ 2 \\ \hline 39.086 \end{array}$

a. $\begin{array}{r} 162.4 \\ \times\ 7 \end{array}$ **b.** $\begin{array}{r} 98.65 \\ \times\ 3 \end{array}$ **c.** $\begin{array}{r} 26.083 \\ \times\ 4 \end{array}$ **d.** $\begin{array}{r} 1473.64 \\ \times\ 8 \end{array}$

3. Use the rules above to do these multiplications by 10,100,1 000.

a. $59.46 \times 10 =$ **b.** $26.372 \times 100 =$ **c.** $9.475 \times 1\,000 =$

d. $2.43 \times 100 =$ **e.** $8.7 \times 100 =$ **f.** $61.43 \times 1\,000 =$

4. Fill in the gaps with 10,100 or 1000 to make these multiplications correct.

a. $94.6 \times \quad = 946$ **b.** $35.473 \times \quad = 3\,547.3$

c. $2.1 \times \quad = 210$ **d.** $117.42 \times \quad = 1\,174.2$

e. $2.98 \times \quad = 2\,980$ **f.** $46.381 \times \quad = 463.81$

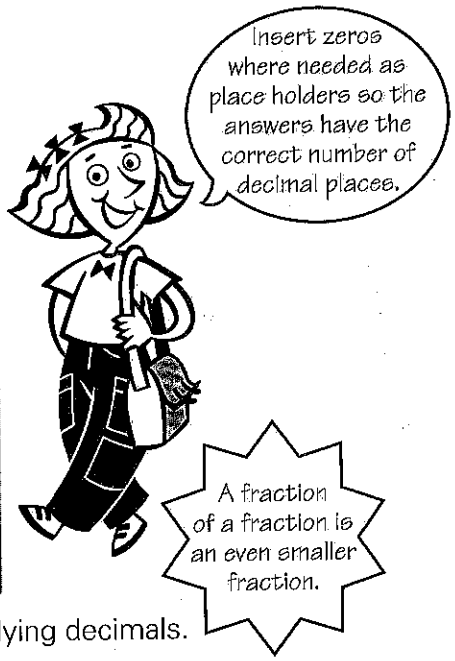
Count how many places right the decimal point has moved.

Number/Algebra: Multiplying decimals by decimals

Decimal multiplications can be explored using a calculator.

Examples:

$0.2 \times 0.3 = 0.06$ 2 decimal places in the multiplication	answer also has 2 decimal places
$0.02 \times 0.03 = 0.0006$ 4 decimal places in the multiplication	answer also has 4 decimal places
$1.2 \times 0.3 = 0.36$ 2 decimal places in the multiplication	answer also has 2 decimal places
$0.2 \times 0.12 = 0.024$ 3 decimal places in the multiplication	answer also has 3 decimal places



The box and example below summarise the steps for multiplying decimals.

Example: 4.3×0.8

$^{2}43$ — 1 decimal place in 4.3 and → 4.3

$\times\ 8$ — 1 decimal place in 0.8 makes → $\times 0.8$

344 — 2 decimal places in answer → 3.44

multiply 43×8 to get 344 (record)

Estimate $4 \times 1 = 4$

insert decimal point to give 2 decimal places in answer

By calculator:

press 4 · 3 × 0 · 8 =

to get 3.44

Multiplication of decimals by decimals

- Multiply the numbers, ignoring decimal points.
- Count the total number of decimal places in the numbers being multiplied.
- Insert the decimal point in the answer so that it has an equal number of decimal places.
- Check your answer with an estimate.

Practising multiplying decimals by decimals

1. Use the steps in the box above to work out these products. Use extra paper if needed.

   a. $0.4 \times 0.6 =$ **b.** $0.3 \times 0.02 =$ **c.** $10.4 \times 0.2 =$

   d. $2.4 \times 0.02 =$ **e.** $0.5 \times 0.4 =$ **f.** $0.01 \times 0.4 =$

2. These problems require long multiplication first. Estimate and compare answers.

   * 7.53 } 3 decimal places
   $\times\ 2.6$ }
   4518 ← 753×6
   15060 ← 753×20
   19.578 — 3 decimal places

   a. 2.47×3.5 _____

   b. 62.7×4.8 _____

   c. 143.62×1.2 _____

   d. 8.653×0.24 _____

Number/Algebra: Dividing decimals by whole numbers

Divide decimals in a similar way to dividing whole numbers.
Insert the decimal point in the answer as you pass it in the division.

Example: Find 64.75 ÷ 5. The working is shown in steps.

Estimate
Round 64.75 to 60
60 ÷ 5 = 12

Tens	→	Ones	→	tenths	→	hundredths
1		12.		12.9		12.95
5)64.75		5)64.75		5)64.75		5)64.75
5 divides into 6 1 time (record) with remainder 1 (transfer). (Rename as 10 ones, add to 4 ones.)		5 divides into 14 2 times (record) with remainder 4 (transfer). Insert decimal point.		5 divides into 47 9 times (record) with remainder 2 (transfer).		5 divides into 25 5 times (record).

Check
12.95
× 5
$64.75

By calculator: press 6 4 . 7 5 ÷ 5 = to get display 12.95.

Practising dividing decimals by whole numbers

1. Estimate an answer (below) before working out each division. Use zeros as place holders where necessary. The first one has been done for you.

* 20.7)62.1 (3) — 60 ÷ 3 = 20

a. 7)94.36 b. 6)53.58 c. 9)23.04 d. 5)4.375

e. 2)52.76 f. 2)13.072 g. 8)90.48 h. 3)122.52 i. 4)48.24

2. Check your answers to question 1. using multiplication or a calculator. Tick the ones you got right. Correct any errors.

Working space

3. 5 identical boxes weigh 63.25 kg. How much does each box weigh? kg

4. 7 pies cost $8.75. What does 1 pie cost? $

5. 9 bottles of water fill a 16.65 litre bucket completely. How much water is in each bottle? litres

6. 8 identical books fit across a shelf which is 23.2 cm wide. How many centimetres wide is each book? cm

7. 6 journeys to school add up to 91.8 km altogether. How long is each journey? km

8. 4 trucks share a load of 3.5 tonnes. How much does each truck carry? **Hint:** Write 3.5 as 3.500. tonnes