



# Decimals: Theory and examples

A decimal involves a number system based on 10. To understand decimals, you first need to understand place values, which can be found in our [Number](#) document. An understanding of decimals and how to add, subtract, multiply and divide is a foundation for work in primary mathematics. Explanations of some of the terms that have been used in this document can be found in the [glossary on our website](#). [Part 2](#) of this document contains exercises to practise.

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## 1. Place value for decimals

We use a decimal place to represent numbers greater than or less than one by placing them to the right of the decimal place. The following is a reminder of place values including past the decimal point.

Tens	Units	Decimal point	Tenths or $\frac{1}{10}$ 's	Hundredths or $\frac{1}{100}$ 's	Thousandths or $\frac{1}{1000}$ 's
3	6	.	5	2	9

### Notes:

- The number to the left of the decimal place is a whole number.
- The first digit to the right of the decimal place represents  $\frac{1}{10}$ .
- As we move to the left each position is 10 times bigger.
- As we move to the right each position is 10 times smaller.

**Examples:**

a)  $\frac{7}{10}$  Tenths fill the first place value after the decimal point so the decimal form is 0.7

Units	Dec. point	Tenths
0	•	7

b)  $\frac{23}{100}$  Hundredths fill the first two decimal places so the decimal form is 0.23

Units	Dec. point	Tenths	Hundredths
0	•	2	3

c)  $\frac{3}{100}$  The decimal form is 0.03

Units	Dec. point	Tenths	Hundredths
0	•	0	3

**Note:** The number of zeros in the denominator matches the number of decimal places the decimal takes.

d)  $\frac{478}{1000}$  The decimal form is 0.478

Units	Dec. point	Tenths	Hundredths	Thousandths
0	•	4	7	8

e)  $\frac{29}{1000}$  The decimal form is 0.029

Units	Dec. point	Tenths	Hundredths	Thousandths
0	•	0	2	9

## 2. Expanded form of decimals

Decimals, like whole numbers, can be written in expanded form.

**Examples:**

a) 0.23

Units	Dec. point	Tenths	Hundredths	Thousandths
1's		$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
0	•	2	3	

Expanded form: 2 tenths + 3 hundredths

$$\text{or } 2 \times \frac{1}{10} + 3 \times \frac{1}{100}$$

b) 2.145

Units	Dec. point	Tenths	Hundredths	Thousandths
1's		$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
2	•	1	4	5

Expanded form: 2 units + 1 tenth + 4 hundredths + 5 thousandths

$$\text{or } 2 \times 1 + 1 \times \frac{1}{10} + 4 \times \frac{1}{100} + 5 \times \frac{1}{1000}$$

### 3. Comparing decimals

To compare decimals, give each decimal the same number of decimal places by filling the places with 0's, then compare each place starting with the tenths.

**Examples:**

Write in ascending order: 0.3, 0.33 and 0.303


Units	Dec. point	Tenths	Hundredths	Thousandths
1's		$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
0	•	3	0	0
0	•	3	3	0
0	•	3	0	3

After giving all the decimals 3 decimal places it is easier to see that 0.300 or 0.3 is the smallest, 0.303 is the next and 0.330 or 0.33 is the biggest decimal.


### 4. Multiplying by a power of ten

To multiply by a power of ten, we move the decimal point to the right the same number of places as the number of noughts in the power of ten. (You may need to add some spare noughts)

**Examples:**

a)  $2.56 \times 10^2$   = 256

Tens	Units	Dec. point	Tenths	Hundredths
	2	•	5	6
2	5	•	6	

b)  $0.83 \times 10^2$   = 83

Tens	Units	Dec. point	Tenths	Hundredths
	0	•	8	3
	8	•	3	

c)  $35.6 \times 100$  3 5 • 6 0 • = 3560 (a 0 needs to be added after the 6 to fill in the place value)

Thousands	Hundreds	Tens	Units	Dec. point	Tens
		3	5	•	6
3	5	6	0	•	0

d)  $0.62 \times 100$  0 • 8 2 • = 62

Tens	Units	Dec. point	Tenths	Hundredths
	0	•	6	2
6	2	•	0	

e)  $34 \times 1000$  The decimal point is not showing here but we know that it is after the 4. Move the decimal point 3 places to the right or add 3 noughts to the whole number 34.

3 4 • 0 0 0 • = 34000

Ten thousands	Thousands	Hundreds	Tens	Units	Dec. point	Tenths
			3	4	•	0
3	4	0	0	0	•	

## 5. Dividing by a power of ten

To divide by a power of ten, we move the decimal point to the left the same number of places as the number of noughts in the power of ten. (You may need to add some spare noughts)

Examples:

a)  $6325.4 \div 10$  6 3 2 • 5 • = 632.54

Thousands	Hundreds	Tens	Units	Dec. point	Tens	Hundredths
6	3	2	5	•	4	
	6	3	2	•	5	4

b)  $823.5 \div 100$       8      •      2      3      •      5      =      8.235

Hundreds	Tens	Units	Dec. point	Tenths	Hundredths	Thousandths
8	2	3	•	5		
		8	•	2	3	5

c)  $0.658 \div 100$

0      •      0      0      •      6      5      8      =      0.00658 (two 0s need to be added before the 6 to fill in the place value)

Units	Dec. point	Tenths	Hundredths	Thousandths	Ten thousandths	Hundred thousandths
0	•	6	5	8		
0	•	0	0	6	5	8

d)  $13.8 \div 1000$       0      •      0      1      3      •      8      =      0.0138

Tens	Units	Dec. point	Tenths	Hundredths	Thousandths
1	3	•	8		
0	0	•	1	3	8

## 6. Adding or subtracting decimals

To add or subtract decimals align the decimal places and fill in any blank places with noughts, then add or subtract place by place.

Examples:

a)  $25.68 + 5.279$

$$\begin{array}{r} 21 \ 5. \ 6 \ 8 \ 0 \ + \\ \quad \underline{5. \ 2 \ 7 \ 9} \\ 3 \ 0. \ 9 \ 5 \ 9 \end{array}$$

b)  $181.92 - 53.43$

$$\begin{array}{r} 1 \ 78 \ 11. \ 89 \ 12 \ - \\ \quad \underline{5 \ 3. \ 4 \ 3} \\ 1 \ 2 \ 8. \ 4 \ 9 \end{array}$$

## 7. Multiplying decimals

To multiply decimals, multiply the digits then count the number of decimal places in the question and give the answer to the same number of decimal places.

### Examples:

a)  $8 \times 0.3$

- i. Work out  $8 \times 3 = 24$
- ii. Count the decimal places: 8 has 0 dp  
0.3 has 1 dp  
total dp =  $0 + 1 = 1$
- iii. Now give the answer 1 decimal place by putting a decimal point 1 place in from the end.  
 $= 2.4$

**Estimate:** 0.3 is a little less than  $\frac{1}{2}$  and  $\frac{1}{2}$  of 8 is 4, so 2.4 looks OK.

b)  $0.7 \times 0.6$

- i. Work out  $7 \times 6 = 42$
- ii. Count the decimal places: 0.7 has 1 dp  
0.6 has 1 dp total dp = 2
- iii. Now give the answer 2 decimal places by putting a decimal point 2 places in from the end.  
 $= 0.42$

**Estimate:** 0.6 is a little more than  $\frac{1}{2}$  and  $\frac{1}{2}$  of 0.7 is 0.35, so 0.42 looks OK.

c)  $600 \times 0.2$

- i. Work out  $600 \times 2 \rightarrow 6 \times 2(00) = 1200$
- ii. Count the decimal places: 600 has 0 dp  
0.2 has 1 dp total dp = 1
- iii. Now give the answer 1 decimal place by putting a decimal point 1 place in from the end.  
 $= 120.0$  or just 120

**Estimate:**  $600 \times 0.5 = 300$  so 120 looks OK.

d)  $12.3 \times 2.1$

- i. Work out  $123 \times 21$   
$$\begin{array}{r} 123 \times \\ 21 \\ \hline 2460 \\ 2583 \\ \hline \end{array}$$

ii. Count the decimal places: 12.3 has 1 dp

2.1 has 1 dp

total dp = 2

iii. Now give the answer 2 decimal places by putting a decimal point 2 places in from the end.

= 25.83

**Estimate:**  $12 \times 2$  is 24. So, our answer of 25.83 looks OK.

e)  $0.5 \times 0.0011$

i. Work out  $5 \times 11 = 55$

ii. Count the decimal places: 0.5 has 1 dp

0.0011 has 4 dp

total dp = 5

iii. Now give the answer 5 decimal places.

= 0.00055

**Estimate:**  $\frac{1}{2}$  of  $11/10000$  is  $5.5/10000$ .

## 8. Dividing decimals when the divisor is a whole number

To divide decimals when the number you are dividing by (the divisor) is a whole number, divide in decimal places. You may need to add some noughts to make more decimal places for the division. **Note** that the decimal places need to line up.

**Examples:**

a)  $4.6 \div 2$

$$\begin{array}{r} 2.3 \\ 2 \overline{)4.6} = 2.3 \end{array}$$

**Estimate:** 4 divided by 2 is 2 so 2.3 looks OK.

b)  $26.45 \div 5$

$$\begin{array}{r} 5.29 \\ 5 \overline{)26.45} = 5.29 \end{array}$$

**Estimate:** 25 divided by 5 is 5 so 5.29 looks OK.

## 9. Dividing decimals when the divisor is not a whole number

To divide decimals if the divisor is not a whole number, multiply both numbers by a power of 10 to make the number you are dividing by a whole number.

### Examples:

a)  $2.4 \div 0.4$

Make the 0.4 into a whole number by multiplying it by 10:

$$\frac{2.4 \times 10}{0.4 \times 10} = \frac{24}{4}$$

So,  $2.4 \div 0.4 = 24 \div 4 = 6$

**Note:** Remember that division means sharing into equal groups. So, if 2.4 units of length is divided into 0.4 unit lengths, how many sections are there? Sketch it and see!

b)  $0.8 \div 0.02$

Make the 0.02 into a whole number by multiplying it by 100:

$$\frac{0.8 \times 100}{0.02 \times 100} = \frac{80}{2}$$

So,  $0.8 \div 0.02 = 80 \div 2 = 40$

**Estimate:** there are 50 lots of 0.02 shares to make 1 whole so 40 make 0.8 looks OK.

c)  $0.02 \div 0.8$

Make the 0.8 into a whole number by multiplying it by 10:

$$\frac{0.02 \times 10}{0.8 \times 10} = \frac{0.2}{8}$$

So,  $0.02 \div 0.8 = 0.2 \div 8 = 0.025$

**Estimate:** 0.8 is a much bigger portion than 0.02 so the number of shares will be a lot less than 1.

## 10. Converting other fractions to decimals

We can convert fractions to decimals by two methods:

### Method 1

By forming an equivalent fraction with 10 or 100 in the denominator. This only works with some denominators but is the easier method.

### Method 2

Divide the numerator by the denominator (add two or three noughts after the decimal point so that you have something to divide into). This works with all fractions.

### Examples:

a)  $\frac{1}{2}$

$$\frac{1}{2} \rightarrow \frac{1 \times 5}{2 \times 5} \rightarrow \frac{5}{10} \rightarrow 0.5$$

or divide 1 by 2 
$$2 \overline{)1.0} \quad 0.5$$

b)  $\frac{9}{25}$

$$\frac{9}{25} \rightarrow \frac{9 \times 4}{25 \times 4} \rightarrow \frac{36}{100} \rightarrow 0.36$$



or divide 9 by 25

$$\begin{array}{r} 0.36 \\ 25 \overline{)9.0^{15}0} \end{array}$$

c)  $\frac{5}{8}$  This fraction cannot be made into a  $1/10^{\text{th}}$  or  $1/100^{\text{th}}$  so we need to use the division method.

divide 5 by 8

$$\begin{array}{r} 0.625 \\ 8 \overline{)5.0^20^40} \end{array}$$

d)  $\frac{3}{40}$

$$\begin{array}{r} 0.075 \\ 40 \overline{)3.00^{20}0} \end{array} = 0.075$$

e)  $\frac{1}{3}$

$$\begin{array}{r} 0.333 \\ 3 \overline{)1.0^10^10^1} \end{array} = 0.33333333\text{.....}$$

**Note:** a decimal such as 0.33333... is call a recurring or repeating decimal and is written as  $0.\dot{3}$

## 11. Rounding off or correcting

Look at the next place value to the one you are rounding off to. If the number is 5 or greater, round up. If it is less than 5 then round down.

**Examples:**

a) Round off 34.6 to the nearest whole number.

$$\begin{array}{c} \updownarrow \\ 34 \quad .6 \end{array} \quad \text{as 6 is bigger than 5, round up.}$$

$$= 35$$


b) Round off 6.24825 to the nearest tenth (1 decimal place).


$$\begin{array}{c} \updownarrow \\ 6.2 \end{array} \quad 4825 \quad \text{the 825 is dropped off straight away.}$$

$$\begin{array}{c} \updownarrow \\ 6.2 \end{array} \quad 4 \quad \text{as 4 is smaller than 5, round down}$$


$$= 6.2$$

c) Round off 24.6685 to the nearest hundredth (2 decimal places).

24.66  85 the 5 is dropped off straight away.

24.66  8 as 8 is greater than 5, round up = 35

d) Round off 656.4599 to 3 decimal places.

656.456  9 as 9 is greater than 5, round up = 656.460

## 12. For more information

Visit our [intro to maths](#) page on the Charles Sturt Student Portal where you can access more mathematics and numeracy resources, find and register for our Enhancing Numeracy workshops or make a 1:1 appointment with our numeracy advisers.