

# Percentage Basics



Curriculum Ready



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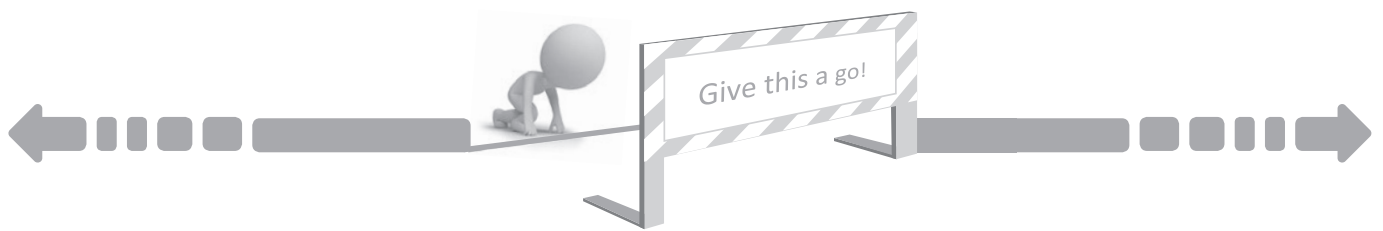
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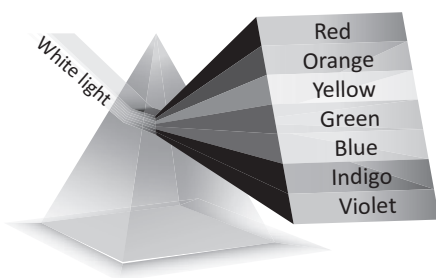


Percentages allow us to compare the size of one quantity in relation to another!

Give two examples where you have seen percentages used or mentioned?  
Write what you think it meant in the situation you saw it being used.



**Q** When white light enters a glass prism, the light is split up (dispersed) into different colours. Describe in as many different clear ways as possible, how much of the dispersed white light is green.



Work through the book for a great way to do this



### Proper fractions to percentages

Percent (%) = for every (per) 100 (cent)

In fraction terms, this means the denominator is equal to 100.

$$\therefore 5\% = 5 \text{ for every } 100 = \frac{5}{100}$$



Since the values are compared to 100, the whole amount is represented by 100%

For many percentage calculations, you will need to change fractions into percentages.

So, just write as an **equivalent fraction** with a denominator of 100!

Here are some examples involving proper fractions and percentages:

(i)  $\frac{11}{100} = 11\%$

Percent sign means 'for every 100'

(ii)  $\frac{30}{200} = \frac{30 \div 2}{200 \div 2}$

Divide numerator and denominator by 2

$$= \frac{15}{100}$$

Equivalent fraction with 100 in denominator

$$= 15\%$$

Numerator < denominator < 100%

(iii)  $\frac{1}{50} = \frac{1 \times 2}{50 \times 2}$

Multiply numerator and denominator by 2

$$= \frac{2}{100}$$

Equivalent fraction with 100 in denominator

$$= 2\%$$

Numerator < denominator < 100%

(iv)  $\frac{25}{25} = \frac{25 \times 4}{25 \times 4}$

Multiply numerator and denominator by 4

$$= \frac{100}{100}$$

Equivalent fraction with 100 in denominator

$$= 100\%$$

Numerator = denominator = 100%



Proper fractions to percentages



1 Write these fractions as a percentage.

a  $\frac{9}{100} = \boxed{\phantom{000}}\%$     b  $\frac{40}{100} = \boxed{\phantom{000}}\%$     c  $\frac{75}{100} = \boxed{\phantom{000}}\%$     d  $\frac{100}{100} = \boxed{\phantom{000}}\%$

2 Write these percentages as a fraction in simplest form.

a  $7\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$     b  $13\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$     c  $29\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$

d  $50\% = \frac{\boxed{\phantom{00}}}{100} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$     e  $20\% = \frac{\boxed{\phantom{00}}}{100} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$     f  $25\% = \frac{\boxed{\phantom{00}}}{100} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$   
 Simplest Form    Simplest Form    Simplest Form

g  $75\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$     h  $14\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$     i  $55\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$   
 Simplest Form    Simplest Form    Simplest Form

j  $78\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$     k  $45\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$     l  $68\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$   
 Simplest Form    Simplest Form    Simplest Form

3 Write these as equivalent fractions with a denominator of 100 and then as a percentage.

a  $\frac{6}{200} = \frac{6 \div \boxed{\phantom{00}}}{200 \div \boxed{\phantom{00}}}$     b  $\frac{80}{400} = \frac{80 \div \boxed{\phantom{00}}}{400 \div \boxed{\phantom{00}}}$     b  $\frac{150}{500} = \frac{150 \div \boxed{\phantom{00}}}{500 \div \boxed{\phantom{00}}}$

$= \frac{\boxed{\phantom{00}}}{100}$      $= \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$      $= \frac{\boxed{\phantom{00}}}{\boxed{\phantom{000}}}$

$= \boxed{\phantom{00}}\%$      $= \boxed{\phantom{00}}\%$      $= \boxed{\phantom{00}}\%$



### Proper fractions to percentages

3 Write these as equivalent fractions with a denominator of 100 and then as a percentage.

$$\text{d } \frac{7}{10} = \frac{7 \times \boxed{\phantom{00}}}{10 \times \boxed{\phantom{00}}}$$

$$= \frac{\boxed{\phantom{00}}}{100}$$

$$= \boxed{\phantom{00}}\%$$

$$\text{e } \frac{5}{50} = \frac{5 \times \boxed{\phantom{00}}}{50 \times \boxed{\phantom{00}}}$$

$$= \frac{\boxed{\phantom{00}}}{100}$$

$$= \boxed{\phantom{00}}\%$$

$$\text{f } \frac{10}{25} = \frac{10 \times \boxed{\phantom{00}}}{25 \times \boxed{\phantom{00}}}$$

$$= \frac{\boxed{\phantom{00}}}{100}$$

$$= \boxed{\phantom{00}}\%$$

4 Write these fractions as an equivalent percentage (show your working).

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

$$= \boxed{\phantom{00}}\%$$

$$\text{b } \frac{3}{25}$$

$$= \boxed{\phantom{00}}\%$$

$$\text{c } \frac{10}{10}$$

$$= \boxed{\phantom{00}}\%$$

$$\text{d } \frac{3}{4}$$

$$= \boxed{\phantom{00}}\%$$

$$\text{e } \frac{3}{5}$$

$$= \boxed{\phantom{00}}\%$$

$$\text{f } \frac{27}{300}$$

$$= \boxed{\phantom{00}}\%$$

$$\text{g } \frac{198}{200}$$

$$= \boxed{\phantom{00}}\%$$

$$\text{h } \frac{50}{2500}$$

$$= \boxed{\phantom{00}}\%$$

$$\text{i } \frac{355}{500}$$

$$= \boxed{\phantom{00}}\%$$



**Proper fractions to percentages**

Here are two other calculator-friendly methods

(i) Multiply the fraction by 100 and then simplify.

$$\begin{aligned} \cdot \frac{2}{5} &= \left(\frac{2}{5} \times 100\right)\% \\ &= \frac{200}{5}\% \\ &= 40\% \end{aligned}$$

Multiply fraction by 100 and add a percentage sign

Simplify the fraction to get percentage



(ii) Since a fraction = numerator ÷ denominator, we can also do this calculation:

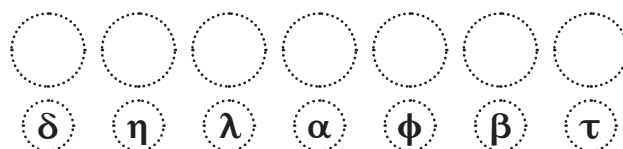
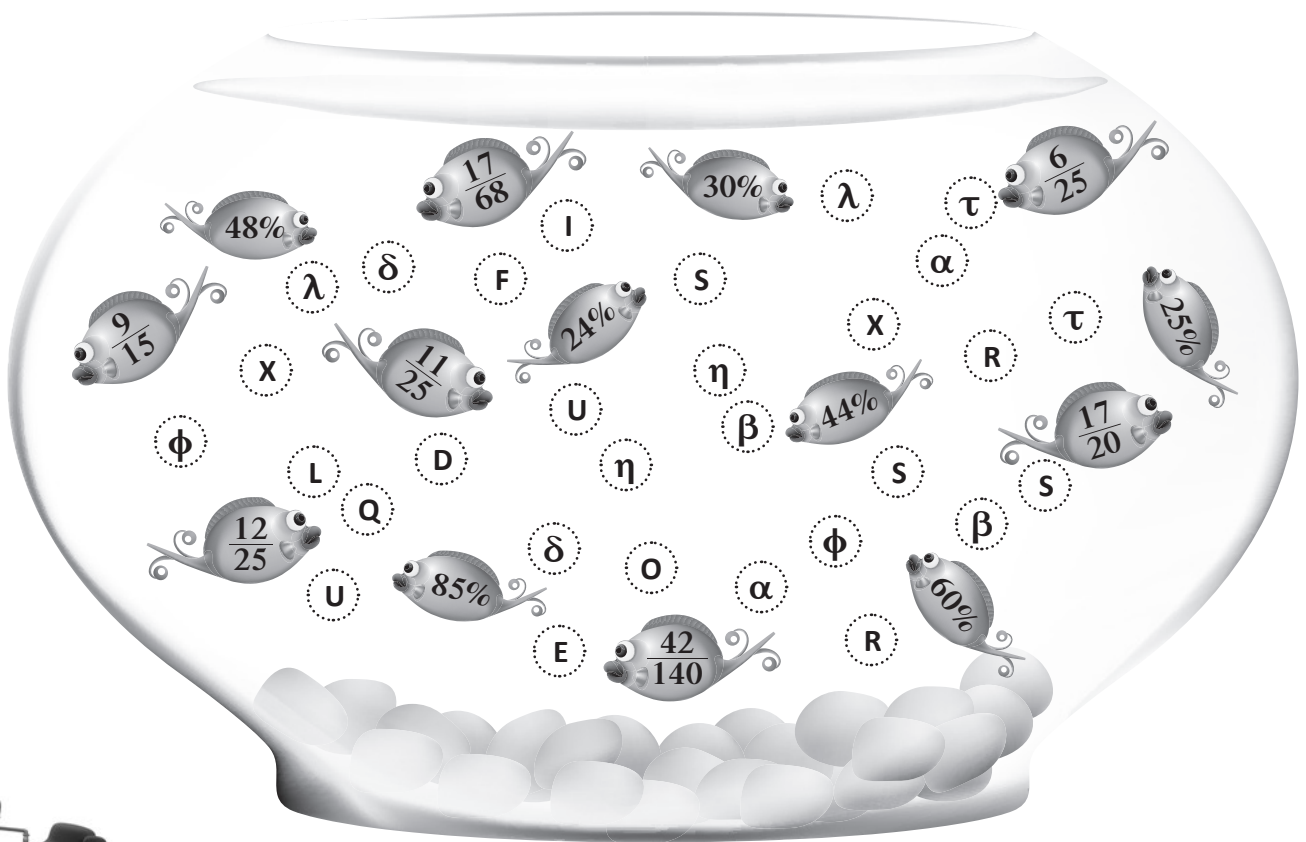
$$\begin{aligned} \cdot \frac{1}{10} &= ((1 \div 10) \times 100)\% \\ &= 10\% \end{aligned}$$

(numerator ÷ denominator) × 100

Percentage value

5 Use your calculators to find the matching percentage fish. Draw straight lines joining their lips to solve this:

What is the name given to the punctuation mark “/” used in modern percentage signs?



### Decimals and percentages

To change a percentage to a decimal, just divide by 100:



Writing the percentage in fraction form shows why we divide by 100 for the decimal

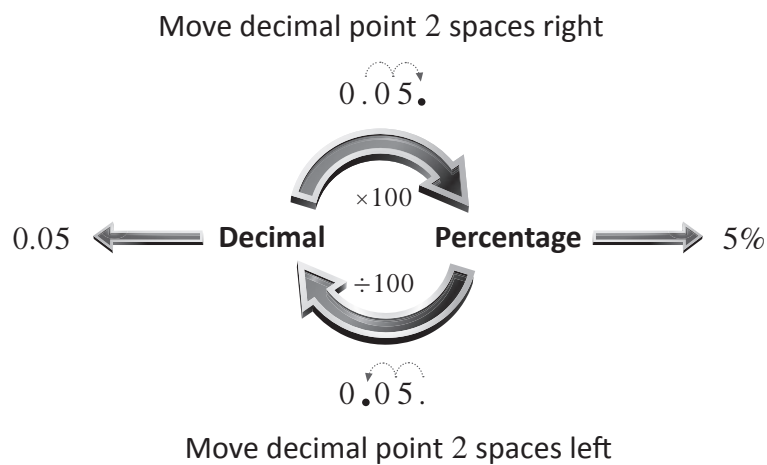
$$5\% = \frac{5}{100} \quad \text{Percentage as a fraction}$$

$$\frac{5}{100} = 5 \div 100$$

$$= 0.05 \quad \text{Fraction as a decimal}$$

$$\therefore 5\% = 0.05$$

This chart shows how we convert between decimals and percentages:



Let's look at two more examples moving in opposite directions.

Write these as their equivalent percentage or decimal:

(i) 20%

$$20\% = 20 \div 100 \quad \text{Divide by 100 to get equivalent decimal}$$

$$= .20 \quad \text{Move decimal point 2 spaces left}$$

$$= 0.20 \quad \text{Equivalent decimal}$$

(ii) 0.4

$$0.4 = (0.4 \times 100)\% \quad \text{Multiply by 100 to get equivalent percentage}$$

$$= 0.40\% \quad \text{Move decimal point 2 spaces right}$$

$$= 40\% \quad \text{Equivalent percentage}$$

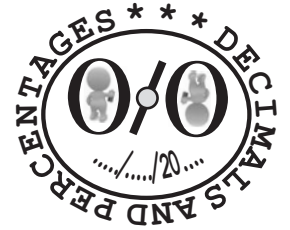




## Decimals and percentages

- 1 Use all of the words below to describe how you write a percentage as an equivalent decimal.

decimal point          places          moved          divide by



- 2 Write each of these percentages as their equivalent decimal.

a 35%

b 75%

c 32%

d 4%

e 1%

f 9%

- 3 Use all of the words below to describe how you write a decimal as an equivalent percentage.

decimal point          places          moved          multiplied by

- 4 Write these decimals as their equivalent percentage.

a 0.55

b 0.23

c 0.7

d 0.8

e 0.01

f 0.04



### Combo time: Decimals, fractions and percentages

We can combine what we know now to change values from fractions to decimals to percentages and back.

Write two equivalent values in simplest form for each of these:

(i) 65%

$$65\% = 65 \div 100$$

$$= 0.65$$

Equivalent decimal

$$\therefore 65\% = 0.65 = \frac{13}{20}$$

$$65\% = \frac{65}{100}$$

$$= \frac{13}{20}$$

Equivalent simplest fraction

Remember:  
Use smallest place  
value for changing  
decimals to fractions.

(ii) 0.28

$$0.28 = (0.28 \times 100)\%$$

$$= 28\%$$

Equivalent decimal

$$\therefore 0.28 = 28\% = \frac{7}{25}$$

$$0.28 = \frac{28}{100}$$

$$= \frac{7}{25}$$

Equivalent simplest fraction



1 Fill in the gaps with equivalent values in simplest form:

Fraction	$\frac{1}{4}$		$\frac{4}{5}$		$\frac{7}{10}$		$\frac{3}{4}$
Decimal	0.25		0.5			0.18	
Percentage	25%	10%			60%		

**Combo time: Decimals, fractions and percentages**

2 Write the two other equivalent values in simplest form for each of these:

a 40%

b 90%

c 0.42

d 0.15

e  $\frac{90}{200}$

f  $\frac{7}{50}$

3 Writing two other equivalent values in simplest form for each of these:

a 0.08

b  $\frac{1}{20}$

c 36%

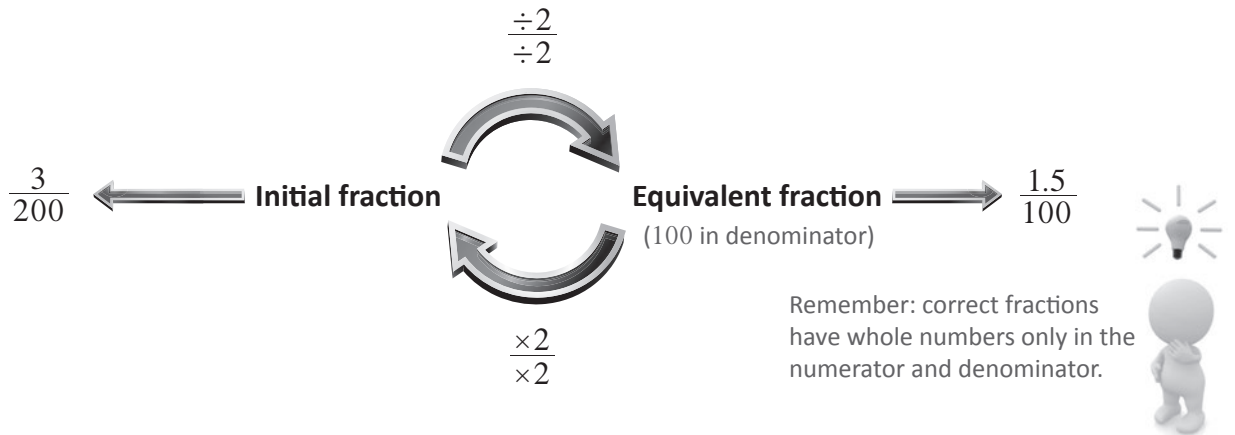
d  $\frac{6}{25}$

e  $\frac{84}{300}$

f  $\frac{60}{1500}$

### Fractional and decimal percentages

Sometimes the equivalent fraction with a denominator of 100 has a decimal numerator.



Simply write the answer as the matching decimal and fraction/mixed number.

$$\therefore \frac{3}{200} = 1.5\% = 1\frac{1}{2}\%$$

decimal
mixed number

Here are some examples involving proper fractions and percentages:

(i)  $\frac{1}{200} = \frac{1 \div 2}{200 \div 2}$   
 $= \frac{0.5}{100}$       Equivalent fraction with 100 in denominator  
 $= 0.5\% \text{ or } \frac{1}{2}\%$       Decimal and equivalent fraction form

(ii)  $\frac{25}{400} = \frac{25 \div 4}{400 \div 4}$   
 $= \frac{6.25}{100}$       Equivalent fractions with 100 in denominator  
 $= 6.25\% \text{ or } 6\frac{1}{4}\%$       Decimal and equivalent mixed number form

Multiply or divide by 100 to change values between equivalent decimal percentages and decimals.

(iii) 34.25%  
 $34.25\% = 34.25 \div 100$       Divide by 100, move decimal point 2 places left  
 $= 0.3425$

(iv) 0.056  
 $0.056 = 0.056 \times 100\%$       Multiply by 100, move decimal point 2 places right  
 $= 5.6\% \text{ or } 5\frac{3}{5}\%$       Decimal and equivalent mixed number form



### Fractional and decimal percentages

1 Write these as a percentage in decimal and proper fraction form.

a  $\frac{2}{400} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Proper fraction

b  $\frac{3}{400} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Proper fraction

c  $\frac{4}{500} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Proper fraction

d  $\frac{3}{750} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Proper fraction

2 Write these as a percentage in decimal and mixed number form.

a  $\frac{15}{200} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \boxed{\phantom{00}}\frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Mixed number

b  $\frac{10}{400} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \boxed{\phantom{00}}\frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Mixed number

c  $\frac{13}{500} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \boxed{\phantom{00}}\frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Mixed number

d  $\frac{30}{800} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \boxed{\phantom{00}}\frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Mixed number

e  $\frac{17}{400} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \boxed{\phantom{00}}\frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Mixed number

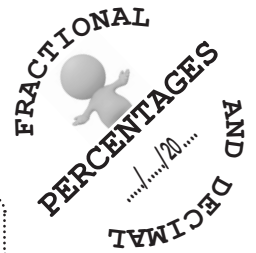
f  $\frac{26}{500} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \boxed{\phantom{00}}\frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Mixed number

g  $\frac{47}{500} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \boxed{\phantom{00}}\frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Mixed number

h  $\frac{75}{400} = \frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}} = \boxed{\phantom{00}}\% = \boxed{\phantom{00}}\frac{\boxed{\phantom{00}}}{\boxed{\phantom{00}}}\%$   
 Decimal Mixed number



Fractional and decimal percentages



3 Write these percentages as equivalent decimals.

a  $10.5\% =$

b  $37.05\% =$

c  $2.45\% =$

d  $6.04\% =$

e  $0.75\% =$

f  $0.015\% =$

4 Write these decimals as equivalent percentages.

a  $0.025 =$

b  $0.0625 =$

c  $0.1185 =$

d  $0.4505 =$

e  $0.0705 =$

f  $0.0096 =$

5 Write these as equivalent decimal and mixed number percentages.

a  $0.255 =$    $\% =$    $\frac{\text{$   $\%}{\text{$

Decimal                      Mixed number

b  $0.085 =$    $\% =$    $\frac{\text{$   $\%}{\text{$

Decimal                      Mixed number

c  $0.1025 =$    $\% =$    $\frac{\text{$   $\%}{\text{$

Decimal                      Mixed number

d  $0.5075 =$    $\% =$    $\frac{\text{$   $\%}{\text{$

Decimal                      Mixed number

e  $0.046 =$    $\% =$    $\frac{\text{$   $\%}{\text{$

Decimal                      Mixed number

f  $0.084 =$    $\% =$    $\frac{\text{$   $\%}{\text{$

Decimal                      Mixed number

g  $0.218 =$    $\% =$    $\frac{\text{$   $\%}{\text{$

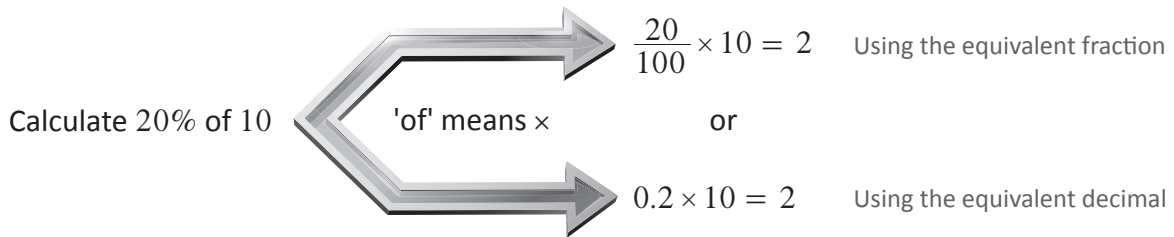
Decimal                      Mixed number

h  $0.555 =$    $\% =$    $\frac{\text{$   $\%}{\text{$

Decimal                      Mixed number



### Percentage of an amount



Here are two word questions involving percentage amounts:

- (i) 60 pieces of biscuit crumbs were spilt on the floor. If 80% of the crumbs were sucked up by a vacuum cleaner on the first sweep, how many biscuit crumbs were sucked up?



Always answer word problems with a statement

$$80\% \text{ of } 60 = \frac{80}{100} \times 60 \quad \text{Multiply by equivalent fraction (or decimal)}$$

$$= \frac{4800}{100} \quad \text{Simplify fraction}$$

$$= 48$$

$\therefore$  48 biscuit crumbs were sucked up in the first sweep.

Since the whole amount in percentage terms = 100%, we can use this fact to simplify some problems.

- (ii) During an 8 hour work day, Jee Un spends 90% of the time working. The rest of the time she is taking breaks etc. How many hours does she spend each day doing non-work activities?

Jee Un spends 90% of the time working.

$\therefore$  she spends  $100\% - 90\% = 10\%$  of the time doing non-work activities

$$\therefore 10\% \text{ of } 8 = 0.10 \times 8 \quad \text{Multiply by equivalent decimal (or fraction)}$$

$$= 0.8 \text{ hours} \quad \text{or } 0.8 \text{ hours} \times 60 \text{ minutes} = 48 \text{ minutes}$$

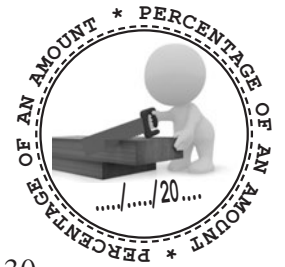
$\therefore$  Jee Un spends 0.8 hours (48 minutes) each day doing non-work activities.

You could also have found 90% first, then subtracted that time from 8 hours.





## Percentage of an amount



1 Complete the steps for these percentage calculations:

a  $25\%$  of  $20 = \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array} \times \square$

b  $30\%$  of  $30 = \begin{array}{|c|} \hline \square \\ \hline \square \\ \hline \square \\ \hline \end{array} \square 30$

c  $40\%$  of  $65 = \square \div \square \times 65$

$= \square \times 65$

$= \square$

d  $45\%$  of  $40 = 45 \square 100 \square \square$

$= \square \times \square$

$= \square$

2 Calculate these percentage amounts using equivalent fractions only (show all working).

a  $10\%$  of  $60$

b  $50\%$  of  $18$

c  $25\%$  of  $16$

d  $75\%$  of  $28$

e  $60\%$  of  $20$

f  $80\%$  of  $30$

g  $40\%$  of  $24$

h  $20\%$  of  $39$



**Percentage of an amount**

3 Calculate these percentage amounts using equivalent decimals only (show all working).

a 20% of 40

b 30% of 20

c 50% of 32

d 35% of 80

e 25% of 44

f 75% of 18

g 21% of 30

h 19% of 25

4 Solve these percentage problems, showing all working.

a At an Angels and Devils fancy dress party, 40% of the 45 people there were dressed as angels. How many people wore angel outfits at the party?



b 15% of a 200 GB (gigabytes) hard drive on a laptop is filled with Qian's music collection. How many gigabytes does her music take up in storage?



## Percentage of an amount

5 Solve these percentage problems, showing all working.

- a Justin wrote a love poem containing a total of 150 words. If the word 'love' represented 18% of the words used, how many words were **not** the word 'love' in Justin's poem?



- b According to a recent zoo study, 58% of all the 800 fruit-eating animals seemed to prefer the taste of bananas over the taste of apples. How many animals preferred the taste of apples?

6 Try these trickier ones to earn an awesome passport stamp.

- a A pancake mixture contains 35% self-raising flour, 14% eggs and 6% butter. The rest of the mixture contains milk. How many millilitres (mL) of milk are there in 430 mL of the pancake mixture?

Hint: calculate the total percentage of non-flour ingredients first



- b A set of balance scales currently has 245 grams on the heaviest side. If 20% of this weight needs to be moved to the other side to make the scale balanced, what is the total amount of weights on the scales?

Hint: find how much needs to be moved and then what it means to be in balance

## Percentages greater than 100%

Now you have seen proper fractions as percentages, what happens when you have improper fractions?

For improper fractions, the percentage value will be greater than 100%.

So if you have 10% **more** than what you started with, you now have 110% of the starting amount.



These examples show that the method used is just the same as for percentage values smaller than 100%

(i) Improper fractions and mixed numbers:

$$\frac{480}{400} = \frac{480 \div 4}{400 \div 4}$$

$$= \frac{120}{100}$$

$$= 120\%$$

Equivalent fraction with 100 in denominator

Numerator > denominator > 100%

$$2\frac{4}{20} = \frac{44}{20}$$

$$= \frac{44 \times 5}{20 \times 5}$$


$$= \frac{220}{100}$$

$$= 220\%$$

Equivalent improper fraction

Equivalent fraction with 100 in denominator

Mixed number > 100%



$$2 \text{ whole (200\%)} + \frac{4}{20} = \frac{20}{100} \text{ (20\%)} \\ = 220\%$$

$$340\% = \frac{340}{100}$$

$$= 3\frac{40}{100}$$

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

Equivalent improper fraction

Simplified mixed number

(ii) Decimals without leading zeros:

$$250\% = 250 \div 100$$

$$= 2.50.$$

$$= 2.5$$

Divide by 100 to get equivalent decimal

Move decimal point 2 spaces left

Equivalent decimal, no leading zero.


$$1.75 = (1.75 \div 100)\%$$

$$= 1.75\%$$

$$= 175\%$$

Move decimal point 2 spaces right

No leading zero, > 100%.



No leading zero means the number in front of the decimal point is not 0.



Percentages greater than 100%

1 Change improper fractions to their equivalent percentage.

a  $\frac{25}{20} = \frac{25 \times 5}{20 \times 5} = \frac{125}{100} = 125\%$   
 Equivalent fraction

b  $\frac{320}{200} = \frac{\quad \div 2}{\quad \div 2} = \frac{\quad}{\quad} = \quad\%$   
 Equivalent fraction

c  $\frac{30}{25} = \frac{\quad}{\quad} = \frac{\quad}{\quad} = \quad\%$

d  $\frac{720}{300} = \frac{\quad}{\quad} = \frac{\quad}{\quad} = \quad\%$

e  $\frac{9}{5} = \frac{\quad}{\quad} = \frac{\quad}{\quad} = \quad\%$

f  $\frac{576}{200} = \frac{\quad}{\quad} = \frac{\quad}{\quad} = \quad\%$

2 Change these mixed numbers to improper fractions and then their equivalent percentages.

a  $1\frac{1}{2} = \frac{3}{2} = \frac{150}{100} = 150\%$   
 Improper fraction    Fraction    Percentage

b  $2\frac{1}{4} = \frac{\quad}{\quad} = \frac{\quad}{100} = \quad\%$   
 Improper fraction    Fraction    Percentage

c  $1\frac{4}{5} = \frac{\quad}{\quad} = \frac{\quad}{\quad} = \quad\%$

d  $3\frac{13}{10} = \frac{\quad}{\quad} = \frac{\quad}{\quad} = \quad\%$

e  $2\frac{12}{25} = \frac{\quad}{\quad} = \frac{\quad}{\quad} = \quad\%$

f  $1\frac{17}{20} = \frac{\quad}{\quad} = \frac{\quad}{\quad} = \quad\%$

3 Change these percentages to their simplified equivalent mixed number.

a  $120\% = \frac{120}{100} = 1\frac{20}{100} = 1\frac{2}{5}$   
 Improper fraction    Mixed number    Simplified

b  $270\% = \frac{\quad}{\quad} = \quad\frac{\quad}{\quad} = \quad\frac{\quad}{\quad}$   
 Improper fraction    Mixed number    Simplified

c  $110\% = \frac{\quad}{\quad} = \quad\frac{\quad}{\quad} = \quad\frac{\quad}{\quad}$

d  $475\% = \frac{\quad}{\quad} = \quad\frac{\quad}{\quad} = \quad\frac{\quad}{\quad}$

e  $355\% = \frac{\quad}{\quad} = \quad\frac{\quad}{\quad} = \quad\frac{\quad}{\quad}$

f  $192\% = \frac{\quad}{\quad} = \quad\frac{\quad}{\quad} = \quad\frac{\quad}{\quad}$



### Percentages greater than 100%

4 Change each of these to their equivalent decimal or percentage.

a  $124\% = 124 \div 100 = 1.24$



b  $2.35 = 2.35 \times 100 = \quad \%$

c  $213\% = \quad = \quad$

d  $1.68 = \quad = \quad \%$

e  $490\% = \quad = \quad$

f  $9.07 = \quad = \quad \%$

g  $300\% = \quad = \quad$

h  $4.5 = \quad = \quad \%$

5 **Combo time:**

Use the same methods to change these fractional and decimal percentages that are greater than 100%.

a  $212.5\%$  as a decimal

b  $105.75\%$  as a decimal

c  $165\frac{1}{2}\%$  as a decimal

d  $286\frac{1}{4}\%$  as a decimal

e  $3.105$  as a decimal percentage

f  $1.0535$  as a decimal percentage.

g  $2.125$  as a mixed number percentage

h  $1.902$  as a mixed number percentage

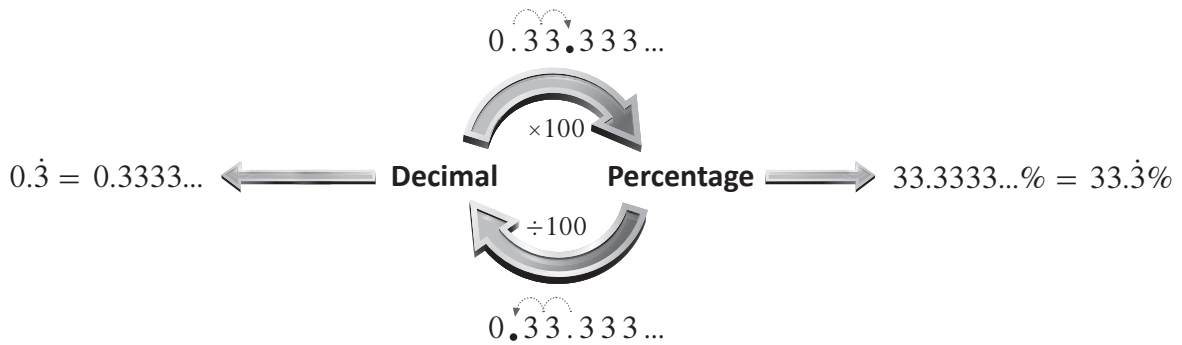
i  $3.004$  as a mixed number percentage

j  $2.0075$  as a mixed number percentage

### Recurring decimal percentages

Recurring decimals should be treated just like terminating decimals when changing to percentages.

Move decimal point 2 spaces right



Move decimal point 2 spaces left

It is usually nicer to write recurring decimals as a mixed number percentage where possible.

$$\therefore 33.\dot{3}\% = 33\frac{1}{3}\%$$

This table shows that there is a pattern for writing simple recurring decimals as fractions:



$0.\dot{1} = \frac{1}{9}$	$0.\dot{2} = \frac{2}{9}$	$0.\dot{3} = \frac{1}{3}$	$0.\dot{4} = \frac{4}{9}$	$0.\dot{5} = \frac{5}{9}$	$0.\dot{6} = \frac{2}{3}$	$0.\dot{7} = \frac{7}{9}$	$0.\dot{8} = \frac{8}{9}$	$0.\dot{9} = \frac{9}{9} = 1$
---------------------------	---------------------------	---------------------------	---------------------------	---------------------------	---------------------------	---------------------------	---------------------------	-------------------------------

Here are some more examples with slight differences involving recurring decimals.

- (i) Convert  $0.00\dot{1}$  to its equivalent percentage value.

Remember:

Change so the recurring pattern starts from the decimal point.



$$0.00\dot{1} = 0.00111\dots$$

$$= (0.00111\dots \times 100)\% \quad \text{Multiply the decimal by 100}$$

$$= 0.111\dots\%$$

$$= 0.\dot{1}\% \quad \text{Recurring decimal percentage}$$

$$= \frac{1}{9}\% \quad \text{Percentage form from the table}$$

- (ii) Convert  $0.01\dot{6}\dot{4}$  to its equivalent percentage value

The number of '9s' in the denominator equals the number of digits in the repeating pattern.



$$0.01\dot{6}\dot{4} = 0.016464\dots$$

$$= (0.016464\dots \times 100)\% \quad \text{Multiply the decimal by 100}$$

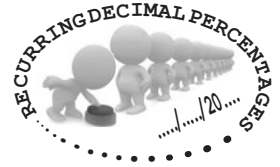
$$= 1.6464\%$$

$$= 1.\dot{6}\dot{4}\% \quad \text{Recurring decimal percentage}$$

$$= 1\frac{64}{99}\% \quad \text{Mixed number form from the table}$$



## Recurring decimal percentages



Use this table to help when answering these questions.

$0.\dot{1} = \frac{1}{9}$	$0.\dot{2} = \frac{2}{9}$	$0.\dot{3} = \frac{1}{3}$	$0.\dot{4} = \frac{4}{9}$	$0.\dot{5} = \frac{5}{9}$	$0.\dot{6} = \frac{2}{3}$	$0.\dot{7} = \frac{7}{9}$	$0.\dot{8} = \frac{8}{9}$	$0.\dot{9} = \frac{9}{9} = 1$
---------------------------	---------------------------	---------------------------	---------------------------	---------------------------	---------------------------	---------------------------	---------------------------	-------------------------------

1 Write these in their equivalent fraction form:

a  $55.\dot{5}\%$

b  $122.\dot{2}\%$

c  $64.\dot{4}\%$

d  $23.\dot{2}\dot{3}\%$

e  $8.\dot{0}\dot{8}\%$

f  $10.\dot{1}\dot{2}\%$

2 Use this table to help write these recurring decimals as their equivalent mixed number percentage:

a  $0.00\dot{2}$

b  $0.00\dot{7}$

c  $0.02\dot{5}$

d  $0.06\dot{4}$

e  $0.0\dot{8}$

f  $0.\dot{1}$

g  $0.\dot{3}$

h  $0.9\dot{8}$

i  $0.2\dot{6}$

3 Write these mixed number percentages as recurring decimals:

a  $2\frac{4}{9}\%$

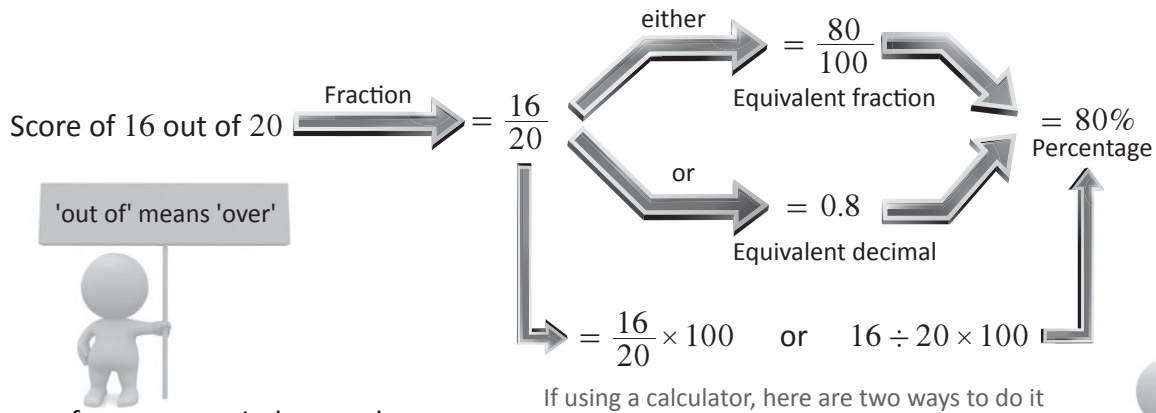
b  $4\frac{16}{18}\%$

c  $1\frac{2}{3}\%$



## One amount as a percentage of another

When comparing values such as scores out of a total amount, the results are often given as a percentage.



Here are a few more varied examples.



These examples show that the method used is just the same as for percentage values smaller than 100%

(i) Calculate what percentage amount 15 is out of 50 without using a calculator.

$$\begin{aligned}
 15 \text{ out of } 50 &= \frac{15}{50} \\
 &= \frac{15 \times 2}{50 \times 2} && \text{Equivalent fraction with 100 in denominator} \\
 &= \frac{30}{100} \\
 &= 30\%
 \end{aligned}$$

The calculator should be used for more complex calculations.

(ii) Deanne scored 23.5 marks out of a possible 30 in a recent competition. Calculate her percentage score.

$$\begin{aligned}
 23.5 \text{ out of } 30 &= ((23.5 \div 30) \times 100)\% \\
 &= 78.\dot{3}\% \\
 &= 78\frac{1}{3}\% && \text{Equivalent mixed number percentage}
 \end{aligned}$$

$\therefore$  Deanne's percentage score in the competition was  $78\frac{1}{3}\%$

Percentages can also be rounded off.

(iii) Write 13 as a percentage out of 19, rounded to 2 decimal places.

$$\begin{aligned}
 13 \text{ out of } 19 &= ((13 \div 19) \times 100)\% \\
 &= 68.42105263\dots\% \\
 &= 68.42\% \quad (\text{to 2 decimal places})
 \end{aligned}$$



Remember: If the next digit is 5 or more, round up.





**One amount as a percentage of another**



1 Calculate these percentage amounts, showing all you working:

- a 5 out of 20
- b 10 out of 25

- c 128 out of 200
- d 450 out of 500

2 Calculate these percentage amounts, leaving your answers as mixed number percentages:

- a 12 out of 32
- b 21 out of 24

- c 25 out of 30
- d 10.1 out of 40

3 Calculate these percentage amounts, rounding your answers to 2 decimal places:

- a 4 out of 9
- b 13 out of 33

- c 8.9 out of 11
- d 22.8 out of 34



**One amount as a percentage of another**

4 Grace was top of her science class when she correctly spelled 48 out of 50 scientific terms in a test. What percentage of the terms did she spell correctly?

5 Luke made 16 good passes during one half of a football match in which he had possession of the ball 25 times. What percentage of his possessions resulted in good passes being completed?



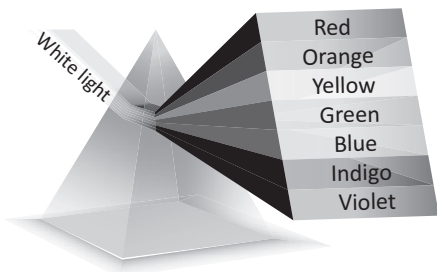
6 Ahmed had these free patterned covers to choose from when he purchased a new mobile phone:



What percentage of Ahmed's choices had striped covers?

Hint: compare how many covers are striped with how many covers there are in total

7 When white light enters a glass prism, the light is split up (dispersed) into different colours. According to the diagram, what percentage of the dispersed light is green, rounded to 2 decimal places?

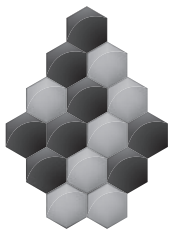


**One amount as a percentage of another**

- 8 A 3.6 L jug of mixed cordial drink contains 0.82 L of flavour syrup. What percentage of the mixed cordial drink is syrup flavour, rounded to 1 decimal place?
- 9 In one particular song at a concert, the rhythm guitarist for “The Lightning Lizards” uses 14 of the 39 different chords played by her throughout the entire concert. What percentage of the chords played are used in that one song, rounded to 2 decimal places?
- 10 Nicola checked the space she had available on a memory stick and found that so far, 12.6 GB of the 16 GB total memory had been used. What percentage of the memory stick storage space has Nicola already used? Write your answer as a mixed number percentage.



- 11 What mixed number percentage represents the number of black hexagons in this picture?



- 12 A bag contains chocolates individually wrapped in different coloured foils. There are 4 pink, 6 green and 8 red. What percentage of the chocolates are wrapped in pink foil?  
Write answer as a mixed number.



## One amount as a percentage of another

Here is what we do if we want to find the remaining percentage amounts:

Twenty five of the thirty people who were rushing for the train successfully caught it. What percentage of the people missed getting to the train on time?

25 out of 30 caught the train

$\therefore (30 - 25) = 5$  out of 30 missed the train

$= [(5 \div 30) \times 100]\%$

$= 16.\dot{6}\%$

Decimal percentage

$= 16\frac{2}{3}\%$

Mixed number percentage

$\therefore 16\frac{2}{3}\%$  the people rushing for the train missed getting to it on time.

- 13 Three students did not complete their Media homework of watching a TV news broadcast. What percentage of students completed their homework if there are twenty five students in the class?



- 14 If thirty five of the sixty seven people at a meeting voted 'yes' on a decision, what percentage voted 'no'? Answer accurate to 1 decimal place.

- 15 A movie cinema is showing: four children's, three action adventure, two romantic comedies, and five drama movies during one week. What percentage of the movies are not romantic comedies, rounded to 1 decimal place?

- 16 19 173 of the 41 500 supporters at a sports game were barracking for the team that eventually won. The remaining spectators all supported the team that lost. What percentage of the supporters left the game disappointed that their team lost?  
Write answer as a mixed number.



**Reflection time**

Reflecting on the work covered within this booklet:

- What useful skills have you gained by learning about percentages?

- Write about one or two ways you think you could apply percentages to a real life situation.

- If you discovered or learnt about any shortcuts to help with percentages or some other cool facts, jot them down here:



Here is a summary of some important things to remember for percentage basics

### Proper fractions to percentages

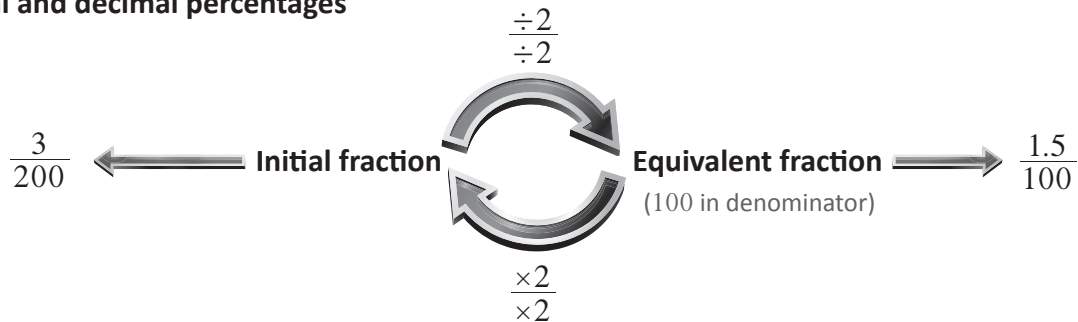
Percent (%) = for every (per) 100 (cent)

$$\therefore 5\% = 5 \text{ for every } 100 = \frac{5}{100}$$

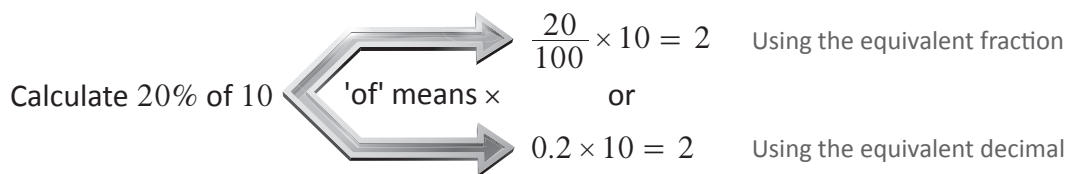
### Decimals and percentages



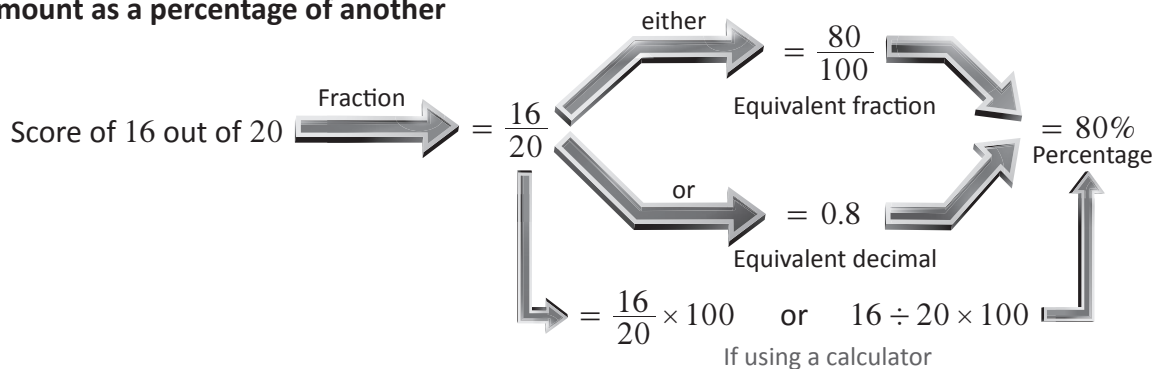
### Fractional and decimal percentages



### Percentage of an amount



### One amount as a percentage of another



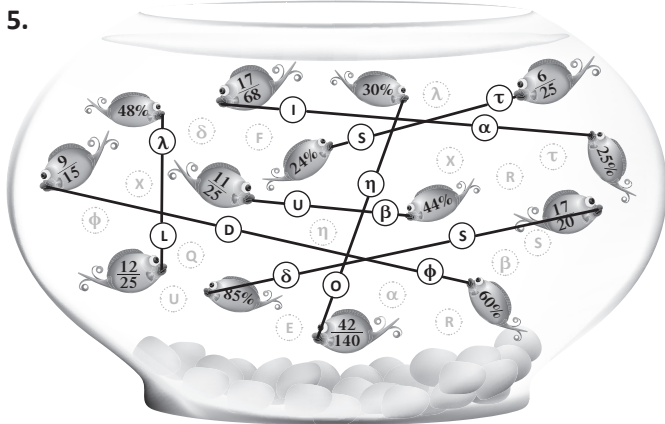
Proper fractions to percentages

1. a 9%      b 40%      c 75%      d 100%

2. a  $\frac{7}{100}$       b  $\frac{13}{100}$       c  $\frac{29}{100}$   
 d  $\frac{1}{2}$       e  $\frac{1}{5}$       f  $\frac{1}{4}$   
 g  $\frac{3}{4}$       h  $\frac{7}{50}$       i  $\frac{11}{20}$   
 j  $\frac{39}{50}$       k  $\frac{9}{20}$       l  $\frac{17}{25}$

3. a 3%      b 20%      c 30%  
 d 70%      e 10%      f 40%

4. a 50%      b 12%      c 100%  
 d 75%      e 60%      f 9%  
 g 99%      h 2%      i 71%



S O L I D U S  
 δ η λ α φ β τ

Decimals and percentages

1. The percentage value is **divided by** 100, so the **decimal point is moved 2 places to the left.**

2. a 0.35      b 0.75      c 0.32  
 d 0.04      e 0.01      f 0.09

Decimals and percentages

3. The decimal is **multiplied by** 100, so the **decimal point is moved 2 places to the right.**

4. a 55%      b 23%      c 70%  
 d 80%      e 1%      f 4%

Combo time:  
Decimals, fractions and percentages

1.

Fraction	$\frac{1}{4}$	$\frac{1}{10}$	$\frac{1}{2}$	$\frac{4}{5}$	$\frac{3}{5}$	$\frac{7}{10}$	$\frac{9}{50}$	$\frac{3}{4}$
Decimal	0.25	0.1	0.5	0.8	0.6	0.7	0.18	0.75
Percentage	25%	10%	50%	80%	60%	70%	18%	75%

2. a 0.4      Decimal  
 $\frac{2}{5}$       Fraction  
 b 0.9      Decimal  
 $\frac{9}{10}$       Fraction  
 c 42%      Percentage  
 $\frac{21}{50}$       Fraction  
 d 15%      Percentage  
 $\frac{3}{20}$       Fraction  
 e 0.45      Decimal  
 45%      Percentage  
 f 0.14      Decimal  
 14%      Percentage

3. a 8%      Percentage  
 $\frac{2}{25}$       Fraction  
 b 0.05      Decimal  
 5%      Percentage  
 c 0.36      Decimal  
 $\frac{9}{25}$       Fraction  
 d 0.24      Decimal  
 24%      Percentage  
 e 0.28      Decimal  
 28%      Percentage  
 f 0.04      Decimal  
 4%      Percentage

Fractional and decimal percentages

1. **a**  $0.5\% = \frac{1}{2}\%$   
 Decimal    Proper fraction
- b**  $0.75\% = \frac{3}{4}\%$   
 Decimal    Proper fraction
- c**  $0.8\% = \frac{4}{5}\%$   
 Decimal    Proper fraction
- d**  $0.4\% = \frac{2}{5}\%$   
 Decimal    Proper fraction

2. **a**  $7.5\% = 7\frac{1}{2}\%$   
 Decimal    Mixed numeral
- b**  $2.5\% = 2\frac{1}{2}\%$   
 Decimal    Mixed numeral
- c**  $2.6\% = 2\frac{3}{5}\%$   
 Decimal    Mixed numeral
- d**  $3.75\% = 3\frac{3}{4}\%$   
 Decimal    Mixed numeral
- e**  $4.25\% = 4\frac{1}{4}\%$   
 Decimal    Mixed numeral
- f**  $5.2\% = 5\frac{1}{5}\%$   
 Decimal    Mixed numeral
- g**  $9.4\% = 9\frac{2}{5}\%$   
 Decimal    Mixed numeral
- h**  $18.75\% = 18\frac{3}{4}\%$   
 Decimal    Mixed numeral

3. **a** 0.105      **b** 0.3705      **c** 0.0245  
**d** 0.0604      **e** 0.0075      **f** 0.000 15

4. **a** 2.5%      **b** 6.25%      **c** 11.85%  
**d** 45.05%    **e** 7.05%      **f** 0.96%

Fractional and decimal percentages

5. **a**  $0.255 = 25.5\% = 25\frac{1}{2}\%$   
 Decimal                  Mixed numeral
- b**  $0.085 = 8.5\% = 8\frac{1}{2}\%$   
 Decimal                  Mixed numeral
- c**  $0.1025 = 10.25\% = 10\frac{1}{4}\%$   
 Decimal                  Mixed numeral
- d**  $50.75 = 50.75\% = 50\frac{3}{4}\%$   
 Decimal                  Mixed numeral
- e**  $0.045 = 4.6\% = 4\frac{3}{5}\%$   
 Decimal                  Mixed numeral
- f**  $0.084 = 8.4\% = 8\frac{2}{5}\%$   
 Decimal                  Mixed numeral
- g**  $0.218 = 21.8\% = 21\frac{4}{5}\%$   
 Decimal                  Mixed numeral
- h**  $0.555 = 55.5\% = 55\frac{1}{2}\%$   
 Decimal                  Mixed numeral

Percentage of an amount

1. **a**  $25\% \text{ of } 20 = \frac{25}{100} \times 20 = 5$
- b**  $30\% \text{ of } 30 = \frac{30}{100} \times 30 = 9$
- c**  $40\% \text{ of } 65 = 40 \div 100 \times 65 = 0.4 \times 65 = 26$
- d**  $45\% \text{ of } 40 = 45 \div 100 \times 40 = 0.45 \times 40 = 18$

2. **a** 6      **b** 9      **c** 4      **d** 21  
**e** 12      **f** 24      **g** 9.6      **h** 7.8



Percentage of an amount

3. a 8      b 6      c 16      d 28  
 e 11      f 13.5      g 6.3      h 4.75

4. a 18 of the people were dressed as angels.  
 b Qian's music collection fills 30 GB of storage space.

5. a 123 of the 150 words in Justin's poem are **not** the word 'love'  
 b 336 of the 800 fruit eating animals at the zoo preferred the taste of apples.

6. a There is 193.5 mL in the pancake mixture.  
 b Total amount of weights on the scales =  $2 \times 196 = 392$  g

Percentages greater than 100%

1. a  $\frac{25}{20} = \frac{25 \times 5}{20 \times 5} = \frac{125}{100} = 125\%$   
Equivalent fraction      Percentage
- b  $\frac{320}{200} = \frac{320 \div 2}{200 \div 2} = \frac{160}{100} = 160\%$   
Equivalent fraction      Percentage
- c  $\frac{30}{25} = \frac{30 \times 4}{25 \times 4} = \frac{120}{100} = 120\%$
- d  $\frac{720}{300} = \frac{720 \div 3}{300 \div 3} = \frac{240}{100} = 240\%$
- e  $\frac{9}{5} = \frac{9 \times 20}{5 \times 20} = \frac{180}{100} = 180\%$
- f  $\frac{576}{200} = \frac{576 \div 2}{200 \div 2} = \frac{288}{100} = 288\%$

Percentages greater than 100%

2. a  $1\frac{1}{2} = \frac{3}{2} = \frac{150}{100} = 150\%$   
Improper fraction      Fraction      Percentage
- b  $2\frac{1}{4} = \frac{9}{4} = \frac{225}{100} = 225\%$   
Improper fraction      Fraction      Percentage
- c  $1\frac{4}{5} = \frac{9}{5} = \frac{180}{100} = 180\%$
- d  $3\frac{13}{10} = \frac{43}{10} = \frac{430}{100} = 430\%$
- e  $2\frac{12}{25} = \frac{62}{25} = \frac{248}{100} = 248\%$
- f  $1\frac{17}{20} = \frac{37}{20} = \frac{185}{100} = 185\%$
3. a  $120\% = \frac{120}{100} = 1\frac{20}{100} = 1\frac{1}{5}$   
Improper fraction      Mixed numeral      Simplified
- b  $270\% = \frac{270}{100} = 2\frac{70}{100} = 2\frac{7}{10}$   
Improper fraction      Mixed numeral      Simplified
- c  $110\% = \frac{110}{100} = 1\frac{10}{100} = 1\frac{1}{10}$
- d  $475\% = \frac{475}{100} = 4\frac{75}{100} = 4\frac{3}{4}$
- e  $355\% = \frac{355}{100} = 3\frac{55}{100} = 3\frac{11}{20}$
- f  $192\% = \frac{192}{100} = 1\frac{92}{100} = 1\frac{23}{25}$
4. a  $124\% = 124 \div 100 = 1.24$   
 b  $2.35 = 2.35 \times 100\% = 235\%$   
 c  $213\% = 213 \div 100 = 2.13$   
 d  $1.68 = 1.68 \times 100\% = 168\%$   
 e  $490\% = 490 \div 100 = 4.90$   
 f  $9.07 = 9.07 \times 100\% = 907\%$   
 g  $300\% = 300 \div 100 = 3.00$   
 h  $4.5 = 4.5 \times 100\% = 450\%$

Percentages greater than 100%

5. **a**  $212.5 \div 100 = 2.125$   
**b**  $105.75 \div 100 = 1.0575$   
**c**  $165.5 \div 100 = 1.655$   
**d**  $286.25 \div 100 = 2.8625$   
**e**  $3.105 \times 100 = 310.5\%$   
**f**  $1.0535 \times 100 = 105.35\%$   
**g**  $212.5\% = 212\frac{1}{2}\%$   
**h**  $190.2\% = 190\frac{1}{5}\%$   
**j**  $300.4\% = 300\frac{2}{5}\%$   
**k**  $200.75\% = 200\frac{3}{4}\%$

Recurring decimal percentages

1. **a**  $55\frac{5}{9}\%$     **b**  $122\frac{2}{9}\%$     **c**  $64\frac{4}{9}\%$   
**d**  $23\frac{23}{99}\%$     **e**  $8\frac{8}{99}\%$     **f**  $10\frac{4}{33}\%$
2. **a**  $\frac{2}{9}\%$     **b**  $\frac{7}{9}\%$     **c**  $2\frac{5}{9}\%$   
**d**  $6\frac{4}{9}\%$     **e**  $8\frac{8}{9}\%$     **f**  $11\frac{1}{9}\%$   
**g**  $33\frac{1}{3}\%$     **h**  $98\frac{8}{9}\%$     **i**  $26\frac{2}{3}\%$
3. **a**  $0.02\dot{4}$     **b**  $0.04\dot{8}$     **c**  $0.01\dot{6}$

One amount as a percentage of another

1. **a** 25%    **b** 40%    **c** 64%    **d** 90%
2. **a**  $37\frac{1}{2}\%$     **b**  $87\frac{1}{2}\%$   
**c**  $83\frac{1}{3}\%$     **d**  $25\frac{1}{4}\%$

One amount as a percentage of another

3. **a** 44.44 (to 2 d.p.)    **b** 39.39 (to 2 d.p.)  
**c** 80.91% (to 2 d.p.)    **d** 67.06% (to 2 d.p.)
4. Grace spelled 96% of the words correctly in the test.
5. 64% of Luke's passes were good.
6. 25% of covers available have a striped pattern.
7. The colour green makes up 14.29% of the dispersed white light.
8. 22.8% of the cordial is syrup flavour.
9. One song contains 35.9% of all the different chords the band plays in one show.
10. Nicola has already used  $78\frac{3}{4}\%$  of the memory stick storage space.
11.  $53\frac{1}{3}\%$  of the hexagons are shaded black.
12.  $22\frac{2}{9}\%$  of the chocolates have pink foil.
13. 88% of the students had completed their homework.
14. 47.8% of the people at the meeting voted 'no'.
15. 85.7% of the movies were not romantic comedies.
16.  $53\frac{4}{5}\%$  of the supporters left the game disappointed.









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