



The Heys School

Maths

3.6 Adding and subtracting fractions

- To add or subtract fractions find equivalent fractions that have the same denominator.

Example 12

Add $\frac{3}{8}$ and $\frac{1}{3}$.

$$\frac{3}{8} \xrightarrow{\times 3} \frac{9}{24}$$

$$\frac{1}{3} \xrightarrow{\times 8} \frac{8}{24}$$

$$\frac{9}{24} + \frac{8}{24} = \frac{17}{24}$$

Example 13

Subtract $\frac{1}{4}$ from $\frac{1}{3}$.

$$\frac{1}{3} \xrightarrow{\times 4} \frac{4}{12}$$

$$\frac{1}{4} \xrightarrow{\times 3} \frac{3}{12}$$

$$\frac{4}{12} - \frac{3}{12} = \frac{1}{12}$$

3.7 Adding and subtracting mixed numbers

To add mixed numbers you must first add the whole numbers, then add the fraction parts. You can then add the mixed numbers together.

Example 14

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

First add the whole numbers: $3 + 1 = 4$

Then add the fractions: $\frac{3}{4} + \frac{1}{8}$

$$\frac{3}{4} \xrightarrow{\times 2} \frac{6}{8} \quad \text{so} \quad \frac{6}{8} + \frac{1}{8} = \frac{7}{8}$$

$$3\frac{3}{4} + 1\frac{1}{8} = 4\frac{7}{8}$$

Example 15

Subtract one and two sevenths from three and a half.

First subtract the whole numbers: $3 - 1 = 2$

Then subtract the fractions: $\frac{1}{2} - \frac{2}{7}$

$$\frac{1}{2} = \frac{7}{14}$$

$$\frac{2}{7} = \frac{4}{14}$$

$$\text{so } \frac{7}{14} - \frac{4}{14} = \frac{3}{14}$$

$$3\frac{1}{2} - 1\frac{2}{7} = 2\frac{3}{14}$$

Example 16

Find $1\frac{3}{12} - \frac{3}{4}$.

$$\frac{3}{4} = \frac{9}{12}$$

$$1\frac{3}{12} - \frac{3}{4} = 1\frac{3}{12} - \frac{9}{12}$$

You cannot subtract the fractions as $\frac{3}{12}$ is smaller than $\frac{9}{12}$.

You must change $1\frac{3}{12}$ into an improper fraction

$$1\frac{3}{12} = \frac{12}{12} + \frac{3}{12} = \frac{15}{12}$$

$$\text{so } 1\frac{3}{12} - \frac{9}{12} = \frac{15}{12} - \frac{9}{12} = \frac{6}{12} = \frac{1}{2}$$

You should write your answer in its simplest form.

Exercise 3F

1 Find the sum of the following fractions:

(a) $\frac{5}{6}$ and $\frac{3}{4}$ (b) $2\frac{1}{3}$ and $\frac{4}{15}$ (c) $1\frac{2}{3}$ and $2\frac{1}{4}$

(d) $\frac{9}{5}$ and $\frac{1}{10}$ (e) $\frac{7}{12}$, $\frac{5}{8}$ and $1\frac{5}{6}$ (f) $\frac{5}{8}$ and $1\frac{1}{3}$

(g) $\frac{15}{6}$ and $\frac{7}{9}$

2 Find the difference between the following fractions:

(a) $\frac{5}{6}$ and $\frac{1}{4}$ (b) $\frac{11}{24}$ and $\frac{3}{8}$ (c) $3\frac{1}{2}$ and $1\frac{1}{4}$

(d) $2\frac{1}{4}$ and $1\frac{2}{3}$ (e) $\frac{9}{5}$ and $\frac{1}{10}$ (f) $1\frac{7}{3}$ and $\frac{7}{6}$

6.2 Working out a percentage of an amount

Sometimes you can work out percentages of an amount without using a calculator.

Example 4

Work out 21% of 65 m without using a calculator.

If

$$\begin{array}{l} \div 10 \left\{ \begin{array}{l} 100\% = 65 \text{ m} \\ 10\% = 6.5 \text{ m} \\ 1\% = 0.65 \text{ m} \end{array} \right. \div 10 \\ \div 10 \left\{ \begin{array}{l} 10\% = 6.5 \text{ m} \\ 1\% = 0.65 \text{ m} \end{array} \right. \div 10 \end{array}$$

so

$$\begin{aligned} 21\% &= 10\% + 10\% + 1\% \\ &= 6.5 \text{ m} + 6.5 \text{ m} + 0.65 \text{ m} \\ &= 13.65 \text{ m} \end{aligned}$$

21% of 65 m is 13.65 m.

Some percentages can't be written as simple fractions. You might need to use a calculator.

Example 5

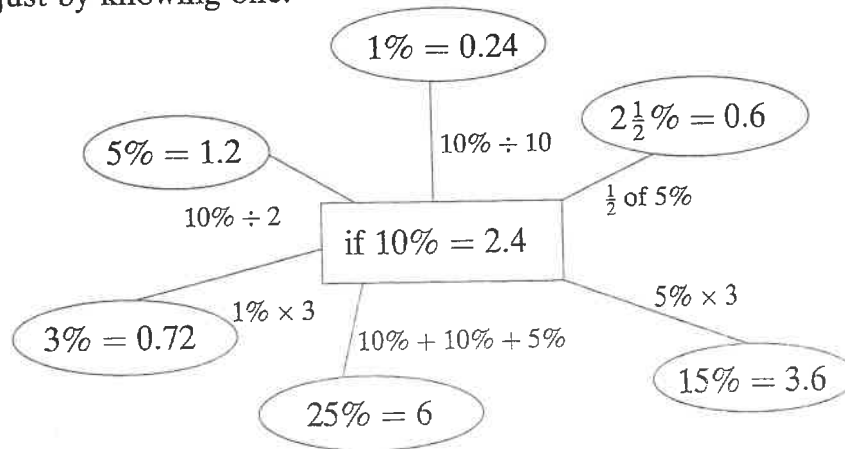
Calculate 23% of 84 kg

$$23\% \text{ of } 84 = 0.23 \times 84 = 19.32$$

$$\text{so } 23\% \text{ of } 84 \text{ kg} = 19.32 \text{ kg}$$

- To work out the percentage of an amount:
 - write the percentage as a decimal
 - multiply the decimal by the amount.

Notice that you can work out many different percentages just by knowing one:



Exercise 6B

Work out the answers to questions 1, 2, 3 and 4 without using a calculator.

- 1 Of the 24 people at a bus stop, 25% have an umbrella. How many of them have an umbrella?
- 2 20% of the 150 pupils in Year 8 chose tennis as their favourite sport. How many of the pupils chose tennis?
- 3 In a sale all the marked prices were reduced by 10%. Work out the reduction for a sweater with a marked price of £23.



4 Work out

- | | | |
|-------------------------------|-----------------|--------------------------------|
| (a) 10% of £6 | (b) 50% of £7 | (c) 20% of £35 |
| (d) 25% of 36 kg | (e) 75% of 32 m | (f) 30% of 40 kg |
| (g) $33\frac{1}{3}\%$ of 24 m | (h) 15% of £50 | (i) $66\frac{2}{3}\%$ of 15 cm |



You may use a calculator for this question.

5 Work out:

- | | | |
|--------------------|------------------------------|-----------------------------|
| (a) 3% of £250 | (b) 7% of £60 | (c) 5% of £26 |
| (d) 4% of 45 kg | (e) 15% of 42 m | (f) 17.5% of £16 |
| (g) 12.5% of 20 kg | (h) $2\frac{1}{2}\%$ of 32 m | (i) $6\frac{1}{4}\%$ of £32 |

6.3 Increasing and decreasing by a percentage

You will often need to find the new value when an amount is increased or decreased by a percentage.



10% extra free



House prices rise by 2%



10% off all marked items

■ To find the new value after a percentage change

- work out the increase and add it to the original amount, or
- work out the decrease and subtract it from the original amount.

Example 6

In September the number of pupils in Year 8 at a school was 180. By the following February that number had increased by 5%. Use a non-calculator method to calculate how many pupils there were in Year 8 in February.

$$\begin{array}{l} \div 10 \left\{ \begin{array}{l} 100\% = 180 \\ 10\% = 18 \end{array} \right. \div 10 \\ \div 2 \left\{ \begin{array}{l} 5\% = 9 \end{array} \right. \div 2 \end{array}$$

The increase in number of pupils = 9

$$\begin{aligned} \text{The number of pupils in February} &= \text{original number} + \text{increase} \\ &= 180 + 9 = 189 \end{aligned}$$

There were 189 pupils in Year 8 in February.

Example 7

A shop offered a discount of 15% off the usual prices. Work out the new price of a CD player originally costing £48, using a calculator.

Discount = 15% of £48

$$= 0.15 \times 48 = 7.2$$

remember this
means £7.20

The new price = original price – discount

$$= £48 - £7.20$$

$$= £40.80$$

The new price of the radio is £40.80.

**Exercise 6C**

Do not use a calculator for questions 1 to 6.

1 Without using a calculator, find the new amount when:

- | | |
|------------------------------|---|
| (a) £60 is increased by 10% | (b) £48 is decreased by 50% |
| (c) 36 m is increased by 25% | (d) 23 kg is decreased by 10% |
| (e) 24 m is increased by 75% | (f) £400 is decreased by 3% |
| (g) £150 is increased by 8% | (h) 27 kg is decreased by $33\frac{1}{3}\%$ |

2 Last year the minimum train fare in a city was £1.20. This year all fares have increased by 5%. What is the minimum train fare now?

3 Kwong paid £275 for his clarinet four years ago. It has increased in value by 8%. Work out the value of Kwong's clarinet now.

4 Becky earns £180 a week. She is given a 3% pay rise. Work out Becky's new weekly wage. [Hint: $3\% = 1\% \times 3$].

5 On 1st May the number of pupils present at a school was 760. On 1st July, after the GCSE examinations, the number had decreased by 15%. How many pupils were present on 1st July?

6 A new car was bought for £7300. After 2 years it had lost 30% of its value. Work out the value of the car after 2 years.





You may use a calculator for the following questions.

- 7 In May an office had 150 employees. By September the number of employees had increased by 4%.
How many employees were there in September?
- 8 Last year Yasmina's Council Tax bill was £638. This year the Council Tax has risen by 3.5%.
What is Yasmina's Council Tax bill this year?
- 9 A travel agency offers a discount of 16% off a holiday usually costing £450. What is the new cost of the holiday?
- 10 In a sale prices were reduced by 20%. Work out the sale price of a coat usually priced at £42.50.
- 11 Find the new amount when:

(a) £135 is increased by 7%,	(b) £32 is decreased by 4%,
(c) £56 is increased by 13%,	(d) 62.5 kg is decreased by 8%,
(e) 18 litres is increased by $6\frac{2}{3}\%$,	(f) 12.8 kg is decreased by 2.5%.

6.4 Writing one quantity as a percentage of another

Sometimes you need to write one quantity as a percentage of another.

Example 8

Write 920 g as a percentage of 8 kg.

To compare the quantities the units must be the same, so change 8 kg to 8000 g.

Step 1: Write as a fraction: $\frac{920}{8000}$

Step 2: Change to a decimal: $920 \div 8000 = 0.115$

Step 3: Multiply by 100%: $0.115 \times 100\% = 11.5\%$

So 920 g is 11.5% of 8 kg.

Hint: $g \begin{matrix} \xrightarrow{\times 1000} \\ \xleftarrow{\div 1000} \end{matrix} kg$

There is more about conversion of units on page 130.

■ To write one quantity as a percentage of another:

- write one quantity as a fraction of the other.
- change the fraction to a decimal.
- multiply the decimal by 100%.

Remember to make sure the units are the same for both quantities.

Exercise 6D

- 1 There are 720 pupils in a school and 108 of them are given commendations for good work. What percentage of the pupils are given commendations?
- 2 Out of 80 new light bulbs tested, 78 worked. What percentage of the light bulbs worked?
- 3 There are 48 cars in the staff car park and 9 of them are white. What percentage of the cars are white?
- 4 Rowena has 150 books and 21 of them are in French. What percentage of her books are in French?
- 5 In a class of 32 pupils 18 are girls. What percentage of the class are (a) girls, (b) boys?
- 6 Of the 180 pupils in Year 8, 144 usually walk to school. Work out the percentage of year 8 pupils who usually walk to school.
- 7 The top mark in a test was 57 out of 60. Write this as a percentage.
- 8 Rob sowed 35 flower seeds and 28 of them produced plants. What percentage of the seeds produced plants?
- 9 750 pupils took part in a sponsored walk and 108 of them finished within 3 hours. What percentage of the pupils is this?
- 10 Write:
 - (a) 81 pence as a percentage of £2.25
 - (b) 700 m as a percentage of 2 km
 - (c) 87 cm as a percentage of 3 m
 - (d) 620 g as a percentage of 5 kg.

