

YEAR 7 — APPLICATION OF NUMBER

Solving problems with addition and subtraction

@whisto_maths

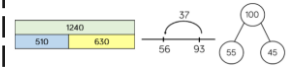
What do I need to be able to do?

- By the end of this unit you should be able to:
- Understand properties of addition/ subtraction
 - Use mental strategies for addition/subtraction
 - Use formal methods of addition/subtraction for integers
 - Use formal methods of addition/subtraction for decimals
 - Solve problems in context of perimeter
 - Solve problems with finance, tables and timetables
 - Solve problems with frequency trees
 - Solve problems with bar charts and line charts

Keywords

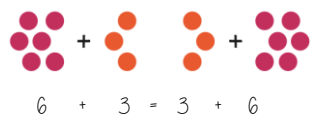
- Commutative:** changing the order of the operations does not change the result
- Associative:** when you add or multiply you can do so regardless of how the numbers are grouped
- Inverse:** the operation that undoes what was done by the previous operation (The opposite operation)
- Placeholder:** a number that occupies a position to give value
- Perimeter:** the distance/ length around a 2D object
- Polygon:** a 2D shape made with straight lines
- Balance:** in financial questions — the amount of money in a bank account
- Credit:** money that goes into a bank account
- Debit:** money that leaves a bank account

Addition/ Subtraction with integers



- Modelling methods for addition/ subtraction
- Bar models
 - Number lines
 - Part/ Whole diagrams

Addition is commutative



The order of addition does not change the result

Subtraction the order has to stay the same

$$360 - 147 = 360 - 100 - 40 - 7$$

- Number lines help for addition and subtraction
- Working in 10's first aids mental addition/ subtraction
- Show your relationships by writing fact families

Formal written methods

| | | | |
|---|---|---|---|
| | H | T | O |
| | 1 | 8 | 7 |
| + | 5 | 4 | 2 |
| | | | |

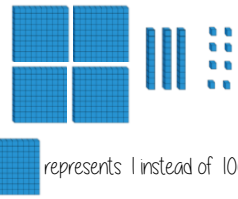
| | | | | |
|---|---|---|---|---|
| | H | T | O | |
| | | 4 | 2 | 7 |
| - | | 2 | 4 | 9 |
| | | | | |

Remember the place value of each column. You may need to move 10 ones to the ones column to be able to subtract

Addition/ Subtraction with decimals

| | | | |
|---|---|---|---|
| 4 | . | 3 | 8 |
| 7 | . | 9 | 0 |
| | | | + |

0 can be used to fill empty places with value



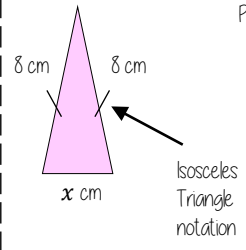
The decimal place acts as the placeholder and aligns the other values

$$5.43 + \frac{8}{10}$$

Revisit Fraction — Decimal equivalence
 $5.43 + 0.8$

Solve problems with perimeter

Perimeter is the length around the outside of a polygon



The triangle has a perimeter of 25cm
Find the length of x

$$8\text{cm} + 8\text{cm} + x\text{cm} = 25\text{cm}$$

$$16\text{cm} + x\text{cm} = 25\text{cm}$$

$$x\text{cm} = 9\text{cm}$$

Solve problems with finance

- Profit = Income - Costs
- Credit — Money coming into an account
- Debit — Money leaving an account

Money uses a two decimal place system
14.2 on a calculator represents £14.20

Check the units of currency — work in the same unit

Tables and timetables

Distance tables

| | | | | |
|--------|-----|---------|---------|---------|
| London | | Cardiff | Glasgow | Belfast |
| 211 | 556 | 493 | 177 | |
| 518 | | 392 | | |

This shows the distance between Glasgow and London
It is where their row and column intersects

Bus/ Train timetables

| | | | |
|--------|------|------|------|
| Harton | 1005 | 1045 | 1130 |
| Bridge | 1024 | 1106 | 1147 |
| Avile | 1051 | 1133 | 1205 |
| Ware | 1117 | 1202 | 1233 |

Each column represents a journey each row represents the time the 'bus' arrives at that location

TIME CALCULATIONS — use a number line

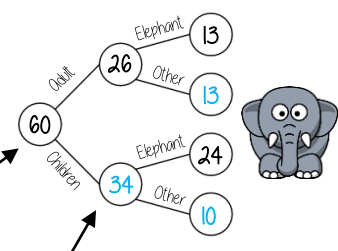
Two-way tables

| | | |
|---|----|----|
| | H | T |
| H | HH | HT |
| T | TH | TT |

Where rows and columns intersect is the outcome of that action

Frequency trees

60 people visited the zoo one Saturday morning
26 of them were adults. 13 of the adult's favourite animal was an elephant. 24 of the children's favourite animal was an elephant

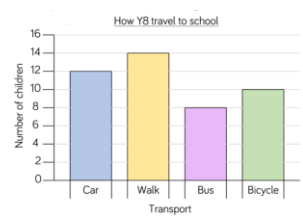


The overall total "60 people"

A frequency tree is made up from part-whole models. One piece of information leads to another

Probabilities or statements can be taken from the completed trees
e.g. 34 children visited the zoo

Bar and line charts



Use addition/ subtraction methods to extract information from bar charts

e.g. Difference between the number of students who walked and took the bus
Walk frequency — bus frequency

When describing changes or making predictions:

- Extract information from your data source
- Make comparisons of difference or sum of values
- Put into the context of the scenario

YEAR 7 — FRACTIONAL THINKING

Addition and subtraction of fractions

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What do I need to be able to do?

- By the end of this unit you should be able to:
- Convert between mixed numbers and fractions
 - Add/Subtract unit fractions (same denominator)
 - Add/Subtract fractions (same denominator)
 - Add/Subtract fractions from integers
 - Use equivalent fractions
 - Add/Subtract any fractions
 - Add/Subtract improper fractions and mixed numbers
 - Use fractions in algebraic contexts

Keywords

- Numerator:** the number above the line on a fraction. The top number. Represents how many parts are taken
- Denominator:** the number below the line on a fraction. The number represent the total number of parts
- Equivalent:** of equal value
- Mixed numbers:** a number with an integer and a proper fraction
- Improper fractions:** a fraction with a bigger numerator than denominator
- Substitute:** replace a variable with a numerical value
- Place value:** the value of a digit depending on its place in a number. In our decimal number system, each place is 10 times bigger than the place to its right

Representing Fractions

$\frac{1}{4}$ is represented in all the images

$1 \div 4$

Mixed numbers and fractions

$\frac{7}{5}$ Improper fraction

$1\frac{2}{5}$ Mixed number

In this model 5 parts make up a whole

Fractions can be bigger than a whole

Odd/Subtract unit fractions

Same denominator

$\frac{1}{12} + \frac{1}{12} - \frac{1}{12} = \frac{2}{12}$

$\frac{1}{4} + \frac{1}{4} = \frac{2}{4}$

With the same denominator ONLY the numerator is added or subtracted

Add/Subtract fractions

Same denominator

$\frac{2}{7} + \frac{3}{7} = \frac{5}{7}$

Sequences

$\frac{1}{3}, 1, 1\frac{2}{3}, 2\frac{1}{3}, 3, \dots$

Represent this on a number line to help

Odd/Subtract from integers

$1 - \frac{2}{6} = \frac{4}{6}$

$3 + \frac{1}{6} = 3\frac{1}{6}$

The denominator indicates the number of parts a whole is made up of

Equivalent fractions

Numerator and denominator have the same multiplier

$\frac{2}{3} = \frac{4}{6}$

$\frac{1}{3} = \frac{2}{6}$

Odd/Subtraction fractions (common multiples)

Addition/Subtraction needs a common denominator

$\frac{3}{5} + \frac{7}{10} = \frac{6}{10} + \frac{7}{10} = \frac{13}{10}$

Odd/Subtraction any fractions

$\frac{4}{5} - \frac{2}{3} = \frac{12}{15} - \frac{10}{15} = \frac{2}{15}$

Use equivalent fractions to find a common multiple for both denominators

Odd/Subtraction fractions (improper and mixed)

$2\frac{1}{5} - 1\frac{3}{10} = 2\frac{2}{10} - 1\frac{3}{10} = \frac{22}{10} - \frac{13}{10} = \frac{9}{10}$

- Convert to an improper fraction
- Calculate with common denominator

Fractions in algebraic contexts

$k - \frac{5}{8} = 2$

Apply inverse operations: $k = 2 + \frac{5}{8}$

Form expressions with fractions: $b + \frac{7}{9} \rightarrow b + \frac{7}{9}$

Substitution: $\frac{p}{8} + \frac{1}{m} = \frac{5}{8} + \frac{1}{2}$

$p = 5 \quad m = 2$

Fractions and decimals

Example: $\frac{6}{10} + 0.3 = 0.6 + 0.3$

$\frac{1}{10} = 0.1$

$\frac{1}{100} = 0.01$

Remember to use equivalent fractions and common denominators

YEAR 7 — APPLICATION OF NUMBER

Solving problems with multiplication and division

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What do I need to be able to do?

By the end of this unit you should be able to:

- Understand and use factors
- Understand and use multiples
- Multiply/ Divide integers and decimals by powers of 10
- Use formal methods to multiply
- Use formal methods to divide
- Understand and use order of operations
- Solve area problems
- Solve problems using the mean

Keywords

Array: an arrangement of items to represent concepts in rows or columns
Multiples: found by multiplying any number by positive integers
Factor: integers that multiply together to get another number.
Mil: prefix meaning one thousandth
Centi: prefix meaning one hundredth
Kilo: prefix meaning multiply by 1000
Quotient: the result of a division
Dividend: the number being divided
Divisor: the number we divide by

Factors

Arrays can help represent factors

Factors of 10
 5×2 or 2×5
 1, 2, 5, 10

10×1 or 1×10

The number itself is always a factor

Square numbers have an **ODD** number of factors

Factors of 4
1, 2, 4

Factors of 36
1, 2, 3, 4, 6, 9, 12, 18, 36

Be strategic - Lay factors out in pairs can help you not to miss any

Multiples

Bar models can represent by something is a multiple. Eg 20 is a multiple of 4

Lowest Common Multiples

LCM of 9 and 12
 9: 9, 18, 27, 36, 45, 54
 12: 12, 24, 36, 48, 60
 LCM = 36

The first time their multiples match

Multiply/ Divide by powers of 10

$3 \times 100 = 300$

$0.03 \times 100 = 3$

Repeated multiplication and division by powers of 10 is commutative
 $\div 10$ then $\div 10 \rightarrow \div 100$

Metric conversions

Useful Conversions

mm $\xrightarrow{\times 10}$ cm $\xrightarrow{\times 100}$ m $\xrightarrow{\times 1000}$ km
 cm $\xleftarrow{-10}$ mm, m $\xleftarrow{-100}$ cm, km $\xleftarrow{-1000}$ m

g $\xrightarrow{\times 1000}$ kg, kg $\xleftarrow{-1000}$ g

ml $\xrightarrow{\times 1000}$ L, L $\xleftarrow{-1000}$ ml

Repeated multiplication and division by powers of 10 is commutative
 $\div 10$ then $\div 10 \rightarrow \div 100$

Multiplication methods

Less effective method especially for bigger multiplication

Long multiplication (column)

Grid method

Repeated addition

Multiplication with decimals
 Perform multiplications as integers
 e.g. $0.2 \times 0.3 \rightarrow 2 \times 3$

Make adjustments to your answer to match the question:
 $0.2 \times 10 = 2$
 $0.3 \times 10 = 3$
 Therefore $6 \div 100 = 0.06$

Division methods

Short division: $3584 \div 7 = 512$

Complex division: $\div 24 = \div 6 \div 4$
 Break up the divisor using factors

Division with decimals
 The placeholder in division methods is essential - the decimal lines up on the dividend and the quotient

$24 \div 0.02 \rightarrow 24 \div 0.2 \rightarrow 240 \div 2$

All give the same solution as represent the same proportion
 Multiply the values in proportion until the divisor becomes an integer

Order of operations

Brackets
 Indices or roots
 Multiplication or division
 Addition or subtraction

If you have multiple operations from the same tier work from left to right

e.g. $10 - 3 + 5 \rightarrow 10 - 3 \rightarrow 7 + 5$

$6 \times 4 + 8 \times 2 = 24 + 16 = 40$

Area problems

Rectangle
 Base x Perpendicular height

Parallelogram/ Rhombus
 Base x Perpendicular height

Triangle
 $\frac{1}{2} \times$ Base x Perpendicular height

A triangle is half the size of the rectangle it would fit in

Mean problems

Mean - a measure of average. It gives an idea of the central value

Lilly, Annie and Ezra have the following cubes

Lilly: 8 cubes, Annie: 8 cubes, Ezra: 8 cubes. Total: 24 cubes.

Finding the mean amount is the average amount each person would have if shared out equally

The mean number of blocks would be 8 each

YEAR 7 — DIRECTED NUMBER

Operations with equations and directed numbers

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What do I need to be able to do?

- By the end of this unit you should be able to:
- Perform calculations that cross zero
 - Add/ Subtract directed numbers
 - Multiply/ Divide directed numbers
 - Evaluate algebraic expressions
 - Solve two-step equations
 - Use order of operations with directed number

Keywords

- Subtract:** taking away one number from another.
Negative: a value less than zero.
Commutative: changing the order of the operations does not change the result.
Product: multiply terms.
Inverse: the opposite function.
Square root: a square root of a number is a number when multiplied by itself gives the value (symbol $\sqrt{\quad}$)
Square: a term multiplied by itself.
Expression: a maths sentence with a minimum of two numbers and at least one math operation (no equals sign)

Perform calculations that cross zero

Number lines are useful to help you visualise the calculation crossing 0

$4 - 6 = -2$

Use the number line to guide subtraction of 6

Start at 4

Find the difference between 6 and -4

From 6 to 0
6
From 0 to -4
4
10 beads between them

$-5 + 5 = 0$ Rearrangements of the same equation $5 - 5 = 0$

Add directed numbers

$2 + -4 = -2$

Zero pair $(-1 + 1 = 0)$

Two -1 's left $= -2$

$8 + -3 = 5$

Partitioning

$8 + -3 = 5$ $5 + 3 + -3 = 5$

Partition the value to create a zero pair calculation

Generalisation $+ - = -$

Subtract directed numbers

Representation for calculation

$2 - -1 = 3$

Take away one

Start with the representation of 2

$2 - -3 = 5$

Generalisation $- - = +$

Multiply/ Divide directed numbers

Two representations of the same calculation $2 \times -3 = -6$

Negative, Negative calculation

-2×-3

This is the negative of 2×-3

$-2 \times -3 = 6$

The act of making counters into their negative is turning them over

Divisions are the inverse operations

Evaluate algebraic expressions

$a = 5$ $b = -4$

$a^2 = 5^2$ $b^2 = (-4)^2$
 $a^2 = 25$ $b^2 = 16$

With negative numbers the brackets are important so that it performs -4×-4 .

Brackets around negative substitutions helps remove calculation errors

$2a - b = 2 \times 5 - (-4) = 10 + 4 = 14$
 $3b - 2a = 3(-4) - 2(5) = -12 - 10 = -22$

Two-step equations

Bar Model

$4x + 2 = 10$

Representing the same question (use fact families)

$10 - 4x = 2$

Function machine

$x \rightarrow \times 4 \rightarrow +2 \rightarrow 10$

Inverse operations to find x

Use order of operations

Brackets

Indices or roots

Multiplication or division

Addition or subtraction

Remember square roots have a positive and negative value

| | | | | | | | |
|----|----|----|----|---|----|----|----|
| x | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| -3 | 9 | 6 | 3 | 0 | -3 | -6 | -9 |
| -2 | 6 | 4 | 2 | 0 | -2 | -4 | -6 |
| -1 | 3 | 2 | 1 | 0 | -1 | -2 | -3 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | -3 | -2 | -1 | 0 | 1 | 2 | 3 |
| 2 | -6 | -4 | -2 | 0 | 2 | 4 | 6 |
| 3 | -9 | -6 | -3 | 0 | 3 | 6 | 9 |

YEAR 7 — APPLICATION OF NUMBER

Fractions and percentages of amounts

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What do I need to be able to do?

- By the end of this unit you should be able to:
- Find a fraction of a given amount
 - Use a given fraction to find the whole or other fractions
 - Find the percentage of an amount using mental methods
 - Find the percentage of a given amount using a calculator

Keywords

- Fraction:** how many parts of a whole we have
Equivalent: of equal value
Whole: a number with no fractional or decimal part
Percentage: parts per 100 (uses the % symbol)
Place Value: the value of a digit depending on its place in a number. In our decimal number system, each place is 10 times bigger than the place to its right
Convert: change into an equivalent representation, often fraction to decimal to a percentage cycle.

Fraction of a given amount

Find $\frac{2}{5}$ of £205

The bar represents the whole amount

£205

£41

2 out of the 5 equal parts
 $2 \times £41 = \underline{£82}$

$£205 \div 5 = £41$

Each part of the bar model represents £41

90

30 30 30

15 15 15

Use bar models for comparisons

$\frac{1}{3}$ of 90 = 30

$\frac{2}{3}$ of 45 = 30

$\therefore \frac{1}{3}$ of 90 = $\frac{2}{3}$ of 45

Use a fraction of amount

$\frac{2}{3}$ of a value is 70. What is the whole number?

70

$70 \div 2 = 35$

Each part of the bar model represents 35

35 35 35

$35 \times 3 = 105$

The whole number is 105

The wording of the question is important to setting up the bar model

$\frac{3}{4}$ of a number is 63. Find the whole

63

21 21 21 21

What is $\frac{1}{6}$ of the number? Use the whole to find a given part

84

14 14 14 14 14 14

= 14

Find the percentage of an amount (Mental methods)

The whole represents 100%

0% 20% 40% 60% 80% 100%

$10\% = \frac{1}{10}$ of the whole

$10\% = \frac{1}{10}$ of the whole $50\% = \frac{5}{10} = \frac{1}{2}$ of the whole

$20\% = \frac{2}{10} = \frac{1}{5}$ of the whole $5\% = \frac{1}{20}$ of the whole

Find 65% of 80

80

8 8 8 8 8 8 8 8 8 8

Method 1
 $65\% = 10\% \times 6 + 5\%$
 $= (8 \times 6) + 4$
 $= 52$

Method 2
 $65\% = 50\% + 10\% + 5\%$
 $= 40 + 8 + 4$
 $= 52$

For bigger percentages it is sometimes easier to take away from 100%

Find the percentage of an amount (Calculator methods)

Using a multiplier

Find 65% of 80

Fraction, decimal, percentage conversion

$65\% = \frac{65}{100} = 0.65$ ← The multiplier

$0.65 \times 80 = 52$

Using the percent button

Find 65% of 80

Type 65

Press **SHIFT** **(%)**

Press **80** and then press **=**

This brings up the % button on screen
 You will see 65%

You can also use the calculator to support non calculator methods and find 1% or 10% then add percentages together

"of" can represent 'x' in calculator methods