

NUMBER

Mental calculation methods

Pupils should learn to:	As outcomes, Year 7 pupils should, for example:
<p>Recall number facts and use known facts to derive unknown facts</p>	<p>Use, read and write, spelling correctly: <i>increase, decrease, double, halve, complement, partition...</i></p> <p>Addition and subtraction facts Know with rapid recall addition and subtraction facts to 20.</p> <p>Complements Derive quickly:</p> <ul style="list-style-type: none"> • whole-number complements in 100 and 50, e.g. $100 = 63 + 37$, $50 = 17 + 33$ • decimal complements in 1 (one or two decimal places), e.g. $1 = 0.8 + 0.2$, $1 = 0.41 + 0.59$ <p>Doubles and halves Derive quickly:</p> <ul style="list-style-type: none"> • doubles of two-digit numbers including decimals, e.g. 23×2, 3.8×2, 0.76×2 • doubles of multiples of 10 to 1000, e.g. 670×2, 830×2 • doubles of multiples of 100 to 10 000, e.g. 1700×2, 6500×2 and all the corresponding halves. <p>Multiplication and division facts Know with rapid recall multiplication facts up to 10×10, and squares to at least 12×12. Derive quickly the associated division facts, e.g. $56 \div 7$, $\sqrt{81}$.</p> <p>Use knowledge of place value to multiply and divide mentally any number by 10, 100, 1000, or by a small multiple of 10. For example:</p> <ul style="list-style-type: none"> • 4.3×100 • $60 \div 1000$ • $1.6 \times 20 = 16 \times 2 = 32$ • $\square \div 100 = 4.7$ <p>Use knowledge of multiplication facts and place value to multiply mentally examples such as:</p> <ul style="list-style-type: none"> • 0.2×8 • 8×0.5 • $\square \times 0.2 = 10$ • 0.04×9 • 7×0.03 • $80 \times \square = 8$

NUMBER

Mental calculation methods

As outcomes, Year 8 pupils should, for example:

Use vocabulary from previous year.

Use known facts to derive unknown facts

For example, generate constant-step sequences, such as:

- Start at 108, the rule is 'add 8'.
- The start number is 5, target is 33. What is the rule?

Complements

Derive quickly:

- complements in 1, 10, 50, 100, 1000.

Solve mentally equations such as:

- $100 = x + 37$
- $10 = 3.62 + x$
- $50 - x = 28$
- $220 = 1000 - x$

Doubles and halves

Use doubling and halving methods to multiply and divide by powers of 2. For example:

- $18 \times 16 = 18 \times 2 \times 2 \times 2 \times 2$
- $180 \div 8 = 180 \div 2 \div 2 \div 2$

[Link to using the laws of arithmetic \(pages 84–5\).](#)

Multiplication and division facts

Derive the product and quotient of multiples of 10 and 100 (whole-number answers). For example:

- 30×60
- $1400 \div 700$
- 900×20
- $6300 \div 30$

Use knowledge of place value to multiply and divide whole numbers by 0.1 and 0.01. For example:

- 47×0.1
- $8 \div 0.1$
- 9×0.01
- $16 \div 0.1$
- 432×0.01
- $37 \div 0.01$

Extend to decimals, such as:

- 0.5×0.1
- $5.2 \div 0.01$
- $0.1 \times \square = 0.08$
- $\square \div 0.01 = 3$

Use knowledge of multiplication and division facts and place value to:

derive products involving numbers such as 0.4 and 0.04.

For example:

- $4 \times 0.6 = 4 \times 6 \div 10 = 24 \div 10 = 2.4$
- $0.7 \times 0.9 = 7 \times 9 \div 100 = 0.63$
- $0.04 \times 8 = 4 \times 8 \div 100 = 0.32$
- $\square \times \square = 0.08$

divide mentally by 2, 4 and 5. For example:

- $0.2 \div 4 = 2 \div 4 \div 10 = 0.5 \div 10 = 0.05$
- $0.03 \div 5 = 3 \div 5 \div 100 = 0.6 \div 100 = 0.006$
- $\square \div \square = 0.4$

As outcomes, Year 9 pupils should, for example:

Use vocabulary from previous years.

Use known facts to derive unknown facts

For example:

- Derive 36×24 from 36×25 .

Multiplication and division facts

Derive the product and quotient of multiples of 10, 100 and 1000. For example:

- 600×7000
- $400 \div 8000$
- $48\,000 \div 800$
- $60 \div 90\,000$

Use knowledge of place value to multiply and divide decimals by 0.1 and 0.01. For example:

- 0.47×0.1
- $0.8 \div 0.1$
- 9.6×0.01
- $0.016 \div 0.1$
- 0.0432×0.01
- $3.7 \div 0.01$
- $0.01 \times \square = 1.7$
- $\square \div 0.01 = 3.2$

Consolidate knowledge of multiplication and division facts and place value to multiply and divide mentally.

For example:

- $0.24 \times 0.4 = 24 \times 4 \div 1000 = 96 \div 1000 = 0.096$
- $800 \times 0.7 = 80 \times 7 = 56 \times 10 = 560$
- $72 \div 0.9 = 72 \div 9 \times 10 = 8 \times 10 = 80$
- $0.48 \div 0.6 = 4.8 \div 6 = 48 \div 6 \div 10 = 8 \div 10 = 0.8$
- $720 \div 0.03 = 72\,000 \div 3 = 24\,000$
- $\square \times \square \times \square = 0.08$

[Link to using the laws of arithmetic \(pages 84–5\).](#)

NUMBER

Mental calculation methods

Pupils should learn to:	As outcomes, Year 7 pupils should, for example:
Recall number facts and use known facts to derive unknown facts (continued)	<p>Factors, powers and roots Know or derive quickly:</p> <ul style="list-style-type: none">• prime numbers less than 30;• squares of numbers 0.1 to 0.9, and of multiples of 10 to 100, and the corresponding roots;• pairs of factors of numbers to 100. <p>Calculate mentally:</p> <ul style="list-style-type: none">• $4^2 + 9$• $(4 + 3)^2$• $4^2 + 5^2$• $5^2 - 7$• $\sqrt{9 + 7}$• $\sqrt{40 - 2^2}$• What is the fourth square number? <p>Solve mentally:</p> <ul style="list-style-type: none">• $3a = 15$• $x^2 = 49$• $n(n + 1) = 12$ <p>Link to multiples, factors and primes (pages 52–5), and powers and roots (pages 56–9).</p> <p>Fraction, decimal and percentage facts See pages 70–1.</p> <p>Measurements Recall and use <i>formulae</i> for:</p> <ul style="list-style-type: none">• the perimeter and area of a rectangle. <p>Calculate simple examples mentally.</p> <p>Recall:</p> <ul style="list-style-type: none">• relationships between units of time;• relationships between metric units of length, mass and capacity (e.g. between km, m, cm and mm). <p>Convert between units of measurement. For example:</p> <ul style="list-style-type: none">• Convert 38 cm into mm.• Convert 348p into pounds.• Convert 45 minutes into seconds. <p>Link to measures and mensuration (pages 228–31).</p>

NUMBER

Mental calculation methods

As outcomes, Year 8 pupils should, for example:

Factors, powers and roots

Know or derive quickly:

- cubes of numbers from 1 to 5, and 10, and the corresponding roots;
- the prime factorisation of numbers to 30.

Calculate mentally:

- $\sqrt{24 + 12}$
- $(7 + 4)^2$
- $\sqrt{89 - 25}$
- $(12 + 9 - 18)^2$

Solve mentally:

- $3a - 2 = 31$
- $n(n - 1) = 56$

[Link to multiples, factors and primes \(pages 52–5\), and powers and roots \(pages 56–9\).](#)

Fraction, decimal and percentage facts

See pages 70–1.

Measurements

Recall and use *formulae* for:

- the perimeter and area of a rectangle;
- the area of a triangle;
- the volume of a cuboid.

Calculate simple examples mentally.

Know and use *rough metric equivalents* for:

1 mile, 1 yard, 1 pound (lb), 1 gallon, 1 pint,
and rough imperial equivalents for:
1 km, 1 m, 1 kg, 1 litre.

For example, use 5 miles \approx 8 kilometres to work out:

- The signpost said that it was 50 miles to London. How many kilometres is that, approximately?
- The jogger was pleased that she had run 32 km. About how many miles is this?

Convert between units of time. For example:

- How many minutes in:
3 hours, 4.5 hours, 2.25 hours, 5 hours 25 minutes?
- Change to hours and minutes:
120 minutes, 75 minutes, 300 minutes.
- How many hours in:
3 days, $5\frac{1}{4}$ days, 1 week 2 days, ...?
- How many days in:
36 hours, 100 hours, the last 3 months of the year?
- How many days to Christmas? Your birthday?

[Link to measures and mensuration \(pages 228–31\).](#)

As outcomes, Year 9 pupils should, for example:

Factors, powers and roots

Find mentally:

- the HCF and LCM of pairs of numbers such as 36 and 48, 27 and 36;
- products of small integer powers, such as $3^3 \times 4^2 = 27 \times 16 = 432$;
- factor pairs for a given number.

Calculate mentally:

- $(23 - 15 + 4 - 8)^3$
- $\sqrt[3]{(89 + 36)}$

Solve mentally:

- $(3 + x)^2 = 25$
- $(12 - x)^2 = 49$

Identify numbers from property questions, such as:

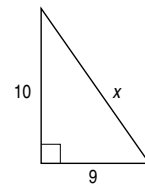
- This number is a multiple of 5. It leaves remainder 1 when divided by 4. What could it be?
- This number has a digit sum of 6. It is divisible by 7. What is it?

Know simple Pythagorean triples such as 3, 4, 5, or 5, 12, 13, and their multiples.

- *Apply Pythagoras' theorem:*

$$x^2 = 9^2 + 10^2 = 181$$

$$x = \sqrt{181}$$



Measurements

Recall and use *formulae* for:

- the perimeter of a rectangle and circumference of a circle;
- the area of a rectangle, triangle, parallelogram, trapezium, circle;
- the volume of a cuboid and a prism.

Calculate simple examples mentally.

[Link to measures and mensuration \(pages 228–31\), and use of compound measures in science.](#)

Know that speed = distance/time.

Use this to derive facts from statements such as:

- *A girl takes 20 minutes to walk to school, a distance of 1.5 km. Find her average speed in km/h.*

Solve problems such as:

- *£1 is equivalent to 1.65 euros. £1 is also equivalent to 1.5 US dollars (\$1.5). How many euros are equivalent to \$6?*
- *A car travels 450 km on 50 litres of fuel. How many litres of fuel will it use to travel 81 km?*

[Link to speed and solving problems involving constant rates of change \(page 4-233\).](#)