NUMBERS AND THE NUMBER SYSTEM

Pupils should be taught to:	As outcomes, Year 7 pupils should, for example:
Understand and use decimal notation and place value; multiply and divide integers and decimals by powers of 10	Use, read and write, spelling correctly: place value, zero place holder, tenth, hundredth, thousandth… equivalent, equivalence… **Understand and use decimal notation and place value. Read and write any number** from 0.001 to 1 000000, knowing what each digit represents. For example, know that: • In 5.239 the digit 9 represents nine thousandths, which is written as 0.009. • The number 5.239 in words is 'five point two three nine', not 'five point two hundred and thirty-nine'. • The fraction $5\frac{239}{1000}$ is read as 'five and two hundred and thirty-nine thousandths'. Know the significance of 0 in 0.35, 3.05, 3.50, and so on. Know that decimals used in context may be spoken in different ways. For example: • 1.56 is spoken in mathematics as 'one point five six'. • £1.56 is spoken as 'one pound fifty-six'. • £1.06 is spoken as 'one pound and six pence'. • £0.50 is spoken as 'fifty pence'. • 1.56 km is sometimes spoken as 'one kilometre, five hundred and sixty metres'. • 3.5 hours can be spoken as 'three and a half hours' or 'three hours and thirty minutes'. Answer questions such as: • Write in figures: four hundred and three thousand, and seventeen. • Write in words: 4.236, 0.5, 35.08, … • Write as a decimal the fraction six, and two hundred and forty-three thousandths. • Make the largest and smallest number you can using: the digits 2, 0, 3, 4; the digits 2, 0, 3, 4, and a decimal point. **Add or subtract 0.1 and 0.01** to or from any number. Count forwards or backwards from any number. For example: • Count on in 0.1s from 4.5. • Count back from 23.5 in 0.1s. • Count on in 0.01s from 4.05. Answer questions such as: • What is 0.1 less than 2.0? What is 0.01 more than 2.09? • What needs to be added or subtracted to change: 27.48 to 37.48, 27.48 to 27.38, 27.48 to 26.38? 5.032 to 5.037, 5.032 to 5.302? **See Y456 examples (pages 2–5, 28–9).**

As outcomes, Year 8 pupils should, for example:

Use vocabulary from previous year and extend to: billion, power, index…

Read and write positive integer powers of 10.

Know that:

1 hundred is $10 \times 10 = 10^2$
1 thousand is $10 \times 10 \times 10 = 10^3$
10 thousand is $10 \times 10 \times 10 \times 10 = 10^4$, etc.
1 million is 10^6
1 billion is 10^9, one thousand millions
(In the past, 1 billion was 10^{12}, one million millions, in the UK.)

Recognise that successive powers of 10 (i.e. 10, 10^2, 10^3, …) underpin decimal (base 10) notation.

Read numbers in standard form, e.g. read 7.2×10^3 as 'seven point two times ten to the power three'.

Link to using index notation (pages 56–9).

Add or subtract 0.001 to or from any number.

Answer questions such as:

- What is 0.001 more than 3.009?
  What is 0.001 more than 3.299?
  What is 0.002 less than 5?
  What is 0.005 less than 10?

- What needs to be added or subtracted to change:
  4.257 to 4.277? 6.132 to 6.139?

As outcomes, Year 9 pupils should, for example:

Use vocabulary from previous years and extend to: standard (index) form… exponent…

Extend knowledge of integer powers of 10.

Know that:

$10^0 = 1$ $10^{-1} = 1/10^1 = 1/10$
$10^1 = 10$ $10^{-2} = 1/10^2 = 1/100$

Know the prefixes associated with powers of 10. Relate to commonly used units. For example:

10^9	giga	10^{-2}	centi
10^6	mega	10^{-3}	milli
10^3	kilo	10^{-6}	micro
		10^{-9}	nano
		10^{-12}	pico

Know the term standard (index) form and read numbers such as 7.2×10^{-3}.

Link to using index notation (pages 56–9) and writing numbers in standard form (pages 38–9).

Know that commonly used units in science, other subjects and everyday life are:

kilogram (kg) – SI unit		**metre (m)** – SI unit
gram (g)	kilometre (km)	litre (l)
milligram (mg)	millimetre (mm)	millilitre (ml)

Pupils should be taught to:	As outcomes, Year 7 pupils should, for example:
Understand and use decimal notation and place value; multiply and divide integers and decimals by powers of 10 (continued)	**Multiply and divide numbers by 10, 100 and 1000.**

Investigate, describe the effects of, and explain multiplying and dividing a number by 10, 100, 1000, e.g. using a place value board, **calculator** or **spreadsheet**.

In particular, recognise that:

- Multiplying a positive number by 10, 100, 1000… has the effect of increasing the value of that number.
- Dividing a positive number by 10, 100, 1000… has the effect of decreasing the value of that number.
- When a number is multiplied by 10, the digits move one place to the left:

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   3  4  .  1  2        34.12 multiplied by 10 = 341.2
3  4  1  .  2
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- When a number is divided by 10, the digits move one place to the right:

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3  4  .  1           34.1 divided by 10 = 3.41
   3  .  4  1
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Complete statements such as:

4 × 10 = □	4 × □ = 400
4 ÷ 10 = □	4 ÷ □ = 0.04
0.4 × 10 = □	0.4 × □ = 400
0.4 ÷ 10 = □	0.4 ÷ □ = 0.004
□ ÷ 100 = 0.04	□ ÷ 10 = 40
□ × 1000 = 40 000	□ × 10 = 400

See Y456 examples (pages 6–7).

Link to converting mm to cm and m, cm to m, m to km… (pages 228–9).

As outcomes, Year 8 pupils should, for example:

Multiply and divide numbers by 0.1 and 0.01.

Investigate, describe the effects of, and explain multiplying and dividing a number by 0.1 and 0.01, e.g. using a **calculator** or **spreadsheet**.

In particular, recognise how numbers are increased or decreased by these operations.

0.1 is equivalent to $\frac{1}{10}$ and 0.01 is equivalent to $\frac{1}{100}$, so:

- Multiplying by 0.1 has the same effect as multiplying by $\frac{1}{10}$ or dividing by 10. For example, 3×0.1 has the same value as $3 \times \frac{1}{10}$, which has the same value as $3 \div 10 = 0.3$, and 0.3×0.1 has the same value as $\frac{3}{10} \times \frac{1}{10} = \frac{3}{100} = 0.03$.

- Multiplying by 0.01 has the same effect as multiplying by $\frac{1}{100}$ or dividing by 100. For example, 3×0.01 has the same value as $3 \times \frac{1}{100}$, which has the same value as $3 \div 100 = 0.03$, and 0.3×0.01 has the same value as $\frac{3}{10} \times \frac{1}{100} = \frac{3}{1000} = 0.003$.

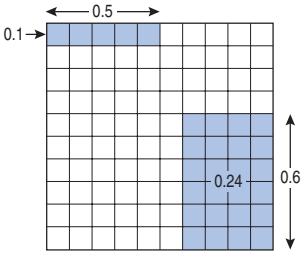
- Dividing by 0.1 has the same effect as dividing by $\frac{1}{10}$ or multiplying by 10. For example, $3 \div 0.1$ has the same value as $3 \div \frac{1}{10}$.
  (How many tenths in three? $3 \times 10 = 30$)
  $0.3 \div 0.1$ has the same value as $\frac{3}{10} \div \frac{1}{10}$.
  (How many tenths in three tenths? $0.3 \times 10 = 3$)

- Dividing by 0.01 has the same effect as dividing by $\frac{1}{100}$ or multiplying by 100. For example, $3 \div 0.01$ has the same value as $3 \div \frac{1}{100}$.
  (How many hundredths in three? $3 \times 100 = 300$)
  $0.3 \div 0.01$ has the same value as $\frac{3}{10} \div \frac{1}{100}$.
  (How many hundredths in three tenths?
  $0.3 \times 100 = 30$)

Complete statements such as:

$0.5 \times 0.1 = \square$ $\quad$ $0.8 \times \square = 0.08$
$0.7 \div 0.1 = \square$ $\quad$ $0.6 \div \square = 6$

Understand a diagrammatic explanation to show, for example, that $0.1 \times 0.5 = 0.05$, or $0.24 \div 0.6 = 0.4$.



Discuss the effects of multiplying and dividing by a number less than 1.

- Does division always make a number smaller?
- Does multiplication always make a number larger?

As outcomes, Year 9 pupils should, for example:

Multiply and divide by any integer power of 10.

For example:

- Calculate:

7.34×100	$37.4 \div 100$
46×1000	$3.7 \div 1000$
$8042 \times 10\,000$	$4982 \div 10000$
9.3×0.1	$0.27 \div 0.1$
0.63×0.01	$5.96 \div 0.01$

Link to converting mm^2 to cm^2, cm^2 to m^2, mm^3 to cm^3 and cm^3 to m^3 (pages 228–9).

Begin to write numbers in standard form, expressing them as
$A \times 10^n$ where $1 \leq A < 10$, and n is an integer.

For example:
$734.6 = 7.346 \times 10^2$
$0.0063 = 6.3 \times 10^{-3}$

Know how to use the 'EXP' key on a **calculator** to convert from index form.

Answer questions such as:

- Complete these. The first is done for you.
  $3 \times 10^n = 300 \times 10^{n-2}$
  $0.3 \times 10^n = 30\,000 \times \square$
  $0.3 \times 10^n = 0.0003 \times \square$
  $3 \div 10^n = 0.003 \times \square$
  $0.3 \div 10^n = 300 \times \square$
  $0.003 \div 10^n = 3 \times \square$

- Put these numbers in ascending order:
  2×10^{-2}, 3×10^{-1}, 2.5×10^{-3}, 2.9×10^{-2}, 3.2×10^{-1}

- Write these numbers in standard form:
  a. The population of the UK is 57 million.
  b. The dwarf pigmy goby fish weighs 0.000 14oz.
  c. The shortest millipede in the world measures 0.082 inches.
  d. After the Sun, the nearest star is 24800000000000 miles away.

- The probability of dying before the age of 40 is 1 in 850, or 0.00118, or 1.8×10^{-3}.

  These are the risks of dying from particular causes:

smoking 10 cigarettes a day	1 in 200
road accident	1 in 8000
accident at home	1 in 260 000
railway accident	1 in 500000

  Write each of these as a probability in standard form.

Link to writing numbers in standard form in science and geography.