

# YEAR 8 - DEVELOPING NUMBER...

# Standard Form

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## What do I need to be able to do?

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

- Write numbers in standard form and as ordinary numbers
- Order numbers in standard form
- Add/ Subtract with standard form
- Multiply/ Divide with standard form
- Use a calculator with standard form

## Keywords

**Standard (index) Form:** A system of writing very big or very small numbers

**Commutative:** an operation is commutative if changing the order does not change the result.

**Base:** The number that gets multiplied by a power

**Power:** The exponent — or the number that tells you how many times to use the number in multiplication

**Exponent:** The power — or the number that tells you how many times to use the number in multiplication

**Indices:** The power or the exponent

**Negative:** A value below zero.

## Positive powers of 10

1 billion = 1 000 000 000

$$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^9$$

Addition rule for indices  $10^a \times 10^b = 10^{a+b}$

Subtraction rule for indices  $10^a \div 10^b = 10^{a-b}$

## Standard form with numbers > 1

Any number between 1 and less than 10  $\rightarrow A \times 10^n$  ← Any integer

**Example**

$$3.2 \times 10^4$$

$$= 3.2 \times 10 \times 10 \times 10 \times 10$$

$$= 32000$$

**Non-example**

$0.8 \times 10^4$

$5.3 \times 10^{07}$

## Negative powers of 10

0.001	10	1	•	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
$1 \times \frac{1}{1000}$	$10^1$	$10^0$	•	$10^{-1}$	$10^{-2}$	$10^{-3}$
$1 \times 10^{-3}$	0	0	•	0	0	1

Any value to the power 0 always = 1

Negative powers do not indicate negative solutions

## Numbers between 0 and 1

0.054	1	•	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
$= 5.4 \times 10^{-2}$	$10^0$	•	$10^{-1}$	$10^{-2}$	$10^{-3}$
	0	•	0	5	4

A negative power does not mean a negative answer — it means a number closer to 0

## Order numbers in standard form

$6.4 \times 10^{-2}$	$2.4 \times 10^2$	$3.3 \times 10^0$	$1.3 \times 10^{-1}$
0.064	240	1	0.13

Look at the power first will the number be = > or < than 1

Use a place value grid to compare the numbers for ordering

## Mental calculations

$6.4 \times 10^2 \times 1000$  Not in Standard Form

$= 6.4 \times 10^2 \times 10^3$

Use addition for indices rule

$= 6.4 \times 10^5$

$(2 \times 10^3) \div 4$

Divide the values

$= (2 \div 4) \times 10^3$

$= 0.5 \times 10^3$

$8 \times 10^5 \times 3$

$= 24 \times 10^5$  Not in Standard Form

$= 2.4 \times 10^1 \times 10^5$  Use addition for indices rule

$= 2.4 \times 10^6$

Remember the layout for standard form

Any number between 1 and less than 10  $\rightarrow A \times 10^n$  ← Any integer

## Addition and Subtraction

Tip: Convert into ordinary numbers first and back to standard form at the end

Method 1

$6 \times 10^5 + 8 \times 10^5$

$= 600000 + 800000$

$= 1400000$

$= 1.4 \times 10^6$

More robust method  
Less room for misconceptions  
Easier to do calculations with negative indices  
Can use for different powers

Method 2

$= (6 + 8) \times 10^5$

$= 14 \times 10^5$

$= 1.4 \times 10^1 \times 10^5$

$= 1.4 \times 10^6$

This is not the final answer

Only works if the powers are the same

## Multiplication and division

For multiplication and division you can look at the values for A and the powers of 10 as two separate calculations

Division questions can look like this

$\frac{1.5 \times 10^5}{0.3 \times 10^3}$

$(1.5 \times 10^5) \div (0.3 \times 10^3)$

$15 \div 0.3 \times 10^5 \div 10^3$

$= 5 \times 10^2$

Addition law for indices  
 $a^m \times a^n = a^{m+n}$

Subtraction law for indices  
 $a^m \div a^n = a^{m-n}$

Revisit addition and subtraction laws for indices — they are needed for the calculations

## Using a calculator

$14 \times 10^5 \times 3.9 \times 10^3$

Use a calculator to work out this question to a suitable degree of accuracy

Input 14 and press  $\times 10^1$  Then press 5 (for the power)

Press  $\times$

Input 3.9 and press  $\times 10^3$  Then press 3 (for the power)

Press  $=$

This gives you the solution



Click calculator for video tutorial

To put into standard form and a suitable degree of accuracy

Press **SHIFT** **SETUP** and then press 7 for sci mode

Choose a degree of accuracy so in most cases press 2

Answer:  $5.5 \times 10^6$