

## 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  $10^a \div 10^b = 10^{a-b}$

## Numbers between 0 and 1

$$0.054 = 5.4 \times 10^{-2}$$

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

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

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

Any value to the power 0 always = 1

Negative powers do not indicate negative solutions

## 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

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

$$= 0.5 \times 10^3$$

$$(8 \times 10^5) \times (3)$$

Not in Standard Form

$$= 24 \times 10^5$$

Use addition for indices rule

$$= 2.4 \times 10^1 \times 10^5$$

$$= 2.4 \times 10^6$$

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

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

$$= 600000 + 800000$$

$$= 1400000$$

$$= 1.4 \times 10^6$$

### 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

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

Only works if the powers are the same

## Multiplication and division

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

Division questions can look like this

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

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

$$= 5 \times 10^2$$

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

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

Addition law for indices

$$a^m \times a^n = a^{m+n}$$

Subtraction law for indices

$$a^m \div a^n = a^{m-n}$$

## 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  $\times 10^5$  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:  $5.5 \times 10^8$