# DEVELOPING NUMBER....
## Standard Form

## 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 from
- 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
$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^9$

| 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 & 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 Forms with numbers >1

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

**Example**
$3.2 \times 10^4$
$= 3.2 \times 10 \times 10 \times 10 \times 10$
$= 32000$

**Non-example**
$(0.8) \times 10^4$
$5.3 \times 10^{(0.7)}$

## Order numbers in Standard form

| | | $10^2$ | $10^1$ | $10^0$ | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ | $10^{-4}$ |
|---|---|---|---|---|---|---|---|---|

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

**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

## Negative Powers of 10

0.001
$1 \times \frac{1}{1000}$
$1 \times 10^{-3}$

| 10 | 1 | $\frac{1}{10}$ | $\frac{1}{100}$ | $\frac{1}{1000}$ |
|---|---|---|---|---|
| $10^1$ | $10^0$ | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ |
| 0 | 0 | 0 | 0 | 1 |

Any value to the power 0 always = 1

Negative powers do not indicate negative solutions

## 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
$= 6.4 \times 10^5$

$(8) \times 10^0 \times (3)$   **Not in Standard Form**
$= 24 \times 10^0$
$= 2.4 \times 10^1 \times 10^0$   Use addition for indices rule
$= 2.4 \times 10^6$

$(2 \times 10^9) \div 4$   **Divide the values**
$= (2 \div 4) \times 10^5$
$= 0.5 \times 10^5$

**Remember the layout for standard form**
Any number between 1 and less than 10 → $A \times 10^n$ ← Any integer

## Addition & Subtraction

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

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

**Method 1**
$= 600000 + 800000$
$= 1400000$
$= 1.4 \times 10^6$

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 & Division

$\frac{1.5 \times 10^9}{0.3 \times 10^5}$   Division questions can look like this

$((1.5) \times 10^9) \div ((0.3) \times 10^5)$

$(1.5 \div 0.3) \times 10^9 \div 10^5$

$= 5 \times 10^2$

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 for indices | Subtraction for indices |
|---|---|
| $a^m \times a^n = a^{m+n}$ | $a^m \div a^n = a^{m-n}$ |

## Using a Calculator

$1.4 \times 10^0$   $\times$   $3.9 \times 10^5$

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

Input 1.4 and press $\boxed{\times 10^x}$ Then press 5 (for the power)
Press $\boxed{\times}$
Input 3.9 and press $\boxed{\times 10^x}$ Then press 3 (for the power)
Press $\boxed{=}$

This gives you the solution

Click calculator for video tutorial

**To put into standard form and a suitable degree of accuracy**
Press $\boxed{SHIFT}$ $\boxed{SETUP}$ and then press 7 for sci mode
Choose a degree of accuracy so in most cases press 2

Answer: $5.5 \times 10^6$

# DEVELOPING GEOMETRY
# Line Symmetry & Reflection

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

By the end of this unit you should be able to:
- Recognise line symmetry
- Reflect in a horizontal line
- Reflect in a vertical line
- Reflect in a diagonal line

## Keywords

**Mirror line:** a line that passes through the center of a shape with a mirror image on either side of the line

**Line of symmetry:** same definition as the mirror line

**Reflect:** mapping of one object from one position to another of equal distance from a given line.

**Vertex:** a point where two or more-line segments meet.

**Perpendicular:** lines that cross at 90°

**Horizontal:** a straight line from left to right (parallel to the x axis)

**Vertical:** a straight line from top to bottom (parallel to the y axis)

## Lines of Symmetry

Mirror line (line of reflection)

**Rhombus**
two lines of symmetry

**Parallelogram**
No lines of symmetry
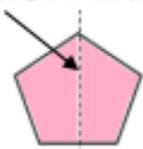
Shapes can have more than one line of symmetry...
This regular polygon (a regular pentagon has 5 lines of symmetry)

A circle has an infinite amount of lines of symmetry
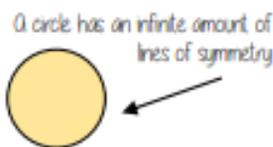
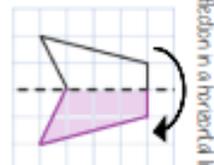## Reflect Horizontally /Vertically (1)

Note: a reflection doubles the area of the original shape
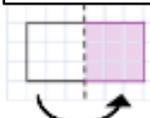
Reflection in a vertical line

Reflection in a horizontal line
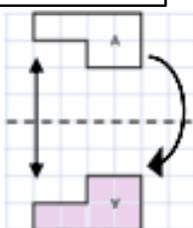
Reflection on an axis grid
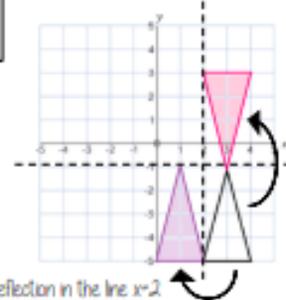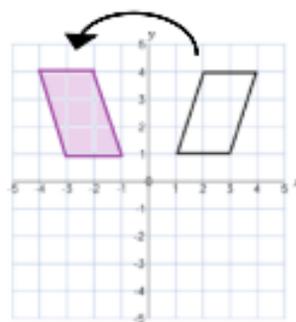
Reflection in the line $y=-2$

Reflection in the line $x=2$

## Reflect Horizontally /Vertically (2)

All points need to be the same distance away from the line of reflection

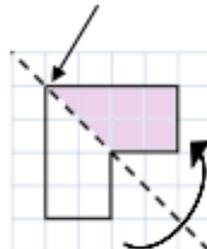Reflection in the line y axis — this is also a reflection in the line $x=0$

**Lines parallel to the x and y axis**
REMEMBER
Lines parallel to the x-axis are y = _____
Lines parallel to the y-axis are x = _____
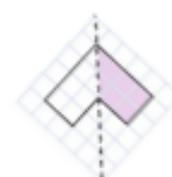
## Reflect Diagonally (1)

Points on the mirror line don't change position

Fold along the line of symmetry to check the direction of the reflection

**Turn your image**
If you turn your image it becomes a vertical/ horizontal reflection (also good to check your answer this way)
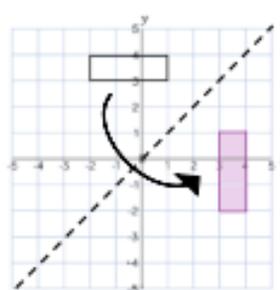
**Drawing perpendicular lines**
Perpendicular lines to and from the mirror line can help you to plot diagonal reflections.

## Reflect Diagonally (2)

This is the line **y = x** (every y coordinate is the same as the x coordinate along this line)

This is the line **y = -x**
The x and y coordinate have the same value but opposite sign

**Turn your image**
If you turn your image it becomes a vertical/ horizontal reflection (also good to check your answer this way)