

What do I need to be able to do?

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

- Identify square and cube numbers
- Calculate higher powers and roots
- Understand powers of 10 and standard form
- Know the addition and subtraction rule for indices
- Understand power zero and negative indices
- Calculate with numbers in 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.

Coefficient: The number used to multiply a variable

Square and cube numbers

Square numbers

1, 4, 9, 16...

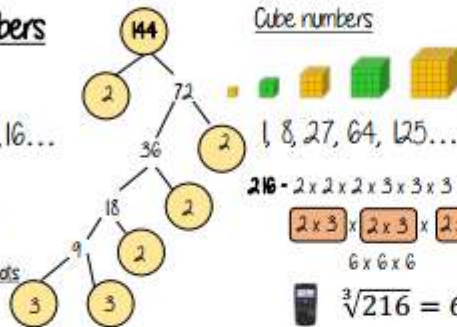
$$44 = 2 \times 2 \times 2 \times 2 \times 3 \times 3$$

$$= (2 \times 2 \times 3) \times (2 \times 2 \times 3)$$

$$= 12 \times 12$$

Prime factors can find square roots

$$\sqrt{144} = 12$$



Higher powers and roots

x^n ← n – power (number of times multiplied by itself)

x – the base number.

$\sqrt[n]{x}$ ← Finding the n th root of any value.

Other mental strategies for square roots

$$\sqrt{810000} = \sqrt{81} \times \sqrt{10000}$$

$$= 9 \times 100$$

$$= 900$$

Standard form

Any number between 1 and less than 10

$$A \times 10^n$$

Any integer

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}
10	1	0.1	0.01	0.001

Any value to the power 0 always = 1

Numbers in standard form with negative powers will be less than 1

Negative powers do not indicate negative solutions

Example

$$3.2 \times 10^4$$

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

$$= 32000$$

Non-example

$$0.8 \times 10^4$$

$$5.3 \times 10^{07}$$

$$3.2 \times 10^{-4} = 3.2 \times \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10} \times \frac{1}{10} = 0.00032$$

Addition/ Subtraction Laws

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

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

Zero and negative indices

$$x^0 = 1$$

Any number divided by itself = 1

$$\frac{a^6}{a^6} = a^6 \div a^6$$

$$= a^{6-6} = a^0 = 1$$

Negative indices do not indicate negative solutions

$$\left. \begin{array}{l} 2^2 = 4 \\ 2^1 = 2 \\ 2^0 = 1 \\ 2^{-1} = \frac{1}{2} \\ 2^{-2} = \frac{1}{4} \end{array} \right\} \text{Looking at the sequence can help to understand negative powers}$$

Powers of powers

$$(x^a)^b = x^{ab}$$

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

The same base and power is repeated. Use the addition law for indices

$$(2^3)^4 = 2^{12} \leftarrow a \times b = 3 \times 4 = 12$$

NOTICE the difference

$$(2x^3)^4 = 2x^3 \times 2x^3 \times 2x^3 \times 2x^3$$

The addition law applies ONLY to the powers. The integers still need to be multiplied

$$(2x^3)^4 = 16x^{12}$$

Standard form calculations

Addition and Subtraction

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

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

Method 1

- 600000 + 800000
- 1400000
- 1.4×10^6

Method 2

- $(6 + 8) \times 10^5$
- 14×10^5
- $1.4 \times 10^4 \times 10^2$
- 1.4×10^6

This is not the final answer

Multiplication and division

$$\frac{1.5 \times 10^5}{0.3 \times 10^3} \leftarrow \text{Division questions can look like this}$$

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

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

$$= 5 \times 10^2$$

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