Year 10 Maths

Unit 1: Powers and roots

If a questions says '**evaluate**' or 'find the **value**', the answer will be an ordinary number.

using powers...

EXAMPLE:
Evaluate 5^3

$= 5 \times 5 \times 5$
$= 25 \times 5$
$= 125$

5 x 5 = 25 then multiply by 5 again

EXAMPLE:
Find the value of 2^5

$= 2 \times 2 \times 2 \times 2 \times 2$
$= 32$

Start with 2 x 2 then x 2 three more times

finding roots...

Roots are the opposite (**inverse**) of powers.

*This is a **square root**. It's the opposite of squaring*

EXAMPLE: Work out $\sqrt{25}$

$= 5$

because $5^2 = 5 \times 5$
$= 25$

*This is a **cube root**. It's the opposite of cubing (power 3)*

EXAMPLE: Work out $\sqrt[3]{8}$

$= 2$

because $2^3 = 2 \times 2 \times 2$
$= 8$

calculator powers...

Your scientific calculator may have buttons for squaring or cubing.

e.g. 

It will also have a special button that lets you work out *any* power:

e.g. 

Try working out 3^5 on yours.
Can you get the answer 243?

calculator roots...

Your scientific calculator will have a button for square roots.

e.g. 

It will also be able to work out *any* root. You may have to press 'shift' or 'second' to use this.

e.g. 

Try working out $\sqrt[4]{2401}$ on yours.
Can you get the answer 7?

order of operations...

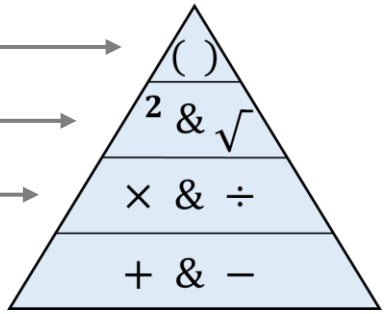
The **order of operations** tells us which order we should work out calculations.

1: Work out anything in brackets first

2: Then any powers or roots

3: Then multiply or divide

4: Then add or subtract



EXAMPLE:
Work out

(a) $4 + 3 \times 2$

$= 4 + \quad 6$
$= 10$

Multiply is before add, so multiply first: 3 x 2

(b) $(4 + 3) \times 2$

$= \quad 7 \quad \times 2$
$= 14$

Work out brackets first

(c) $5 - 2 + 6$

$= \quad 3 \quad + 6$
$= 9$

Add and subtract have the same importance, so work out from left to right

(d) $4 + 5^2 \times 3$

$= 4 + 25 \times 3$
$= 4 + \quad 75$
$= 79$

Work out the power first

Multiply is next

The **reciprocal** of a number is 1 divided by the number.
For a fraction, this has the effect of **inverting** it (turning it upside down).
e.g. the reciprocal of $\frac{5}{3}$ is $\frac{3}{5}$

power of -1...

EXAMPLE:
Evaluate (find the value)

(a) $\left(\frac{3}{4}\right)^{-1} = \frac{4}{3}$

This is the reciprocal

(b) $5^{-1} = \frac{1}{5}$

(c) $\left(\frac{1}{7}\right)^{-1} = \frac{7}{1} = 7$

5 can be written as $\frac{5}{1}$ so its reciprocal is $\frac{1}{5}$

other negative powers

EXAMPLE:

Evaluate $\left(\frac{4}{5}\right)^{-2}$

$= \left(\frac{5}{4}\right)^{2}$

The negative part of the power creates a reciprocal

$= \frac{25}{16}$

Then use the number part of the power

more negative powers

EXAMPLE:

Write in the form 3^n.

"in the form" tells us how the answer should look

(a) 81 $= 3^4$

(b) $\frac{1}{3}$ $= 3^{-1}$

(c) $\frac{1}{9}$ $= \frac{1}{3^2}$ $= 3^{-2}$

× with indices...

When we multiply, with the same **base**, we *add the powers*

EXAMPLE:

Simplify $p^5 \times p^7$

*p is the **base***

$= p^{12}$

Add the powers

EXAMPLE:

Simplify $7m^6 \times 3m^{-2}$

Multiply the numbers, then add the powers

$= 21m^4$

EXAMPLE: Simplify $4a^3m^5 \times 2a^7m$

$= 8a^{10}m^6$

$4 \times 2 = 8$

$a^3 \times a^7 = a^{10}$

$m^5 \times m = m^6$

index means 'power'
indices means 'powers'

÷ with indices...

When we divide, with the same base, we *subtract the powers*

EXAMPLE:

Simplify $7^{12} \div 7^3$

Subtract the powers

$= 7^9$

EXAMPLE:

Simplify $12x^8 \div 3x^2$

Multiply the numbers, then add the powers

$= 4x^6$

EXAMPLE:

Simplify $\frac{3x^7}{6x^2}$

Divide 12 ÷ 3 then subtract the powers

A fraction means 'divide' in algebra

$= \frac{1}{2}x^5$

$\frac{3}{6}$ *simplifies to* $\frac{1}{2}$

Subtract the powers

power 0...

Anything to **power 0** is 1.

EXAMPLE:
Simplify 27^0

$= 1$

EXAMPLE:
Simplify k^0

$= 1$

EXAMPLE:
Simplify $5k^0$

$= 5 \times 1 \ = 5$

$k^0 = 1$
then we need to multiply by 5

EXAMPLE:
Simplify $(5k)^0$

$= 1$