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Year 10 Maths

Unit 1: Powers

MATHOPEDIA

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

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

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

This is the reciprocal

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

other negative powers

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

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

$= \frac{25}{16}$

The negative part of the power creates a reciprocal

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

EXAMPLE:
Write $7n^{-3}$ as a fraction.

$= 7 \times n^{-3}$

$= 7 \times \frac{1}{n^3}$

$= \frac{7}{n^3}$

EXAMPLE:
Write $\frac{1}{m^5}$ using a power

$= m^{-5}$

EXAMPLE:
Write $\frac{1}{4m^5}$ using a power

$= \frac{1}{4}m^{-5}$

The power doesn't apply to the 4

×/÷ with indices...

EXAMPLE:
Simplify $p^5 \times p^7$

$= p^{12}$

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

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

$= 21m^4$

Multiply the numbers before adding powers

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

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

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

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

power of power...

For a power of a power, we *multiply* the indices.

EXAMPLE:
Simplify $(x^6)^5$

$= x^{30}$

EXAMPLE:
Simplify $(4x^6)^3$

4 needs to be cubed too

$= 64x^{18}$

EXAMPLE:
Simplify $(5a^4b^7)^2$

$= 25a^8b^{14}$

square the 5, then the a^4, then the b^7

power 0...

Anything to **power 0** is 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 $(5k)^0$

$= 1$

combining rules...

EXAMPLE:
Simplify $\frac{8h^4 \times 2h^5}{2h^{-3}}$

Simplify the numerator

$= \frac{16h^9}{2h^{-3}}$

16 ÷ 2 = 8 and 9 - -3 = 12

$= 8h^{12}$

EXAMPLE: Simplify $(3t^5 \times t)^2 \times t^{-12}$

$= (3t^6)^2 \times t^{-12}$

$= 9t^{12} \times t^{-12}$

Anything to power 0...

$= 9t^0 = 9 \times 1 = 9$

In a fraction power, the denominator is a root and the numerator is a power.

e.g.

$$16^{\frac{5}{2}} = (\sqrt{16})^5$$

$$64^{\frac{2}{3}} = (\sqrt[3]{64})^2$$

fraction powers...

EXAMPLE:

Evaluate $125^{\frac{2}{3}}$

$$= \left(\sqrt[3]{125}\right)^2$$

$$= (5)^2$$

$$= 25$$

Easiest to start with the root

Then the power

EXAMPLE:

Evaluate $16^{\frac{1}{4}}$

$$= \sqrt[4]{16}$$

$$= 2$$

Just the root this time, as the numerator is 1

$2^4 = 16$

negative too...

EXAMPLE:

Evaluate $\left(\frac{16}{25}\right)^{-\frac{3}{2}}$

The negative power is a reciprocal

$$= \left(\frac{25}{16}\right)^{\frac{3}{2}}$$

Then apply the fraction power

$$= \frac{(\sqrt{25})^3}{(\sqrt{16})^3}$$

$$= \frac{5^3}{4^3}$$

$$= \frac{125}{64}$$