LAWS OF INDICES

LO: To use index notation for multiplying and dividing.

15 September 2025

Week 4, Day 1-2

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Mental Maths

Complete the missing numbers.

a) $7^2 + 4^3 =$	b) $8^2 + 10^2 =$	c) $5^3 - 5^2 =$
d) $5^2 +$ _____ $= 89$	e) _____ $- 8^2 = 17$	f) $3^2 \times 2^3 =$
g) $3^2 +$ _____ $= 5^2$	h) $6^3 \div 2^2 =$	i) $13^2 =$
j) $10^3 - 2^2 =$	k) $100^2 =$	l) _____$^2 = 144$

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GCSE/iGCSE Assessment Objective Specification – Foundation/Higher

A identify square numbers and cube numbers	
B calculate squares, square roots, cubes and cube roots	
C use index notation and index laws for multiplication and division of positive and negative integer powers including zero	
C use index notation for positive and negative integer powers (including zero)	$a \times a \times a = a^3$ $a^{-5} = \frac{1}{a^5}$; $a^0 = 1$
D use index laws in simple cases	$x^m \times x^n = x^{m+n}$ $x^m \div x^n = x^{m-n}$ $(x^m)^n = x^{mn}$

C use index laws to simplify and evaluate numerical expressions involving integer, fractional and negative powers	Evaluate: $\sqrt[3]{8^2}$, $625^{-\frac{1}{2}}$, $\left(\frac{1}{25}\right)^{\frac{3}{2}}$

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Key Concept

02:00

$$4^6 \times 4^2 = 4^8$$

$$4^5 \times 4^{-5} = 4^?$$

$$\frac{4^7}{4^7} = ?$$

Why is $4^0 = 1$?

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02:00

Law 1: Product Law

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

When multiplying two powers with the same base, just add the indices.

Example:

1.) $9^2 \cdot 9 \cdot 9^3 = 9^{2+1+3}$

$= 9^6$

2.) $3^4 \cdot 3^5 \cdot 3 = 3^{4+5+1}$

$= 3^{10}$

3.) $4(4^4)(4^7) = 4^{1+4+7}$

$= 4^{12}$

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Law 2: Quotient Law

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

When dividing two powers with the same base, just subtract the indices.

Example:

1.) $\frac{9^3}{9} = 9^{3-1} = 9^2 = 81$

2.) $\frac{4^2 \cdot 4^3}{4^3} = \frac{4^{2+3}}{4^3}$

$= \frac{4^5}{4^3} = 4^2 = 16$

3.) $\frac{4^9}{4^9} = 4^{9-9}$

$= 4^0$

$= 1$

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Law 3: Power Law

$$(a^m)^n = a^{mn}$$

To simplify any power of power, simply multiply the indices.

Example:

1.) $(3^2)^3 = 3^{2\times 3}$

$= 3^6$

2.) $(2^2)^2 = 2^{2\times 2}$

$= 2^4 = 16$

3.) $(2\cdot 2^2)^3 = (2^3)^3$

$= 2^9$

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Key Concept

02:00

Powers with different bases

$$a^n b^n = (ab)^n$$

To simplify power of different bases, simply multiply the indices on each base.

Example:

1.) $(2^2 \cdot 3^2) = 6^2$

$= 36$

2.) $(3^3 \cdot 1^3) = 3^3$

$= 27$

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Mini-Plenary

05:00

Unsimplified Expression	Index Law	Simplified Expression
n^{-2}	Multiply the exponents	n^{12}
$7m^{12} \div 7m^{8}$		$9n^{6}$
$n^{0} + 2$	Write as a fraction and change the sign	m^{8}
$9m^{4} \times 2m^{4}$		$16n^{2}$
$(3n^{3})^{2}$	Simplify expression to 1	1
$4n^{2} \times 4n^{4}$		$\frac{1}{n^{2}}$
$(m^{2})^{4}$	Add the exponents	$18m^{8}$
$n^{16} \div n^{4}$		$16n^{6}$
n^{0}	Subtract the exponents	3
$32n^{4} \div 2n^{2}$		n^{4}

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Core Task

LO: To use index notation for multiplying and dividing.

Task 1:

Simplify each expression.

1) $(7^4)^8 =$ _____	2) $3^7 \cdot 3^7 =$ _____
3) $\frac{4^3}{4^3} =$ _____	4) $2^6 \cdot 2^5 =$ _____
5) $\frac{5^3}{5^8} =$ _____	6) $5^7 \cdot 8^7 =$ _____
7) $(2^4)^5 =$ _____	8) $3^7 \cdot 3^7 =$ _____
9) $6^8 \cdot 6^0 =$ _____	10) $\frac{3^5}{3^5} =$ _____

Task 2:

10:00

The following statements are all INCORRECT.

1. Identify the mistake.
2. Correct.
3. Justify (show) your reasoning.

a) $2^5 = 10$

b) $(-2)^3 = 8$

c) $-6^2 = 36$

d) $x^0 = 0$

e) $x^3 \bullet x^4 = x^{12}$

f) $\frac{x^{10}}{x^5} = x^2$

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Extension

Find the correct path through the maze. You can only move horizontally and vertically one square at a time.

$2^6 \times 2^3$	$3^2 \times 2^3$	$(\sqrt{16})^2$	$(2^3)^3$	$8^3 \div 8$	$4^4 \times 4^{-3}$	$(\sqrt[3]{8})^4$	8×4^2
$\sqrt{8^3}$	$(2^3)^2$	$8^7 \times 8^{-5}$	4^3	$2^{-2} \times 2^7$	64^0	$2^5 \times 2^3$	$4^7 \div 2^3$
$(\sqrt{64})^3$	8^2	$2^2 \times 2^3$	$2^3 \times 2^3$	$(2^3)^3$	$(\sqrt[3]{8})^6$	$4^6 \times 4^{-3}$	$2^2 \times 4^2$
2^6	$(\sqrt{64})^2$	$4^6 \times 4^{-2}$	$(\sqrt{16})^3$	$(2^2)^4$	$8^3 \div 2^3$	$2^{-3} \times 2^7$	$(2^2)^4$
3^5	$2^6 \times 2^1$	8^3	$4^5 \div 2^4$	$(-4)^{-3}$	$(2^2)^3$	$(\sqrt{8})^3$	$4^6 \div 2^6$
$4^3 \times 4^{-3}$	$(2^5)^1$	$(\sqrt[3]{64})^2$	$2^3 \times 8$	$2^{-1} \times 2^7$	$(\frac{1}{4})^{-3}$	16^2	64

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Plenary

05:00

Work out the following problem with your groupmates.

Write each calculation as a single power.

a $\frac{4^2 \times 4^8}{4^3}$

b $\frac{7^{12}}{7^2 \times 7^6}$

c $\frac{5^6 \times 5^6}{5^7 \times 5}$

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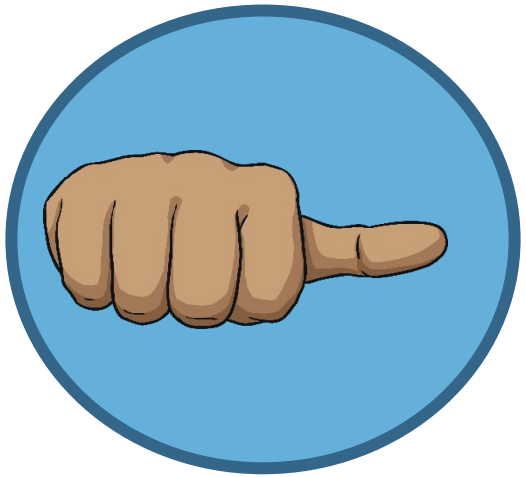
Self Check

Secure



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Working Towards