

Laws of Indices

Starter

1. (Review of GCSE material)

Simplify:

(a)	$3a^{-3} \times 2a^7$	(b)	$\frac{4c^2}{8(c^5)^2}$
(c)	$(4d^2)^3$	(d)	$(3x)^4 \times (2x)^4$

2. (Review of GCSE material)

Without using a calculator, evaluate: (a) $16^{\frac{1}{4}}$ (b) $64^{-\frac{2}{3}}$ (c) $7a^0$

3. (Review of GCSE material)

Correct the mistakes in this simplification: $(3x^2)^3 \times 2x^{-4} = 3x^6 \times 2x^{-4} = 5x^{10}$

Notes

Laws of indices:

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

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

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

when multiplying, add the indices

when dividing, subtract the indices

when raised to a power, multiply the indices

Zero index:

$$a^0 = 1$$

any number or letter to the power of 1 is zero

Negative indices:

$$a^{-m} = \frac{1}{a^m}$$

"1 over..."

N.B. With fractions, flip the fraction and change the sign of the index:

$$\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$$

E.g. 1 Without a calculator, find the value of $\left(\frac{2}{5}\right)^{-3}$.

Fractional indices:

$$a^{\frac{m}{n}} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$$

N.B. When evaluating fractional indices, do the rooting part before the denominator of the power.

E.g. 2 Without a calculator, find the value of $8^{\frac{2}{3}}$.

Same power:

$$a^m \times b^m = (a \times b)^m$$

like question 1(d) from the starter

E.g. 3 Express $2^5 \times 3^5$ in the form x^y .

E.g. 4 Without a calculator, evaluate:

(a)	$27^{\frac{4}{3}}$	(b)	$\left(3\frac{3}{8}\right)^{\frac{2}{3}}$
(c)	$9^{-\frac{3}{2}}$	(d)	$\left(2\frac{1}{4}\right)^{-\frac{1}{2}}$

E.g. 5 Simplify:

(a)	$9a^{-2} \times \frac{1}{3}a^{-3} \div \frac{2}{3}a^{-2}$	(b)	$\frac{6x^4 + 10x^6}{2x}$
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E.g. 6 Solve the equation $4^x \times 3^{2x} = 6$.

E.g. 7 Given that $2^{x+y} = 1$ and $10^{3x-y} = 100$, find x and y . Hence find 5^{y-x} and x^y .

[Video: Classwiz - solving simultaneous equations](#)

[Video: Simplifying using the laws of indices](#)

[Video: Equations involving indices](#)

[Solutions to Starter and E.g.s](#)

Exercise

p20 2A Qu 1ace..., 2ace..., 3ac, 4, 5ace, 6(i), 7-13 odd, 14-16 (Not 17 - need logs)

Summary

Laws of indices:

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

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

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

Zero index:

$$a^0 = 1$$

Negative indices:

$$a^{-m} = \frac{1}{a^m} \quad \left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n$$

Fractional indices:

$$a^{\frac{m}{n}} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$$

Same power:

$$a^m \times b^m = (a \times b)^m$$