
LAWS OF INDICES

Indices (also called powers) provide a short way of showing repeated multiplication. In the expression 2^3 , 2 is the base and 3 is the index. This means $2 \times 2 \times 2 = 8$.

The Laws

- Multiplying powers with the same base:** add the indices.
 $a^m \times a^n = a^{m+n}$
Example: $2^3 \times 2^4 = 2^7 = 128$
- Dividing powers with the same base:** subtract the indices.
 $a^m \div a^n = a^{m-n}$
Example: $5^6 \div 5^2 = 5^4 = 625$
- Raising a power to another power:** multiply the indices.
 $(a^m)^n = a^{mn}$
Example: $(3^2)^3 = 3^6 = 729$
- Power of a product:** apply the index to each factor.
 $(ab)^n = a^n b^n$
Example: $(2x)^3 = 2^3 x^3 = 8x^3$
- Zero index:** any non-zero number raised to the power zero equals 1.
 $a^0 = 1$
Example: $7^0 = 1$
- Negative index:** take the reciprocal and make the index positive.
 $a^{-n} = 1 \div a^n$
Example: $2^{-3} = 1 \div 2^3 = 1/8$
- Roots as powers:** a root can be written as a fractional index.
 $a^{1/n} = \sqrt[n]{a}$
Example: $16^{1/2} = \sqrt{16} = 4$
- Fractional powers:** the denominator gives the root and the numerator gives the power.
 $a^{m/n} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$
Example: $8^{2/3} = (\sqrt[3]{8})^2 = 2^2 = 4$

Worked Examples

- Simplify: $x^4 \times x^3$**
The bases are the same, so add the indices: $x^{4+3} = x^7$.
- Simplify: $y^8 \div y^3$**
The bases are the same, so subtract the indices: $y^{8-3} = y^5$.

- **Simplify: $(m^2)^4$**

Multiply the indices: $2 \times 4 = 8$, so $(m^2)^4 = m^8$.

- **Simplify: $3a^2 \times 4a^5$**

Multiply the numbers and add the indices: $3 \times 4 = 12$ and $a^2 \times a^5 = a^7$, giving **$12a^7$** .