take note

Properties Properties of Exponents

- $a^0 = 1, a \neq 0$
- $\frac{a^m}{a^n} = a^{m-n}$
- $a^{-n} = \frac{1}{a^n}$
- $(ab)^n = a^n b^n$
- $(a^m)^n = a^{mn}$
- $a^m \cdot a^n = a^{m+n}$
- $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

Roots & Radicals

$\sqrt{x}$

Number	Squared	Square Root
1	1	1
2	4	2
3	9	3
4	16	4
5	25	5
6	36	6
7	49	7
8	64	8
9	81	9
10	100	10
11	121	11
12	144	12
13	169	13

$\sqrt[3]{x}$

Number	Cube	Cube Root
1	1	1
2	8	2
3	27	3
4	64	4
5	125	5
6	216	6
7	343	7
8	512	8
9	729	9
10	1000	10
11	1331	11
12	1728	12
13	2197	13

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Example

Simplify and rewrite each expression using only positive exponents.

a. $(5a^3)(-3a^{-4})$

$$\begin{aligned}(5a^3)(-3a^{-4}) &= 5(-3)a^{(3+(-4))}\\ &= -15a^{-1}\\ &= \frac{-15}{a}, \text{ or } -\frac{15}{a}\end{aligned}$$

b. $(-4x^{-3}y^5)^2$

$$\begin{aligned}(-4x^{-3}y^5)^2 &= (-4)^2(x^{-3})^2(y^5)^2\\ &= 16x^{-6}y^{10}\\ &= \frac{16y^{10}}{x^6}\end{aligned}$$

c. $\frac{4ab^6c^3}{a^5bc^3}$

$$\begin{aligned}\frac{4ab^6c^3}{a^5bc^3} &= 4a^{(1-5)}b^{(6-1)}c^{(3-3)}\\ &= 4a^{-4}b^5c^0\\ &= \frac{4b^5}{a^4}\end{aligned}$$

Example

Think

What does the denominator of the fractional exponent represent?

The denominator of the fraction is the index of the radical.

What is the simplified form of each expression?

A $216^{\frac{1}{3}}$

$$\begin{aligned}216^{\frac{1}{3}} &= \sqrt[3]{216}\\ &= \sqrt[3]{6^3}\\ &= 6\end{aligned}$$

Rewrite as radicals.

B $7^{\frac{1}{2}} \cdot 7^{\frac{1}{2}}$

$$\begin{aligned}7^{\frac{1}{2}} \cdot 7^{\frac{1}{2}} &= \sqrt{7} \cdot \sqrt{7}\\ &= \sqrt{7 \cdot 7}\\ &= \sqrt{7^2}\\ &= 7\end{aligned}$$

You can also solve this problem by adding the exponents.

$7^{\frac{1}{2}} \cdot 7^{\frac{1}{2}} = 7^{\frac{1}{2}+\frac{1}{2}} = 7^1 = 7$