

Evaluate without calc.

$$a) \sqrt[3]{1000} = 10$$

$$b) 25^{\frac{3}{2}} = (\sqrt{25})^3 = 5^3 = 125$$

$$c) 32^{0.2} = 32^{\frac{1}{5}}$$

$$\sqrt[5]{32} = 2$$

Write as a power:

$$a) \sqrt[3]{81^5} = 81^{\frac{5}{3}}$$

$$b) (\sqrt[4]{16})^5 = 16^{\frac{5}{4}}$$

$$c) (\sqrt{100})^3 = 100^{\frac{3}{2}}$$

Reciprocals

Two numbers that multiply to give you 1 are reciprocals.

Example:

$$(3) \left(\frac{1}{3}\right) = 1 \quad \frac{3}{1}$$

$$(23) \left(\frac{1}{23}\right) = 1 \quad 5$$

$$(-6) \left(-\frac{1}{6}\right) = 1$$

$$\left(\frac{4}{7}\right) (\quad) = 1$$

Reciprocals

We define powers with negative exponents so that previously developed properties such as:

$$\text{Product of powers law: } a^m \cdot a^n = a^{m+n}$$

$$\text{Zero rule: } a^0 = 1$$

Example:

Apply these properties.

$$(5^{-2})(5^2) = 5^{-2+2} \quad 5^{-2+2} = 5^0$$

$$(\quad)(25) = 5^0$$

$$\left(\frac{1}{25}\right)\left(\frac{25}{1}\right) = 1$$

$$\frac{25}{25} = 1$$

Since the product of 5^{-2} and 5^2 is 1, then 5^{-2} and 5^2 are reciprocals.

$$(x^3)(x^2)$$

$$x^5$$

$$\boxed{(5^{-2})(5^2)} = 5^0 = 1$$

recips

5^2 and $\frac{1}{5^2}$ are also reciprocals

5^2 and 5^{-2} are reciprocals

equal equal

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

Powers with Negative Exponents

When x is any non-zero number and n is a rational number, x^{-n} is the reciprocal of x^n .

That is, $x^{-n} = \frac{1}{x^n}$ and $\frac{1}{x^{-n}} = x^n$, $x \neq 0$



$$\left. \begin{aligned} x^{-n} &= \frac{1}{x^n} \\ \frac{1}{x^{-n}} &= x^n \end{aligned} \right\}$$

4.5 Negative Exponents and Reciprocals

$$5^{-2} = 0.04$$

$$\frac{1}{5^2} = \frac{1}{25} = 0.04$$

Example 1

Evaluating Powers with Negative Integer Exponents

Evaluate each power.

a) 3^{-2}

✓ SOLUTION

$$\frac{1}{3^2} = \boxed{\frac{1}{9}}$$

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

* Flip the base
change sign of exp.

$$\left(\frac{-4}{3}\right)^3 = \frac{-64}{27}$$

c) 0.3^{-4}

$$\frac{1}{\left(\frac{3}{10}\right)^4} = \frac{10^4}{3^4} = \frac{10000}{81}$$

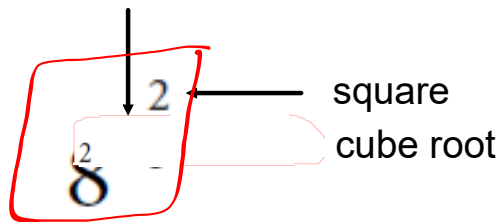


CHECK YOUR UNDERSTANDING

Evaluating Negative Rational Exponents

Evaluating Negative Rational Exponents

reciprocal



Since the exponent $-\frac{2}{3}$ is the product: $(-1)\left(\frac{1}{3}\right)(2)$, and order does not matter when we multiply, we can apply the three operations of reciprocal, cube root, and square in any order.

$$? = \left(\frac{1}{8}\right)^{\frac{2}{3}} = \left(\sqrt[3]{\frac{1}{8}}\right)^2 = \frac{(\sqrt[3]{1})^2}{(\sqrt[3]{8})^2} = \frac{1}{4}$$

Homework

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Exercises

A

3 4 5 6 7 8

B

9 10 11 12 13 14 15 16
17 18 19

C

20 21