Warm Up

Evaluate:

a) $(4+6)^2$

$\cancel{= 4^2 + 6^2}$

$\cancel{16 + 36}$

$\cancel{= 52}$

$(10)^2$

$\boxed{= 100}$

b) $(x^6)(x^9)(x^2)(x^{15})$

$= x^{6+9+2+15}$

$= x^{32}$

.

c) $(-3q^2rs)^2$

$= -3^2 \cdot (q^2)^2 r^2 s^2$

$\boxed{= 9q^4r^2s^2}$

d) $(4x^0)^4$

$(4(1))^4$

$\boxed{= 256}$

BEDMAS

e) $(3m)^{-2}$

$$\frac{1}{(3m)^2}$$

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

f) $3m^{-2}$

$$\boxed{\frac{3}{m^2}}$$

g) $\frac{5h^{-3}}{h^4}$

$$\frac{5}{h^4 \cdot h^3} = \boxed{\frac{5}{h^7}}$$

$$5h^{-3-4}$$

$$5h^{-7}$$

$$\boxed{\frac{5}{h^7}}$$

Exponents and Radicals

Earlier, you learned that powers with integral exponents have a special meaning. The exponent $\frac{1}{2}$ has a special meaning related to the principal square root of a number.

$\sqrt{2} = 2^{\frac{1}{2}} \quad \sqrt{3} = 3^{\frac{1}{2}} \quad \sqrt{5} = 5^{\frac{1}{2}}$

principal square roots

In order to learn mathematics, it is helpful to make comparisons.

- The cube of 2 is 8, since $2 \times 2 \times 2 = 8$.
- The cube of 2 is shown by the symbol $2^3 = 8$.
- The principal cube root of 8 is 2, since $2 \times 2 \times 2 = 8$.
- The principal cube root of 8 is shown by the radical symbol $\sqrt[3]{8} = 2$. means the principal cube root of 8.

Similarly, exponents that are rational have a special meaning.

Using exponent laws — *Using radicals*

$8^{\frac{1}{3}} \times 8^{\frac{1}{3}} \times 8^{\frac{1}{3}} = 8^{\frac{1}{3}+\frac{1}{3}+\frac{1}{3}} = 8 \longleftarrow$ Compare. $\longrightarrow \sqrt[3]{8} \times \sqrt[3]{8} \times \sqrt[3]{8} = 8$

$8^{1/3} = \sqrt[3]{8}$

Based on the above comparison, $\sqrt[3]{8}$ and $8^{\frac{1}{3}}$ behave in a similar way.

It seems reasonable to define $\sqrt[3]{8} = 8^{\frac{1}{3}}$

In general, the nth principal root of a number is shown by $\sqrt[n]{a} = a^{\frac{1}{n}}$

$8^{1/2} = \sqrt{8}$

$3^{1/4} = \sqrt[4]{3}$

$$\boxed{\sqrt[n]{a} = a^{\frac{1}{n}}}$$

Fraction Exponents - To evaluate exponents that are fractions, the denominator of the fraction indicates which root to take and the numerator indicates which power the entire base is to be raised.

$7^{2/3} = \left(\sqrt[3]{7}\right)^2$

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

$2^{4/5} = \left(\sqrt[5]{2}\right)^4$

EXERCISE...

Simplify.

(a) $\sqrt[3]{27}$ (b) $\sqrt[4]{16}$ (c) $\sqrt[3]{64}$ (d) $\sqrt[5]{32}$ (e) $\sqrt[4]{625}$ (f) $\sqrt[5]{1024}$

$27^{1/3}$ $16^{1/4}$ $64^{1/3}$ $32^{1/5}$ $625^{1/4}$ $1024^{1/5}$

Simplify.

(a) $8^{\frac{1}{3}}$ (b) $16^{\frac{1}{4}}$ (c) $243^{\frac{1}{5}}$ (d) $125^{\frac{1}{3}}$ (e) $256^{\frac{1}{4}}$

$\sqrt[3]{8}$ $\sqrt[4]{16}$ $\sqrt[5]{243}$ $\sqrt[3]{125}$ $\sqrt[4]{256}$

More Examples...

$a)\ 125^{-\frac{2}{3}}$

$\left(\sqrt[3]{125}\right)^{-2} = \frac{1}{\left(\sqrt[3]{125}\right)^{2}} = \frac{1}{5^2} = \frac{1}{25}$

$b)\ 256^{0.375}$

$\frac{375}{1000} = \frac{15}{40} = \frac{3}{8}$

$256^{3/8}$

$\boxed{\left(\sqrt[8]{256}\right)^{3} = 2^{3} = 8}$

$c)\ 8^{-\frac{1}{3}}$

$\left(\sqrt[3]{8}\right)^{-1}$

$= (2)^{-1}$

$= \frac{1}{2}$

$d)\ (-8)^{\frac{1}{3}}$

$\left(\sqrt[3]{-8}\right)^{1}$ -2^{3}

$= -2$

$e)\ 125^{2\frac{1}{3}}$ $\quad 7/3$

$\left(\sqrt[3]{125}\right)^{7}$

$\boxed{= 78125}$

$f)\ \left(81^{-2}\right)^{-\frac{1}{4}}$ $\quad 1/4$

$(81)^{1/2}$

$\boxed{\sqrt{81} = 9}$

$$\sqrt[x]{y}$$

$$\sqrt[8]{10}$$

Exercise - Simplify...

$a)\ \left(16x^{8}y^{2}\right)^{\frac{1}{4}}$

$b)\ \left(\dfrac{a^{3}b^{-4}}{x^{-1}y^{2}}\right)\times\dfrac{(x^{-1})(b^{-1})}{a^{\frac{3}{2}}\cdot y^{\frac{4}{5}}}$

$c)\ \left(\dfrac{\sqrt[3]{x^{5}}}{\sqrt{x}}\right)^{3}$

$d)\ 32^{-\frac{3}{5}}-32^{\frac{3}{5}}$

Homework...

Worksheet - Laws of Exponents Review.doc

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