6.1 Properties of Exponents

6.2 Radical and Rational Exponents

Simplify the expression. Write your answer using only positive exponents.

5. $10^4 \cdot 10^{-6}$

$10^{4-6} = 10^{-2} = \frac{1}{10^2}$

6. $x^9 \cdot x^{-9}$

$x^{9-9} = x^0 = 1$

7. $\frac{-5^8}{-5^4}$ $= -5^{8-4} = -5^4$

8. $\frac{y^6}{y^7} = \frac{1}{y^{7-6}} = \frac{1}{y}$

9. $(6^{-2})^{-1}$

$6^{-2 \cdot -1} = 6^2$

10. $(w^{12})^5$ $w^{12(5)} = w^{60}$

Simplify each expression. Write your answer using only positive exponents.

a. $(-1.5y)^2 = (-1.5)^2 y^2$

$2.25y^2$

b. $\left(\frac{a}{-10}\right)^3 = \frac{a^3}{(-10)^3} = \frac{a^3}{-1000}$

c. $\left(\frac{3d}{2}\right)^4 = \frac{3^4 d^4}{2^4} = \frac{81d^4}{16}$

d. $\left(\frac{2x}{3}\right)^{-5}$

$\frac{2^{-5}x^{-5}}{3^{-5}} = \frac{3^5}{2^5 x^5} = \frac{243}{32x^5}$

Simplify the expression. Write your answer using only positive exponents.

11. $(10y)^{-3}$ $\frac{10^{-3}y^{-3}}{1} = \frac{1}{1000y^3}$

12. $\left(-\frac{4}{n}\right)^5 = \frac{(-4)^5}{n^5} = \frac{-1024}{n^5}$

13. $\left(\frac{1}{2k^2}\right)^5 = \frac{1^5}{2^5 k^{10}} = \frac{1}{32k^{10}}$

14. $\left(\frac{6c}{7}\right)^{-2} = \frac{6^{-2}c^{-2}}{7^{-2}} = \frac{7^2}{6^2c^2} = \frac{49}{36c^2}$

Using your calculator: Estimate each positive nth root. ~~Then match each nth root with the point on the number line. Justify your answers.~~

a. $\sqrt[4]{25}$ = $= 2.23$

b. $\sqrt{0.5}$ $= 0.71$

c. $\sqrt[5]{2.5}$ $= 1.20$

d. $\sqrt[3]{65}$ $= 4.02$

e. $\sqrt[3]{55}$ $= 3.80$

f. $\sqrt[6]{20,000}$ $= 5.21$

Core Concept

Real nth Roots of a

Let n be an integer greater than 1, and let a be a real number.

- If n is odd, then a has one real nth root: $\sqrt[n]{a} = a^{1/n}$
- If n is even and $a > 0$, then a has two real nth roots: $\pm\sqrt[n]{a} = \pm a^{1/n}$
- If n is even and $a = 0$, then a has one real nth root: $\sqrt[n]{0} = 0$
- If n is even and $a < 0$, then a has no real nth roots.

Find the indicated real nth root(s) of a.

a. $n = 3$, $a = -27$

$-27^{1/3} = -3$

b. $n = 4$, $a = 16$

$16^{1/4} = \pm 4$

c. $n = 3$, $a = -125$

$-125^{1/3} = -5$

d. $n = 6$, $a = 64$

$64^{1/6} = \pm 2$

Evaluate each expression.

a. $\sqrt[3]{-8}$

$\sqrt[3]{(-2)(-2)(-2)}$

$= -2$

b. $-\sqrt[3]{8}$

$-\sqrt{2 \cdot 2 \cdot 2}$

$= -2$

c. $16^{1/4}$

$\sqrt[4]{16}$

$\sqrt[4]{2 \cdot 2 \cdot 2 \cdot 2}$

$= 2$

d. $(-16)^{1/4}$

$\sqrt[4]{-16}$

$\sqrt[4]{(-2)(-2)(-2)?}$

not a real #.

Core Concept

Rational Exponents

Let $a^{1/n}$ be an nth root of a, and let m be a positive integer.

Algebra $a^{m/n} = (a^{1/n})^m = (\sqrt[n]{a})^m$

Numbers $27^{2/3} = (27^{1/3})^2 = (\sqrt[3]{27})^2$

Evaluate (a) $16^{3/4}$ and (b) $27^{4/3}$.

$a^{m/n} = (a^{1/n})^m = (\sqrt[n]{a})^m$

$16^{3/4} \quad (16^{1/4})^3 \quad (\sqrt[4]{16})^3$

$(\sqrt[4]{2 \cdot 2 \cdot 2 \cdot 2})^3$

$2^3 = 2 \cdot 2 \cdot 2 = 8$

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

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Evaluate the expression.

3. $\sqrt[n=3]{-125}$

$\sqrt[3]{(-5)(-5)(-5)}$

$= -5$

4. $(-64)^{\frac{m}{n}=\frac{2}{3}}$

$(\sqrt[3]{-64})^2$

$(\sqrt[3]{(-4)(-4)(-4)})^2$

$(-4)^2 = 16$

5. $9^{\frac{m}{n}=\frac{5}{2}}$

$(\sqrt{9})^5$

$(3)^5 =$

$3 \cdot 3 \cdot 3$

27

6. $256^{3/4}$

$(\sqrt[4]{256})^3$

$(\sqrt{4 \cdot 4 \cdot 4 \cdot 4})^3$

$(4)^3$

64

Homework

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