Your Name

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9.1

4/6/21

Exponents and Radicals

Notes

Properties of Exponents

$x^2 = x \cdot x$ definition of exponent

$x^{-2} = \frac{1}{x^2} = \frac{1}{x \cdot x}$ negative exponent = flipped

$y^{-3} = \frac{1}{y^3}$

$x^2 \cdot x^5 = x^{2+5} = x^7$ Add Exponents when multiplying same bases

$x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x$

$\left(\frac{2}{3}\right)^{-1} = \frac{3}{2}$

$\frac{x^2}{x^5} = x^{2-5} = x^{-3} = \frac{1}{x^3}$ Subtract Exponents

$\frac{\cancel{x} \cdot \cancel{x}}{\cancel{x} \cdot \cancel{x} \cdot x \cdot x \cdot x}$

$= \frac{1}{0.6}$

$(x^2)^5 = x^{2 \cdot 5} = (x^2)(x^2)(x^2)(x^2)(x^2) = x^{10}$ Multiply Exponents

$\sqrt[2]{\ }$ square root

$\sqrt[3]{\ }$ cubic root

$\sqrt[4]{\ }$ fourth root

$\sqrt[5]{\ }$ fifth root

$\sqrt[5]{x^2} = x^{2/5}$ Divide Exponents

Radicals and Roots

Index, Radical, Radicand

number on shelf

stuff under root

$$\sqrt[3]{27}$$

determines amount needed to be the same

$$\sqrt[3]{\underline{3}\cdot\underline{3}\cdot\underline{3}} = 3$$

Even indexed radicals must have a positive number underneath as the radicand in order to be a Real number

if no index, index is 2

Odd indexed radicals can have a positive or negative number underneath as the radicand and be a Real number

$$\sqrt[4]{16}$$

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

$$2$$

$$\sqrt{-25}$$

$$\sqrt{\cancel{-5\cdot 5}}$$

can't have negatives under radical

$$\sqrt[3]{27}$$

$$\sqrt[3]{\underline{3}\cdot\underline{3}\cdot\underline{3}}$$

$$3$$

$$\sqrt[5]{-32}$$

$$\sqrt[5]{\underline{-2}\cdot\underline{-2}\cdot\underline{-2}\cdot\underline{-2}\cdot\underline{-2}}$$

Division

$$2\overline{)16}^{\,8}$$

b/c 8+8

Square root

$$\sqrt[2]{16} = 4$$

$$\underline{4}\cdot\underline{4}$$

Simplify by prime factorization

$\sqrt{16}$

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

$2\cdot 2$

4

$\sqrt{75x^6}$

$\sqrt{3\cdot 5\cdot 5\cdot x\cdot x\cdot x\cdot x\cdot x\cdot x}$

$5\cdot x\cdot x\cdot x\cdot\sqrt{3}$

$\boxed{5x^3\sqrt{3}}$

Square root need groups of 2

$\sqrt[2]{36x^{11}}$

$\sqrt{2\cdot 2\cdot 3\cdot 3\cdot x\cdot x\cdot x\cdot x\cdot x\cdot x\cdot x\cdot x\cdot x\cdot x\cdot x}$

$2\cdot 3\cdot x\cdot x\cdot x\cdot x\cdot x\sqrt{x}$

$6x^5\sqrt{x}$

Cubic root needs groups of 3 → 3

$\sqrt[3]{-27x^4}$

$\sqrt[3]{-3\cdot -3\cdot -3\cdot x\cdot x\cdot x\cdot x}$

$\boxed{-3x\sqrt[3]{x}}$

$\sqrt{98}$

$\sqrt{7\cdot 7\cdot 2}$

$7\cdot\sqrt{2}$

$\sqrt{63x^7}$

$\sqrt{7\cdot 3\cdot 3\cdot x\cdot x\cdot x\cdot x\cdot x\cdot x\cdot x}$

$3\cdot x\cdot x\cdot x\sqrt{7}\sqrt{x}$

$\boxed{3x^3\cdot\sqrt{7x}}$

Simplify by perfect squares

$1^2=1\to\sqrt{1}=1$

$2^2=4\to\sqrt{4}=2$

$3^2=9\to\sqrt{9}=3$

$4^2=16\to\sqrt{16}=4$

$5^2=25\to\sqrt{25}=5$

$6^2=36\to\sqrt{36}=6$

$7^2=49\to\sqrt{49}=7$

$8^2=64\to\sqrt{64}=8$

$9^2=81\to\sqrt{81}=9$

$10^2=100\to\sqrt{100}=10$

$11^2=121\to\sqrt{121}=11$

$12^2=144\to\sqrt{144}=12$

$\sqrt{32}$

$\sqrt{16\cdot 2}$

$\sqrt{16}\cdot\sqrt{2}$

$\boxed{4\sqrt{2}}$

$\sqrt{75x^6}$

$\sqrt{25\cdot 3\cdot x^2\cdot x^2\cdot x^2}$

$\sqrt{25}\cdot\sqrt{x^2}\cdot\sqrt{x^2}\cdot\sqrt{x^2}\cdot\sqrt{3}$

$5\cdot x\cdot x\cdot x\cdot\sqrt{3}$

$\boxed{5x^3\sqrt{3}}$

$-\left(\sqrt{36x^{11}}\right)$

$-\left(\sqrt{36}\cdot\sqrt{x^2}\cdot\sqrt{x^2}\cdot\sqrt{x^2}\cdot\sqrt{x^2}\cdot\sqrt{x^2}\cdot\sqrt{x}\right)$

$-\left(6x\cdot x\cdot x\cdot x\cdot x\sqrt{x}\right)$

$\boxed{-6x^5\sqrt{x}}$

☆ $\sqrt{-252x^4}$

$\sqrt{4\cdot 9\cdot 7\cdot -1\cdot x^4}$

$\sqrt{4}\cdot\sqrt{9}\cdot\sqrt{-7}\cdot\sqrt{x^2}\cdot\sqrt{x^2}$

$2\cdot 3\cdot x\cdot x\cdot\sqrt{-7}$

$6x^2\cdot\sqrt{-7}$

☆ Imaginary, can't take $\sqrt{\ }$ of negative numbers

$\sqrt{48}$

$\sqrt{16\cdot 3}$

$\sqrt{16}\cdot\sqrt{3}$

$\boxed{4\sqrt{3}}$

$\sqrt{121w^8}$

$\sqrt{121}\cdot\sqrt{w^2}\cdot\sqrt{w^2}\cdot\sqrt{w^2}\cdot\sqrt{w^2}$

$11w\cdot w\cdot w\cdot w$

$\boxed{11w^4}$

Homework: pg. 485 #13-20 and 37

In Exercises 13–20, simplify the expression.
(See Example 1.)

13. $\sqrt{20}$ **14.** $\sqrt{32}$

15. $\sqrt{128}$ **16.** $-\sqrt{72}$

17. $\sqrt{125b}$ **18.** $\sqrt{4x^2}$

19. $-\sqrt{81m^3}$ **20.** $\sqrt{48n^5}$

ERROR ANALYSIS **In Exercises 37 and 38, describe and correct the error in simplifying the expression.**

37. ✗

$$\sqrt{72} = \sqrt{4 \cdot 18} = \sqrt{4} \cdot \sqrt{18} = 2\sqrt{18}$$

13. $2\sqrt{5}$

14. $4\sqrt{2}$

15. $8\sqrt{2}$

16. $-6\sqrt{2}$

17. $5\sqrt{5b}$

18. $2x$

19. $-9m\sqrt{m}$

20. $4n^2\sqrt{3n}$

37. The radicand 18 has a perfect square factor of 9; $\sqrt{72} = \sqrt{36 \cdot 2} = 6\sqrt{2}$