5.1 - nth Roots and Rational Exponents

Warmups

1. $\dfrac{1+\sqrt{2}}{3-\sqrt{2}}$

$\dfrac{5+4\sqrt{2}}{7}$

2. $\dfrac{2+\sqrt{6}}{2-\sqrt{6}}$

$-5-2\sqrt{6}$

3. $\dfrac{2-\sqrt{3}}{5+3\sqrt{3}}$

$\dfrac{-19+11\sqrt{3}}{2}$

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Square Roots

$\sqrt{4} = 2$

$\sqrt{25} = 5$

$\sqrt{20} = \sqrt{2 \cdot 2 \cdot 5} = 2\sqrt{5}$

$4\sqrt{1400} = 4\sqrt{14 \cdot 10 \cdot 10} = 40\sqrt{14}$

Practice

1. $\sqrt{300}$

$10\sqrt{3}$

2. $\sqrt{125}$

$5\sqrt{5}$

3. $5\sqrt{72}$

$30\sqrt{2}$

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nth Roots

$$\sqrt[3]{32x^3y^4} = 12xy^2\sqrt{2x}$$

$$\sqrt[3]{32x^3y^4} = 6xy\sqrt[3]{4y}$$

Practice

1. $\sqrt[3]{24x^4y^3}$ $6x^2y\sqrt{6y}$

2. $\sqrt[5]{12x^3y}$ $10x\sqrt{3xy}$

3. $\sqrt{16x^4y^8}$ $4x^2y^4$

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nth Roots

$\sqrt[3]{-8} = -2$ $\sqrt[3]{-32} = -2\sqrt[3]{4}$

$x^3 = -8$

Practice

1. $3\sqrt[3]{-27}$

-9

2. $2\sqrt[3]{-125x^5}$

$-10x\sqrt[3]{x^2}$

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nth Roots - Multiplication

$$\sqrt[3]{-64} = (-64)^{\frac{1}{3}}$$

$2 \cdot 6 = 12$

$$\sqrt{2} \cdot \sqrt{6} = \sqrt{12} = 2\sqrt{3}$$

$$2\sqrt{2} \cdot 3\sqrt{10} = 6\sqrt{20} = 12\sqrt{5}$$

Practice

1. $\sqrt{6} \cdot \sqrt{9}$

$3\sqrt{6}$

2. $5\sqrt{12} \cdot 2\sqrt{3}$

60

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Square Roots - Division

$$\sqrt{\frac{4}{25}} = \frac{\sqrt{4}}{\sqrt{25}} = \frac{2}{5}$$

$$\sqrt{\frac{3}{5}} = \frac{\sqrt{3}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{15}}{5}$$

No radical in denominator

$$\frac{\sqrt{12}}{\sqrt{8}} \cdot \frac{10}{\sqrt{24}} \cdot \frac{\sqrt{4}}{\sqrt{20}}$$

Practice

1. $\sqrt{\frac{5}{7}}$ $\frac{\sqrt{35}}{7}$

2. $\sqrt{\frac{6}{10}}$ $\frac{\sqrt{15}}{5}$

3. $\frac{6}{2\sqrt{3}}$ $\sqrt{3}$

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nth Roots - Division

$$\sqrt[3]{\frac{2}{5}} = \frac{\sqrt[3]{2}}{\sqrt[3]{5}} \cdot \frac{\sqrt[3]{5 \cdot 5}}{\sqrt[3]{5 \cdot 5}} = \frac{\sqrt[3]{50}}{5}$$

$$\frac{3}{\sqrt[5]{4}} = \frac{3\sqrt[5]{8}}{2}$$

Practice

1. $\sqrt[3]{\frac{5}{2}}$ $\frac{\sqrt[3]{20}}{2}$

2. $\frac{\sqrt[3]{4}}{3\sqrt[3]{6}}$ $\frac{\sqrt[3]{18}}{9}$

3. $\frac{\sqrt[6]{3}}{\sqrt[6]{8}}$ $\frac{\sqrt[6]{24}}{2}$

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Solving Equations

$x^3 = 32$

$x = \sqrt[3]{32} = 2\sqrt[3]{4}$

$x^4 = 32$

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

$x^5 = 128$

$= 2\sqrt[5]{4}$

Practice

1. $x^2 = 72$

$\pm 6\sqrt{2}$

2. $x^3 = 128$

$4\sqrt[3]{2}$

3. $x^4 = \frac{1}{512}$

$\pm \frac{\sqrt[4]{8}}{8}$