Radical Expressions {Exercise 1.2}

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Entire $\sqrt{a}$ is called radical.

$\sqrt{}$ is called radical sign, a is radicand.

$x = \sqrt[n]{a}$ is called nth root of a and n is the index of radical.

$x = (a)^{\frac{1}{n}}$ is called the exponential form of $x = \sqrt[n]{a}$

A real number under the radical sign is called radicand.

Laws of Radicals & Indices

$$\sqrt{16 \times 9} = \sqrt{16} \times \sqrt{9}$$

$$\sqrt{144} = 4 \times 3$$

$$12 = 12$$

$$\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$$

$$\sqrt[n]{ab} = \sqrt[n]{a} \cdot \sqrt[n]{b}$$

$$\sqrt{16+9} \neq \sqrt{16} + \sqrt{9}$$

$$\sqrt{25} \neq 4 + 3$$

$$5 \neq 7$$

$$\sqrt{a+b} \neq \sqrt{a} + \sqrt{b}$$

$$\sqrt[n]{a+b} \neq \sqrt[n]{a} + \sqrt[n]{b}$$

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$$\sqrt{\frac{16}{4}} = \frac{\sqrt{16}}{\sqrt{4}}$$

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

$$2 = 2$$

$$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$$

$$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$$

$$\sqrt[n]{a-b} \neq \sqrt[n]{a} - \sqrt[n]{b}$$

$$\sqrt{x^2} = x$$

$$(x^2)^{\frac{1}{2}} = x^{2 \times \frac{1}{2}} = x$$

$$\sqrt[3]{x^3} = x$$

$$(x^3)^{\frac{1}{3}} = x^{3 \times \frac{1}{3}} = x$$

$$\sqrt[n]{x^n} = x$$

$$(x^n)^{\frac{1}{n}} = x^{n \times \frac{1}{n}} = x$$

In multiplication, if bases are same, powers will be added.

$$x^2 \cdot x^3 = x^{2+3} = x^5$$

$$x^a \cdot x^b = x^{a+b}$$

Power of Power.

$$(x^2)^3 = x^{2 \times 3} = x^6$$

$$(x^a)^b = x^{a \times b} = x^{ab}$$

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$$(ab)^2 = a^2b^2$$

$$(abc)^2 = a^2b^2c^2$$

$$(ab)^n = a^nb^n$$

$$\left(\frac{a}{b}\right)^2 = \frac{a^2}{b^2}$$

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

$$(a+b)^2 \neq a^2+b^2$$

$$(a-b)^2 \neq a^2-b^2$$

$$\frac{a^m}{a^n} = a^m \cdot a^{-n} = a^{m-n}$$

$$\frac{a^m}{a^n} = \frac{1}{a^n \cdot a^{-m}} = \frac{1}{a^{n-m}}$$

$$a^0 = 1$$

$$(1000)^0 = 1$$

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Surd :- An irrational number with rational radicand. e.g $\sqrt{5}$ is a surd.

$\sqrt{4}$ is not surd because $\sqrt{4} = 2$

$\sqrt{\pi}$ is not a surd because π is an irrational number. $\sqrt{e}$ is not a surd.

$\sqrt{5}$ A surd that contains a single term is called monomial.

$\sqrt{3} + \sqrt{5}$ A surd that contains the sum of two surds is called a binomial surd.

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Example 7:- Simplify the following.

i):- $\sqrt[4]{16x^4y^8}$

$\sqrt[4]{16} \cdot \sqrt[4]{x^4} \cdot \sqrt[4]{y^8}$

$\sqrt[4]{2^4}\, x \cdot (y^8)^{\frac{1}{4}}$

$2x \cdot y^{8\times\frac{1}{4}}$

$2xy^2$

2	16
2	8
2	4
2	2
	1

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ii):- $\sqrt[3]{27x^6y^9z^3}$

$\sqrt[3]{27}\sqrt[3]{x^6}\sqrt[3]{y^9}\sqrt[3]{z^3}$

$\sqrt[3]{3^3}(x^6)^{\frac{1}{3}}(y^9)^{\frac{1}{3}}z$

$3x^{6\times\frac{1}{3}} \cdot y^{9\times\frac{1}{3}} z$

$3x^2y^3z$

3	27
3	9
3	3
	1

iii):- $(64)^{-\frac{4}{3}}$

$(2^6)^{-\frac{4}{3}}$

$2^{6\times\frac{-4}{3}}$

2^{-8}

$\frac{1}{2^8} = \frac{1}{256}$

2	64
2	32
2	16
2	8
2	4
2	2
	1

$\sqrt{a}+\sqrt{b}$ and $\sqrt{a}-\sqrt{b}$ are called Conjugate surds.

Rationalization of denominator

Example 8:- Rationalize the denominator

i):- $\dfrac{3}{\sqrt{5}+\sqrt{2}}$

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$$\frac{3}{\sqrt{5}+\sqrt{2}} \times \frac{\sqrt{5}-\sqrt{2}}{\sqrt{5}-\sqrt{2}}$$

$$\frac{3(\sqrt{5}-\sqrt{2})}{(\sqrt{5})^2-(\sqrt{2})^2}$$

$$\frac{3(\sqrt{5}-\sqrt{2})}{5-2}$$

$$\frac{\cancel{3}(\sqrt{5}-\sqrt{2})}{\cancel{3}}$$

$$\sqrt{5}-\sqrt{2}$$

ii):- $\frac{3}{\sqrt{5}-\sqrt{3}}$

$$\frac{3}{\sqrt{5}-\sqrt{3}} \times \frac{\sqrt{5}+\sqrt{3}}{\sqrt{5}+\sqrt{3}}$$

$$\frac{3(\sqrt{5}+\sqrt{3})}{(\sqrt{5})^2-(\sqrt{3})^2}$$

$$\frac{3(\sqrt{5}+\sqrt{3})}{5-3}$$

$$\frac{3(\sqrt{5}+\sqrt{3})}{2}$$

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