

OPERATIONS WITH

RADICAL EXPRESSIONS

Ex 1

$$\sqrt{9} = \sqrt{3^2} = 3^{\frac{2}{2}} = 3^1 = 3$$

$$\sqrt{x^2} = x^{\frac{2}{2}} = x^1 = x$$

$$\sqrt{x^{16}} = x^{\frac{16}{2}} = x^8$$

$$\sqrt[5]{x^{30}} = x^{\frac{30}{5}} = x^6$$

Ex 2

$$\sqrt[5]{243 x^{10} y^{40}} = \sqrt[5]{243} \cdot \sqrt[5]{x^{10}} \cdot \sqrt[5]{y^{40}}$$

$$= \sqrt[5]{3^5} \cdot \sqrt[5]{x^{10}} \cdot \sqrt[5]{y^{40}}$$

$$= 3^{\frac{5}{5}} \cdot x^{\frac{10}{5}} \cdot y^{\frac{40}{5}}$$

$$= \underline{\underline{3x^2y^8}}$$

Ex 3

$$\sqrt{27} = \sqrt{3^3} = \sqrt{3^2 \cdot 3^1} = \sqrt{3^2} \cdot \sqrt{3^1}$$

$$= \underline{\underline{3\sqrt{3}}}$$

$$\begin{aligned}\underline{\underline{\text{Ex 4}}}\quad \sqrt{72} &= \sqrt{36 \cdot 2} = \sqrt{36} \cdot \sqrt{2} \\ &= \underline{\underline{6\sqrt{2}}}\end{aligned}$$

$$\begin{aligned}\underline{\underline{\text{Ex 5}}}\quad \sqrt{x^3} &= \sqrt{x^2 \cdot x^1} = \sqrt{x^2} \cdot \sqrt{x^1} \\ &= \underline{\underline{x\sqrt{x}}}\end{aligned}$$

$$\begin{aligned}\underline{\underline{\text{Ex 6}}}\quad \sqrt[3]{x^7} &= \sqrt[3]{x^6 \cdot x^1} = \sqrt[3]{x^6} \cdot \sqrt[3]{x^1} \\ &= x^{6/3} \cdot \sqrt[3]{x^1} \\ &= \underline{\underline{x^2 \cdot \sqrt[3]{x}}}\end{aligned}$$

$$\begin{aligned}\underline{\underline{\text{Ex 7}}}\quad \sqrt[4]{32x^6y^9z^2} &= \sqrt[4]{32} \cdot \sqrt[4]{x^6} \cdot \sqrt[4]{y^9} \cdot \sqrt[4]{z^2} \\ &= \sqrt[4]{2^5} \cdot \sqrt[4]{x^6} \cdot \sqrt[4]{y^9} \cdot \sqrt[4]{z^2} \\ &= \left(\sqrt[4]{2^4}\right) 2^1 \cdot \left(\sqrt[4]{x^4}\right) x^2 \cdot \left(\sqrt[4]{y^8}\right) y^1 \cdot \sqrt[4]{z^2} \\ &= 2 \cdot x \cdot y^2 \cdot \underline{\underline{\sqrt[4]{2x^2yz^2}}}\end{aligned}$$

Ex 8

$$\begin{aligned} \sqrt[5]{128x^7} &= \sqrt[5]{128} \cdot \sqrt[5]{x^7} \\ &= \sqrt[5]{2^7} \cdot \sqrt[5]{x^7} \\ &= \left(\sqrt[5]{2^5} \cdot 2^2\right) \cdot \left(\sqrt[5]{x^5} \cdot x^2\right) \\ &= 2 \times \sqrt[5]{4x^2} \end{aligned}$$

ADD/SUBTRACTION

LIKE TERMS :

$$3\sqrt{5} + 8\sqrt{5} = 11\sqrt{5}$$

$$2\sqrt[3]{3x} - 9\sqrt[3]{3x} = -7\sqrt[3]{3x}$$

UNLIKE TERMS :

$$3\sqrt{2} - 6\sqrt[3]{2} \leftarrow \text{DIFFERENT RADICANDS}$$

$$4\sqrt[3]{3} + 5\sqrt[3]{5}$$

Ex 9

$$\begin{aligned} \sqrt[3]{81} - \sqrt[3]{192} &= \sqrt[3]{3^4} - \sqrt[3]{64 \cdot 3} \\ &= \sqrt[3]{3^4} - \sqrt[3]{2^6 \cdot 3} \\ &= \left(\sqrt[3]{3^3} \cdot 3\right) - \left(\sqrt[3]{2^6} \cdot 3\right) \\ &= \cancel{3 \cdot 2^2} \cdot \sqrt[3]{3 \cdot 3} \\ &= \cancel{12} \sqrt[3]{9} \end{aligned}$$

$$\begin{aligned}
 &= 3\sqrt[3]{3} - 2^2\sqrt[3]{3} \\
 &= 3\sqrt[3]{3} - 4\sqrt[3]{3} \\
 &= \underline{\underline{-\sqrt[3]{3}}}
 \end{aligned}$$

Ex 10

$$5x\sqrt[4]{32y^5} - 7y\sqrt[4]{162x^4y}$$

$$\begin{aligned}
 162 &= 81 \cdot 2 \\
 &= 3^4 \cdot 2
 \end{aligned}$$

$$\begin{aligned}
 &5x\sqrt[4]{32} \cdot \sqrt[4]{y^5} \\
 &= 5x\sqrt[4]{2^5} \cdot \sqrt[4]{y^5} \\
 &= 5x(\sqrt[4]{2^4} \cdot 2) \cdot (\sqrt[4]{y^4} \cdot \sqrt[4]{y}) \\
 &= 5x \cdot 2 \cdot y \sqrt[4]{2y} \\
 &= 10xy\sqrt[4]{2y}
 \end{aligned}$$

$$\begin{aligned}
 &7y\sqrt[4]{162} \cdot \sqrt[4]{x^4} \cdot \sqrt[4]{y} \\
 &= 7y(\sqrt[4]{3^4} \cdot 2) \cdot (\sqrt[4]{x^4}) \sqrt[4]{y} \\
 &= 7y \cdot 3 \cdot x \sqrt[4]{2y} \\
 &= 21xy\sqrt[4]{2y}
 \end{aligned}$$

$$\begin{aligned}
 &10xy\sqrt[4]{2y} - 21xy\sqrt[4]{2y} \\
 &= \underline{\underline{-11xy\sqrt[4]{2y}}}
 \end{aligned}$$

MULT .

Ex 11 $(\sqrt{5})^2 = (\sqrt{5}) \cdot (\sqrt{5}) = \sqrt{25} = 5$

Ex 12 $(3\sqrt{5})^2 = (3\sqrt{5}) \cdot (3\sqrt{5})$
 $= 3 \cdot \sqrt{5} \cdot 3 \cdot \sqrt{5}$
 $= 9 \cdot \sqrt{25}$
 $= 9 \cdot 5$
 $= 45$

Ret 1

Ret 2 : $(3\sqrt{5})^2 = (3)^2 \cdot (\sqrt{5})^2$
 $= 9 \cdot 5$
 $= 45$

Ex 13 $\sqrt{2x} (\sqrt{8x} - \sqrt{3})$

$$\begin{aligned} &= \sqrt{2x} \cdot \sqrt{8x} - \sqrt{2x} \cdot \sqrt{3} \\ &= \sqrt{(2x) \cdot (8x)} - \sqrt{(2x)(3)} \\ &= \sqrt{16x^2} - \sqrt{6x} \\ &= \sqrt{16} \sqrt{x^2} - \sqrt{6x} \\ &= 4x - \sqrt{6x} \end{aligned}$$

Ex 14

$$(2\sqrt{3} - 5)(7\sqrt{3} + 2)$$

$$= 2\sqrt{3} \cdot 7\sqrt{3} + 2\sqrt{3} \cdot 2 - 5 \cdot 7\sqrt{3} - 5 \cdot 2$$

$$= 14\sqrt{9} + 4\sqrt{3} - 35\sqrt{3} - 10$$

$$= 14 \cdot 3 + 4\sqrt{3} - 35\sqrt{3} - 10$$

$$= \underline{42} + \underline{4\sqrt{3}} - \underline{35\sqrt{3}} - \underline{10}$$

$$= \underline{\underline{32 - 31\sqrt{3}}}$$

Division :

Ex 15

$$\frac{\sqrt{5a^4b^7c^2}}{\sqrt{ab^3e}}$$

$$= \sqrt{\frac{5a^4b^7c^2}{ab^3e}}$$

$$= \sqrt{\frac{5 \overset{4}{a} \overset{7}{b} \overset{2}{c^2}}{1 \overset{1}{a} \overset{3}{b^3} \overset{1}{e}}}$$

$$= \sqrt{5 \cdot a^3 b^4 \cdot c}$$

$$= \sqrt{5} \cdot \sqrt{a^2 a} \cdot \sqrt{b^4} \cdot \sqrt{c}$$

$$= a \cdot b^2 \sqrt{5ac}$$

RATIONALIZING THE DENOMINATOR

Ex 16 $\frac{5}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} = \frac{5\sqrt{6}}{6}$

$$\sqrt{6} \cdot \sqrt{6} = \sqrt{36} = \textcircled{6}$$