

3.4



$$\begin{aligned} 1^2 &= 1 \\ 2^2 &= 4 \\ 3^2 &= 9 \\ 4^2 &= 16 \\ 5^2 &= 25 \\ 6^2 &= 36 \\ 7^2 &= 49 \\ 8^2 &= 64 \\ 9^2 &= 81 \\ 10^2 &= 100 \end{aligned}$$



$$\begin{aligned} 11^2 &= 121 \\ 12^2 &= 144 \\ 13^2 &= 169 \\ 14^2 &= 196 \\ 15^2 &= 225 \\ 16^2 &= 256 \\ 17^2 &= 289 \\ 18^2 &= 324 \\ 19^2 &= 361 \\ 20^2 &= 400 \end{aligned}$$

Simplifying Radicals:

1. $2\sqrt{48}$

$$\begin{aligned} &= 2\sqrt{16 \times 3} \\ &= 2\sqrt{16}\sqrt{3} \\ &= 2(4)\sqrt{3} = 8\sqrt{3} \end{aligned}$$

3. $\frac{1}{8}\sqrt{320}$

$$\begin{aligned} &= \frac{1}{8}\sqrt{64}\sqrt{5} \\ &= \frac{1}{8}(8)\sqrt{5} \\ &= \sqrt{5} \end{aligned}$$

2. $-\sqrt{20}$

$$\begin{aligned} &= -\sqrt{4}\sqrt{5} \\ &= -2\sqrt{5} \end{aligned}$$

4. $-3\sqrt{513}$

$$\begin{aligned} &= -3\sqrt{9}\sqrt{57} \\ &= -3(3)\sqrt{57} \\ &= -9\sqrt{57} \end{aligned}$$

$$\frac{513}{9} = 57$$

Simplifying Radicals with variables:

$$\begin{aligned} 1. \quad & 7\sqrt{288b^4} \\ &= 7\sqrt{144b^4} \sqrt{2} \\ &= 7(12b^2)\sqrt{2} \\ &= 84b^2\sqrt{2} \end{aligned}$$

$$\begin{aligned} 2. \quad & -5\sqrt{45n^3} \\ &= -5\sqrt{9n^2} \sqrt{5n} \\ &= -5(3n)\sqrt{5n} \\ &= -15n\sqrt{5n} \end{aligned}$$

$$\begin{aligned} & \sqrt{x^{23}} \\ &= \sqrt{x^{22} x^1} \\ &= x^{11} \sqrt{x} \end{aligned}$$

$$\begin{aligned} & \sqrt{x^3} \\ &= \sqrt{x^2 x^1} \\ &= x\sqrt{x} \end{aligned}$$

$$\begin{aligned} & \sqrt{x^2} = x \\ & \sqrt{x^4} = x^2 \\ & \sqrt{x^{100}} = x^{50} \end{aligned}$$

Adding and Subtracting Radicals:

① Simplify

$$\begin{aligned} 1. & -2\sqrt{12} - 3\sqrt{8} + 3\sqrt{32} + 2\sqrt{27} \\ & = -2\sqrt{4}\sqrt{3} - 3\sqrt{4}\sqrt{2} + 3\sqrt{16}\sqrt{2} + 2\sqrt{9}\sqrt{3} \\ & = \underline{-4\sqrt{3}} - \underline{6\sqrt{2}} + \underline{12\sqrt{2}} + \underline{6\sqrt{3}} \\ & = 2\sqrt{3} + 6\sqrt{2} \end{aligned}$$

$$\boxed{2x + 3x = 5x}$$

$$\begin{aligned} 2. & 2\sqrt{45} - \sqrt{8} - 2\sqrt{32} - 2\sqrt{18} \\ & = 2\sqrt{9}\sqrt{5} - \sqrt{4}\sqrt{2} - 2\sqrt{16}\sqrt{2} - 2\sqrt{9}\sqrt{2} \\ & = 6\sqrt{5} - \underline{2\sqrt{2} - 8\sqrt{2} - 6\sqrt{2}} \\ & = 6\sqrt{5} - 16\sqrt{2} \end{aligned}$$

Multiplying Radicals:

$$1. \quad 2\sqrt{6} \times 4\sqrt{5}$$

$$= 8\sqrt{30}$$

$$2. \quad -3\sqrt{10} \times 6\sqrt{2}$$

$$= -18\sqrt{20}$$

$$= -18\sqrt{4}\sqrt{5} = -36\sqrt{5}$$

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

$$= 2\sqrt{4} - 5\sqrt{6} + 2\sqrt{6} - 5\sqrt{9}$$

$$= 4 - 3\sqrt{6} - 15$$

$$= -11 - 3\sqrt{6}$$

Rationalizing the Denominator:

$$1. \frac{10}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$$
$$= \frac{10\sqrt{2}}{2} = 5\sqrt{2}$$

$$2. \frac{\sqrt{8}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{24}}{3}$$
$$= \frac{\sqrt{4} \sqrt{6}}{3}$$
$$= \frac{2\sqrt{6}}{3}$$

$$3. \frac{9\sqrt{63}}{7\sqrt{54}}$$
$$= \frac{9\sqrt{9}\sqrt{7}}{7\sqrt{9}\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}}$$
$$= \frac{9\sqrt{42}}{7(6)} = \frac{9\sqrt{42}}{42} = \frac{3\sqrt{42}}{14}$$

$$4. \frac{7+\sqrt{2}}{5\sqrt{40}}$$