

section 8.2

8.2 L1

$$56) \sqrt{80}$$

$$= \sqrt{(2)^4(5)}$$

$$= \sqrt{(2)^4} \sqrt{5}$$

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

$$= \underline{\underline{4\sqrt{5}}}$$

$$\begin{array}{r|l} 80 & \\ 40 & 2 \\ 20 & 2 \\ 10 & 2 \\ 5 & 2 \\ 1 & 5 \end{array}$$

$$58) \sqrt{96}$$

$$= \sqrt{(2)^5(3)}$$

$$= \sqrt{(2)^4} \sqrt{(2)(3)}$$

$$= (2)^2 \sqrt{(2)(3)}$$

$$= \underline{\underline{4\sqrt{6}}}$$

$$\begin{array}{r|l} 96 & \\ 48 & 2 \\ 24 & 2 \\ 12 & 2 \\ 6 & 2 \\ 3 & 2 \\ 1 & 3 \end{array}$$

$$60) \sqrt{450}$$

$$= \sqrt{(2)(3)^2(5)^2}$$

$$= \sqrt{(3)^2(5)^2} \sqrt{(2)}$$

$$= (3)(5) \sqrt{2}$$

$$= \underline{\underline{15\sqrt{2}}}$$

$$\begin{array}{r|l} 450 & \\ 225 & 2 \\ 45 & 5 \\ 9 & 5 \\ 3 & 3 \\ 1 & 3 \end{array}$$

$$62) \sqrt{675}$$

$$= \sqrt{(3)^3(5)^2}$$

$$= \sqrt{(3)^2(5)^2} \sqrt{(3)}$$

$$= (3)(5) \sqrt{3}$$

$$= \underline{\underline{15\sqrt{3}}}$$

$$\begin{array}{r|l} 675 & \\ 135 & 5 \\ 27 & 5 \\ 9 & 3 \\ 3 & 3 \\ 1 & 3 \end{array}$$

$$64-a) \sqrt[3]{625}$$

$$= \sqrt[3]{(5)^4}$$

$$= \sqrt[3]{(5)^3} \sqrt[3]{(5)}$$

$$= \underline{\underline{5\sqrt[3]{5}}}$$

$$\begin{array}{r|l} 625 & \\ 125 & 5 \\ 25 & 5 \\ 5 & 5 \\ 1 & 5 \end{array}$$

$$64-b) \sqrt[6]{128}$$

$$= \sqrt[6]{(2)^7}$$

$$= \sqrt[6]{(2)^6} \sqrt[6]{(2)}$$

$$= \underline{\underline{2\sqrt[6]{2}}}$$

$$\begin{array}{r|l} 128 & \\ 64 & 2 \\ 32 & 2 \\ 16 & 2 \\ 8 & 2 \\ 4 & 2 \\ 2 & 2 \\ 1 & 2 \end{array}$$

$$66-a) \sqrt[4]{3125}$$

$$= \sqrt[4]{(5)^5}$$

$$= \sqrt[4]{(5)^4} \sqrt[4]{(5)}$$

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

$$\begin{array}{r|l} 3125 & \\ \hline 625 & 5 \\ 125 & 5 \\ 25 & 5 \\ 5 & 5 \\ 1 & 5 \end{array}$$

$$66-b) \sqrt[3]{81}$$

$$= \sqrt[3]{(3)^4}$$

$$= \sqrt[3]{(3)^3} \sqrt[3]{(3)}$$

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

$$\begin{array}{r|l} 81 & \\ \hline 27 & 3 \\ 9 & 3 \\ 3 & 3 \\ 1 & 3 \end{array}$$

$$68-a) \sqrt{m^{13}}$$

$$= \sqrt{m^{12}} \sqrt{m^1}$$

$$= |m^6| \sqrt{m}$$

$$= \underline{\underline{m^6 \sqrt{m}}}$$

$$68-b) \sqrt[5]{u^7}$$

$$= \sqrt[5]{u^5} \sqrt[5]{u^2}$$

$$= \underline{\underline{u \sqrt[5]{u^2}}}$$

$$68-c) \sqrt[6]{v^{11}}$$

$$= \sqrt[6]{v^6} \sqrt[6]{v^5}$$

$$= \underline{\underline{|v| \sqrt[6]{v^5}}}$$

$$70-a) \sqrt{n^{25}}$$

$$= \sqrt{n^{24}} \sqrt{n^1}$$

$$= |n^{12}| \sqrt{n}$$

$$= \underline{\underline{n^{12} \sqrt{n}}}$$

$$70-b) \sqrt[5]{p^8}$$

$$= \sqrt[5]{p^5} \sqrt[5]{p^3}$$

$$= \underline{\underline{p \sqrt[5]{p^3}}}$$

$$70-c) \sqrt[4]{m^5}$$

$$= \sqrt[4]{m^4} \sqrt[4]{m^1}$$

$$= \underline{\underline{|m| \sqrt[4]{m}}}$$

$$72-a) \sqrt{80a^{15}}$$

$$= \sqrt{(2)^4(5)a^{15}}$$

$$= \sqrt{(2)^4 a^{14}} \sqrt{(5)(a)}$$

$$= |(2)^2 a^7| \sqrt{5a}$$

$$= \underline{\underline{4|a^7| \sqrt{5a}}}$$

$$72-b) \sqrt[5]{96a^7}$$

$$= \sqrt[5]{(2)^5(3)a^7}$$

$$= \sqrt[5]{(2)^5 a^5} \sqrt[5]{(3)a^2}$$

$$= \underline{\underline{2a \sqrt[5]{3a^2}}}$$

$$72-c) \sqrt[6]{128b^7}$$

$$= \sqrt[6]{(2)^7 b^7}$$

$$= \sqrt[6]{(2)^6 b^6} \sqrt[6]{(2)(b)}$$

$$= \underline{\underline{|2b| \sqrt[6]{2b}}}$$

$$\begin{aligned}
 74-a) \sqrt{175 n^{13}} \\
 &= \sqrt{(5)^2 (7) n^{13}} \\
 &= \sqrt{(5)^2 n^{12}} \sqrt{(7)(n)} \\
 &= |5 n^6| \sqrt{7n} \\
 &= \underline{\underline{5 n^6 \sqrt{7n}}}
 \end{aligned}$$

$$\begin{aligned}
 74-b) \sqrt[5]{512 p^5} \\
 &= \sqrt[5]{(2)^9 p^5} \\
 &= \sqrt[5]{(2)^5 p^5} \sqrt[5]{(2)^4} \\
 &= \underline{\underline{2 p \sqrt[5]{16}}}
 \end{aligned}$$

$$\begin{aligned}
 74-c) \sqrt[4]{324 q^7} \\
 &= \sqrt[4]{(2)^2 (3)^4 q^7} \\
 &= \sqrt[4]{(3)^4 q^4} \sqrt[4]{(2)^2 q^3} \\
 &= |3 q| \sqrt[4]{4 q^3} \\
 &= \underline{\underline{3 |q| \sqrt[4]{4 q^3}}}
 \end{aligned}$$

$$\begin{aligned}
 76-a) \sqrt{96 r^3 s^3} \\
 &= \sqrt{(2)^5 (3) r^3 s^3} \\
 &= \sqrt{(2)^4 r^2 s^2} \sqrt{(2)(3) r s} \\
 &= |(2)^2 r s| \sqrt{6 r s} \\
 &= \underline{\underline{4 |rs| \sqrt{6 rs}}}
 \end{aligned}$$

$$\begin{aligned}
 76-b) \sqrt[3]{80 x^7 y^6} \\
 &= \sqrt[3]{(2)^4 (5) x^7 y^6} \\
 &= \sqrt[3]{(2)^3 x^6 y^6} \sqrt[3]{(2)(5) x} \\
 &= \underline{\underline{2 x^2 y^2 \sqrt[3]{10 x}}}
 \end{aligned}$$

$$\begin{aligned}
 76-c) \sqrt[4]{80 x^8 y^9} \\
 &= \sqrt[4]{(2)^4 (5) x^8 y^9} \\
 &= \sqrt[4]{(2)^4 x^8 y^8} \sqrt[4]{(5) y} \\
 &= |2 x^2 y^2| \sqrt[4]{5 y} \\
 &= \underline{\underline{2 x^2 y^2 \sqrt[4]{5 y}}}
 \end{aligned}$$

$$\begin{aligned}
 78-a) \sqrt{150 m^9 n^3} \\
 &= \sqrt{(2)(3)(5)^2 m^9 n^3} \\
 &= \sqrt{(5)^2 m^8 n^2} \sqrt{(2)(3) m n} \\
 &= |5 m^4 n| \sqrt{6 m n} \\
 &= \underline{\underline{5 m^4 |n| \sqrt{6 m n}}}
 \end{aligned}$$

$$\begin{aligned}
 78-b) \sqrt[3]{81 p^7 q^8} \\
 &= \sqrt[3]{(3)^4 p^7 q^8} \\
 &= \sqrt[3]{(3)^3 p^6 q^6} \sqrt[3]{(3) p q^2} \\
 &= \underline{\underline{3 p^2 q^2 \sqrt[3]{3 p q^2}}}
 \end{aligned}$$

$$\begin{aligned}
 78-c) \sqrt[4]{162 c^{11} d^{12}} \\
 &= \sqrt[4]{(2)(3)^4 c^{11} d^{12}} \\
 &= \sqrt[4]{(3)^4 c^8 d^{12}} \sqrt[4]{(2) c^3} \\
 &= |3 c^2 d^3| \sqrt[4]{2 c^3} \\
 &= \underline{\underline{3 c |d^3| \sqrt[4]{2 c^3}}}
 \end{aligned}$$

$$80-a) \sqrt[5]{-486}$$

$$= \sqrt[5]{(2)(-3)^5}$$

$$= \sqrt[5]{(-3)^5} \sqrt[5]{2}$$

$$= \underline{\underline{-3 \sqrt[5]{2}}}$$

486	
243	2
81	3
27	3
9	3
3	3
1	3

$$80-b) \sqrt[6]{-64}$$

even root

not a real number

$$82-a) \sqrt[3]{-8} = \sqrt[3]{(-2)^3} = \underline{\underline{-2}}$$

$$82-b) \sqrt[4]{-16} \text{ even root not a real number}$$

$$84-a) 8 + \sqrt{96}$$

$$= 8 + \sqrt{(2)^5(3)}$$

$$= 8 + \sqrt{(2)^4} \sqrt{(2)(3)}$$

$$= 8 + (2)^2 \sqrt{6}$$

$$= \underline{\underline{8 + 4\sqrt{6}}}$$

$$84-b) \frac{10 - \sqrt{24}}{2}$$

$$= \frac{10 - \sqrt{(2)^3(3)}}{2}$$

$$= \frac{10 - \sqrt{(2)^2} \sqrt{(2)(3)}}{2} = \frac{10 - 2\sqrt{6}}{2}$$

$$= \frac{2(5 - \sqrt{6})}{2} = \underline{\underline{5 - \sqrt{6}}}$$

$$86-a) 3 + \sqrt{125}$$

$$= 3 + \sqrt{(5)^3}$$

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

$$= \underline{\underline{3 + 5\sqrt{5}}}$$

$$86-b) \frac{15 + \sqrt{75}}{5} = \frac{15 + \sqrt{(3)(5)^2}}{5}$$

$$= \frac{15 + \sqrt{(5)^2} \sqrt{3}}{5} = \frac{15 + 5\sqrt{3}}{5}$$

$$= \frac{5(3 + \sqrt{3})}{5} = \underline{\underline{3 + \sqrt{3}}}$$

$$88-a) \sqrt{\frac{72}{98}} = \sqrt{\frac{36}{49}} = \frac{\sqrt{36}}{\sqrt{49}} = \underline{\underline{\frac{6}{7}}}$$

$$88-b) \sqrt[3]{\frac{24}{81}} = \sqrt[3]{\frac{8}{27}} = \frac{\sqrt[3]{8}}{\sqrt[3]{27}} = \underline{\underline{\frac{2}{3}}}$$

$$88-c) \sqrt[4]{\frac{6}{96}} = \sqrt[4]{\frac{1}{16}} = \frac{\sqrt[4]{1}}{\sqrt[4]{16}} = \underline{\underline{\frac{1}{4}}}$$

$$90-a) \sqrt{\frac{121}{16}} = \frac{\sqrt{121}}{\sqrt{16}} = \underline{\underline{\frac{11}{4}}}$$

$$90-b) \sqrt[3]{\frac{16}{250}} = \sqrt[3]{\frac{8}{125}} = \frac{\sqrt[3]{8}}{\sqrt[3]{125}} = \underline{\underline{\frac{2}{5}}}$$

$$90-c) \sqrt[4]{\frac{32}{162}} = \sqrt[4]{\frac{16}{81}} = \frac{\sqrt[4]{16}}{\sqrt[4]{81}} = \underline{\underline{\frac{2}{3}}}$$

$$92-a) \sqrt{\frac{p^{20}}{p^{10}}} = \sqrt{p^{10}} = \underline{\underline{|p^5|}}$$

$$92-b) \sqrt[5]{\frac{d^{12}}{d^7}} = \sqrt[5]{d^5} = \underline{\underline{d}}$$

$$92-c) \sqrt[8]{\frac{m^{12}}{m^4}} = \sqrt[8]{m^8} = \underline{\underline{|m|}}$$

$$94-a) \sqrt{\frac{q^8}{q^{14}}} = \sqrt{\frac{1}{q^6}} = \frac{\sqrt{1}}{\sqrt{q^6}} = \underline{\underline{\frac{1}{|q^3|}}}$$

$$94-b) \sqrt[3]{\frac{n^{14}}{n^5}} = \sqrt[3]{n^9} = \underline{\underline{n^3}}$$

$$94-c) \sqrt[4]{\frac{c^{21}}{c^9}} = \sqrt[4]{c^{12}} = \underline{\underline{|c^3|}}$$

$$96) \sqrt{\frac{108y^4}{49}} = \frac{\sqrt{108y^4}}{\sqrt{49}} = \frac{\sqrt{36y^4} \sqrt{3}}{\sqrt{49}} = \frac{6y^2\sqrt{3}}{7}$$

$$98) \sqrt{\frac{125n^7}{169}} = \frac{\sqrt{125n^7}}{\sqrt{169}} = \frac{\sqrt{25n^6} \sqrt{5n}}{\sqrt{169}} = \frac{5/n^3/\sqrt{5n}}{13}$$

$$100) \sqrt{\frac{180a^{10}}{144}} = \frac{\sqrt{180a^{10}}}{\sqrt{144}} = \frac{\sqrt{36a^{10}} \sqrt{5}}{\sqrt{144}} = \frac{6/a^5/\sqrt{5}}{12}$$

$$102) \sqrt{\frac{150n^3}{256}} = \frac{\sqrt{150n^3}}{\sqrt{256}} = \frac{\sqrt{25n^2} \sqrt{6n}}{\sqrt{(2)^8}} = \frac{5/n/\sqrt{6n}}{(2)^4} = \frac{5/n/\sqrt{6n}}{16}$$

$$104-a) \sqrt{\frac{72x^5}{y^6}} = \frac{\sqrt{72x^5}}{\sqrt{y^6}} = \frac{\sqrt{36x^4} \sqrt{2x}}{\sqrt{y^6}} = \frac{6x^2\sqrt{2x}}{|y^3|}$$

$$104-b) \sqrt[5]{\frac{96n^{11}}{a^5}} = \frac{\sqrt[5]{96n^{11}}}{\sqrt[5]{a^5}} = \frac{\sqrt[5]{(2)^5 n^{10}} \sqrt[5]{3n}}{\sqrt[5]{a^5}} = \frac{2n^2 \sqrt[5]{3n}}{a}$$

$$104-c) \sqrt[6]{\frac{128u^7}{v^{12}}} = \frac{\sqrt[6]{128u^7}}{\sqrt[6]{v^{12}}} = \frac{\sqrt[6]{(2)^7 u^7}}{\sqrt[6]{v^{12}}} = \frac{\sqrt[6]{(2)^6 u^6} \sqrt[6]{(2)u}}{\sqrt[6]{v^{12}}} = \frac{2/u/\sqrt[6]{2u}}{v^2}$$

$$106-a) \sqrt{\frac{45n^3}{a^{10}}} = \frac{\sqrt{45n^3}}{\sqrt{a^{10}}} = \frac{\sqrt{9n^2} \sqrt{5n}}{\sqrt{a^{10}}} = \frac{3/n/\sqrt{5n}}{|a^5|}$$

$$106-b) \sqrt[3]{\frac{625u^{10}}{v^3}} = \frac{\sqrt[3]{625u^{10}}}{\sqrt[3]{v^3}} = \frac{\sqrt[3]{(5)^4 u^{10}}}{\sqrt[3]{v^3}} = \frac{\sqrt[3]{(5)^3 u^9} \sqrt[3]{(5)u}}{\sqrt[3]{v^3}} = \frac{5u^3 \sqrt[3]{5u}}{v}$$

$$106-c) \sqrt[4]{\frac{729c^{21}}{d^8}} = \frac{\sqrt[4]{729c^{21}}}{\sqrt[4]{d^8}} = \frac{\sqrt[4]{(3)^6 c^{21}}}{\sqrt[4]{d^8}} = \frac{\sqrt[4]{(3)^4 c^{20}} \sqrt[4]{(3)^2 c}}{\sqrt[4]{d^8}} = \frac{3|c^5| \sqrt[4]{9c}}{d^2}$$

$$108-a) \sqrt{\frac{75r^6 s^8}{48rs^4}} = \sqrt{\frac{25r^5 s^4}{16}} = \frac{\sqrt{25r^5 s^4}}{\sqrt{16}} = \frac{\sqrt{25r^4 s^4} \sqrt{r}}{\sqrt{16}} = \frac{5r^2 s^2 \sqrt{r}}{4}$$

$$108-b) \sqrt[3]{\frac{24x^8 y^4}{81x^2 y}} = \sqrt[3]{\frac{8x^6 y^3}{27}} = \frac{\sqrt[3]{8x^6 y^3}}{\sqrt[3]{27}} = \frac{2x^2 y}{3}$$

$$108-c) \sqrt[4]{\frac{32m^9 n^2}{162mn^2}} = \sqrt[4]{\frac{16m^8}{81}} = \frac{\sqrt[4]{16m^8}}{\sqrt[4]{81}} = \frac{2m^2}{3}$$

$$110-a) \sqrt{\frac{50r^5 s^2}{128r^2 s^6}} = \sqrt{\frac{25r^3}{64s^4}} = \frac{\sqrt{25r^3}}{\sqrt{64s^4}} = \frac{\sqrt{25r^2} \sqrt{r}}{\sqrt{64s^4}} = \frac{5|r/\sqrt{r}}{8s^2}$$

$$110-b) \sqrt[3]{\frac{24m^9 n^7}{375m^4 n}} = \sqrt[3]{\frac{8m^5 n^6}{125}} = \frac{\sqrt[3]{8m^5 n^6}}{\sqrt[3]{125}} = \frac{\sqrt[3]{8m^3 n^6} \sqrt[3]{m^2}}{\sqrt[3]{125}} = \frac{2mn^2 \sqrt[3]{m^2}}{5}$$

$$110-c) \sqrt[4]{\frac{81m^2 n^8}{256m^1 n^2}} = \sqrt[4]{\frac{81mn^6}{256}} = \frac{\sqrt[4]{81mn^6}}{\sqrt[4]{256}} = \frac{\sqrt[4]{81n^4} \sqrt[4]{mn^2}}{\sqrt[4]{(2)^8}} = \frac{3n \sqrt[4]{mn^2}}{(2)^2} = \frac{3n \sqrt[4]{mn^2}}{4}$$

$$112-a) \frac{\sqrt{80q^5}}{\sqrt{5q}} = \sqrt{\frac{80q^5}{5q}} = \sqrt{\frac{16q^4}{1}} = \sqrt{16q^4} = \underline{\underline{4q^2}}$$

$$112-b) \frac{\sqrt[3]{-625}}{\sqrt[3]{5}} = \sqrt[3]{\frac{-625}{5}} = \sqrt[3]{\frac{-125}{1}} = \sqrt[3]{-125} = \underline{\underline{-5}}$$

$$112-c) \frac{\sqrt[4]{80m^7}}{\sqrt[4]{5m}} = \sqrt[4]{\frac{80m^7}{5m}} = \sqrt[4]{\frac{16m^6}{1}} = \sqrt[4]{16m^6} = \sqrt[4]{16m^4} \sqrt[4]{m^2} \\ = \underline{\underline{2|m| \sqrt[4]{m^2}}}$$

$$114-a) \frac{\sqrt{72n''}}{\sqrt{2n}} = \sqrt{\frac{72n''}{2n}} = \sqrt{\frac{36n^{10}}{1}} = \sqrt{36n^{10}} = \underline{\underline{6|n^5|}}$$

$$114-b) \sqrt[3]{\frac{162}{6}} = \sqrt[3]{\frac{27}{1}} = \sqrt[3]{27} = \underline{\underline{3}}$$

$$114-c) \sqrt[4]{\frac{160r^{10}}{5r^3}} = \sqrt[4]{\frac{32r^7}{1}} = \sqrt[4]{32r^7} = \sqrt[4]{16r^4} \sqrt[4]{2r^3} \\ = \underline{\underline{2|r| \sqrt[4]{2r^3}}}$$