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Chapter 5 Review Answers

For each type of question, the achievement level is indicated. Showing work is an important strategy in communicating your knowledge and ideas so please be thorough.

Learning Goal 5.1	Express an entire radical as a simplified mixed radical and vice versa. Identify and order irrational numbers.

Developing	**Proficient**	**Extending**
1. Write each radical in simplest form, **without a calculator**.		
a. $\sqrt{125} = 5\sqrt{5}$	b. $\sqrt[3]{216} = 6$	c. $\sqrt{216k^3} = 6k\sqrt{6k}$
d. $\sqrt{512} = 2^4\sqrt{2} = 16\sqrt{2}$	e. $\sqrt[4]{405} = 3\sqrt[4]{5}$	f. $\sqrt[3]{-96xy^4} = 2y\sqrt[3]{-12xy}$
g. $\sqrt{80} = 4\sqrt{5}$	h. $\sqrt[3]{-100} = \sqrt[3]{-100}$	i. $\sqrt[4]{48m^5n^4} = 2mn\sqrt[4]{3m}$
j. $\sqrt{147} = 7\sqrt{3}$	k. $\sqrt[3]{80} = 2\sqrt[3]{10}$	l. $\sqrt[5]{a^7b^{10}c^2d^{12}} = ab^2d^2\sqrt[5]{a^2c^2d^2}$

Developing	**Proficient**	**Extending**
2. Write each mixed radical as an entire radical, **without a calculator**.		
a. $2\sqrt{3} = \sqrt{2^2 \times 3} = \sqrt{12}$	b. $-2\sqrt[3]{8} = \sqrt[3]{-2^3 \times 8} = \sqrt[3]{-64}$	c. $12\sqrt{k^3} = \sqrt{12^2k^3} = \sqrt{144k^3}$
d. $3\sqrt{5} = \sqrt{3^2 \times 5} = \sqrt{45}$	e. $5\sqrt[4]{2} = \sqrt[4]{2 \times 5^4} = \sqrt[4]{1250}$	f. $-xy\sqrt[3]{9xy^4} = \sqrt[3]{(-xy)^3 \times 9xy^4} = \sqrt[3]{-9x^4y^7}$
g. $6\sqrt{3} = \sqrt{3 \times 6^2} = \sqrt{108}$	h. $6\sqrt[3]{10} = \sqrt[3]{6^3 \times 10} = \sqrt[3]{2\,160}$	i. $-3m\sqrt[4]{4mn^4} = \sqrt[4]{(-3m)^4 \times 4mn^4} = \sqrt[4]{324m^5n^4}$
j. $4\sqrt{2} = \sqrt{2 \times 4^2} = \sqrt{32}$	k. $-8\sqrt[3]{8} = \sqrt[3]{8 \times -8^3} = \sqrt[3]{-4\,096}$	l. $a^2d^3\sqrt[5]{a^3b^5c^2} = \sqrt[5]{(a^2d^3)^5 \times a^3b^5c^2} = \sqrt[5]{a^{13}b^5c^2d^{15}}$

Extending
3. Simplify the radical. $\sqrt[n]{3 \times 2^n \times x^{2n}y^{n+3}}$ $2x^2y\sqrt[n]{3y^3}$
4. Write the mixed radical as an entire radical. $2ab^2 \times \sqrt[n]{5ab^2}$ $\sqrt[n]{(2ab^2)^n \times 5ab^2} = \sqrt[n]{2^n \times 5 \times a^{n+1}b^{2n+2}}$

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Proficient	
5. Use a number line to order these numbers from least to greatest, **without a calculator**.	
a. $\sqrt{25}, \sqrt[3]{30}\ \sqrt[3]{-8}, \sqrt[4]{20}, \sqrt{\frac{144}{9}}$ $\sqrt[3]{-8}, \sqrt[4]{20}, \sqrt[3]{30}\,, \sqrt{\frac{144}{9}}, \sqrt{25}$	b. $\sqrt[5]{-243}, \sqrt{4}, \sqrt[3]{\frac{27}{216}}, \sqrt{12}, \sqrt[3]{6}$ $\sqrt[5]{-243}, \sqrt[3]{\frac{27}{216}}, \sqrt[3]{6}, \sqrt{4}, \sqrt{12}$
c. $3\sqrt{28}, \sqrt{45}\,, 5\sqrt{20}, 2\sqrt{32}, 8\sqrt{3}$ $\sqrt{45}, 2\sqrt{32}, 8\sqrt{3}, 3\sqrt{28}, 5\sqrt{20},$	d. $-4\sqrt{6}, -\sqrt{75}\,, -3\sqrt{20}, -5\sqrt{10}, -6\sqrt{2}$ $-5\sqrt{10}, -3\sqrt{20}, -4\sqrt{6}, -\sqrt{75}\,, -6\sqrt{2}$

Developing		
6. Simplify. State restrictions on the variable, where applicable.		
a. $5\sqrt{6} - 2\sqrt{6} = 3\sqrt{6}$	b. $9\sqrt{5} - 5\sqrt{5} = 4\sqrt{5}$	c. $9\sqrt{x} - 15\sqrt{x} = -6\sqrt{x}$ $x \geq 0$
d. $6\sqrt{a} + 5\sqrt{a} - 11\sqrt{a} = 0$ $a \geq 0$	e. $5\sqrt{q} + 3\sqrt{q} - 4\sqrt{q}$ $= 4 \times \sqrt{q}$ $q \geq 0$	f. $2\sqrt{x} - 3\sqrt{y} + 5\sqrt{x} + 2\sqrt{y}$ $= 7 \times \sqrt{x} - \sqrt{y}$ $x, y \geq 0$
g. $7\sqrt{m} + 2\sqrt{n} + 5\sqrt{n} - 3\sqrt{m} = 4\sqrt{m} + 7\sqrt{n}$ $m, n \geq 0$		h. $2\sqrt[3]{3b} + 8\sqrt{3b} - 9\sqrt[3]{3b} + 3\sqrt{3b}$ $= -7\sqrt[3]{3b} + 11\sqrt{3b}$ $b \geq 0$
Proficient		
i. $\sqrt[3]{128} - \sqrt[3]{16} - \sqrt[3]{54}$ $= -\sqrt[3]{2}$	j. $\sqrt[3]{24} - \sqrt[3]{192} - \sqrt[3]{375}$ $= -7 \times \sqrt[3]{3}$	k. $\sqrt{20} + \sqrt{18} + \sqrt{45} - \sqrt{50}$ $= 5 \times \sqrt{5} - 2 \times \sqrt{2}$
l. $\sqrt{63} + \sqrt{40} - \sqrt{90} - \sqrt{28}$ $= \sqrt{7} - \sqrt{10}$	m. $\sqrt{25a^2b} + \sqrt{4a^2b} = 7a\sqrt{b}$ $a \in \mathbb{R}, b \geq 0$	n. $\sqrt[4]{81p^3q^5} - 2\sqrt[4]{p^3q^5}$ $= q \times \sqrt[4]{p^3q}$ $p, q \geq 0$
o. $5\sqrt{8x^3} + 4y\sqrt{75y^3} - 2\sqrt{27y^5} - 3x\sqrt{50x}$ $= 14y^2 \times \sqrt{3y} - 5x \times \sqrt{2x}$ $x, y \geq 0$		p. $2\sqrt[3]{-3b} + 8\sqrt{-3b} - 9\sqrt[3]{-3b} + 3\sqrt{-3b}$ $= -7 \times \sqrt[3]{-3b} + 11 \times \sqrt{-3b}$ $b \leq 0$
q. $3\sqrt{32a^5} - 2\sqrt{45b^3} + 5b\sqrt{125b} - 2a\sqrt{72a^3}$ $= 19b \times \sqrt{5b}$ $a, b \geq 0$		r. $3\sqrt{x^3} + 5\sqrt{2x} - \sqrt{4x^3} = x\sqrt{x} + 5\sqrt{2x}$ $x \geq 0$

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Chapter 5 Review Answers

For each type of question, the achievement level is indicated. Showing work is an important strategy in communicating your knowledge and ideas so please be thorough.

Learning Goal 5.2	Evaluate expressions with fractional and negative exponents. Connect fractional exponents to radicals, and negative exponents to reciprocals.

Developing		
1. Simplify each power, to a mixed radical where appropriate, **without a calculator**.		
a. $20^{1/2} = 2\sqrt{5}$	b. $12^{1/2} = 2\sqrt{3}$	c. $15^{1/3} = \sqrt[3]{15}$
d. $18^{1/3} = \sqrt[3]{18}$	e. $32^{1/2} = 4\sqrt{2}$	f. $\left(\frac{2}{3}\right)^{-4} = \frac{81}{16}$
g. $\left(\frac{1}{10}\right)^{-2} = 100$	h. $\left(\frac{5}{2}\right)^{-3} = \frac{8}{125}$	i. $\left(\frac{6}{2}\right)^{-4} = \frac{1}{81}$
Proficient		
j. $18^{2/3} = 3 \times \sqrt[3]{12}$	k. $32^{4/3} = 64\sqrt[3]{4}$	l. $50^{3/2} = 125 \times \sqrt{2}$
m. $125^{2/3} = 25$	n. $27^{5/3} = 243$	o. $0.5^{-2} = 4$
p. $\left(\frac{1}{4}\right)^{-1/2} = 2$	q. $(-1000)^{-2/3} = \frac{1}{100}$	r. $(-0.008)^{-4/3} = 625$
s. $(0.6)^{-3} = \frac{125}{27}$	t. $(0.75)^{-3.5} = \frac{64 \times \sqrt{3}}{81}$	u. $(0.75)^{-3/2} = \frac{8 \times \sqrt{3}}{9}$
Extending		
v. $((25^9 \times 5^{-8})^3)^{-2} = \frac{1}{5^{60}}$	w. $(3^{-4} \times 81^2)^{-6} = \frac{1}{3^{24}}$	x. $((p^{-3} \times p^{-8})^{-2})^5 = p^{110}$
y. $\left(-\left(\frac{64^{-3}}{16^3}\right)^2\right)^{-3} = -2^{198}$	z. $\left(\frac{k^5}{k^{-9}}\right)^2 \Big/ k^{10} = k^{18}$	aa. $-\left(\frac{b^{-2}}{b^x}\right)^4 = -\frac{1}{b^{4(x+2)}}$

Developing		
2. Express each radical as a power.		
a. $\sqrt{17^3} = 17^{3/2}$	b. $\sqrt[4]{15^5} = 15^{5/4}$	c. $\sqrt[2]{12^6} = 12^2$
d. $\sqrt{(4x^2)^3} = 8x^3$	e. $\sqrt[3]{64x^6} = 4x^2$	f. $\left(\sqrt[4]{81a^8}\right)^2 = 9a^4$

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Chapter 5 Review Answers

Proficient	Extending
3. Write each power as a radical in **two different ways**.	Write each power as a radical in **two different ways**, then write in simplest form **without a calculator**.
a. $26^{2/5} = \sqrt[5]{26^2} = \left(\sqrt[5]{26}\right)^2$	b. $20^{2/3} = \sqrt[3]{20^2} = \left(\sqrt[3]{20}\right)^2 = 2 \times \sqrt[3]{50}$
c. $19^{3/4} = \sqrt[4]{19^3} = \left(\sqrt[4]{19}\right)^3$	d. $25^{2/3} = \sqrt[3]{25^2} = \left(\sqrt[3]{25}\right)^2 = 5 \times \sqrt[3]{5}$
e. $6^{5/2} = \sqrt{6^5} = \left(\sqrt{6}\right)^5$	f. $(9n^4)^{3/2} = \sqrt{(9n^4)^3} = \left(\sqrt{9n^4}\right)^3 = 27n^6$
g. $40^{2/3} = \sqrt[3]{40^2} = \left(\sqrt[3]{40}\right)^2$	h. $(40a^3b^4)^{2/3}$ $= \sqrt[3]{(40a^3b^4)^2} = \left(\sqrt[3]{40a^3b^4}\right)^2 = 4a^2b^2 \times \sqrt[3]{25b^2}$
i. $3^{5/4} = \sqrt[4]{3^5} = \left(\sqrt[4]{3}\right)^5$	j. $(72p^3q)^{5/2}$ $= \sqrt{(72p^3q)^5} = \left(\sqrt{72p^3q}\right)^5 = 2^7 3^5 p^7 q^2 \times \sqrt{2pq}$

Extending
Suppose you want \$5000 in three years. The interest rate for a savings account is 2.9% compounded annually. The money, *P* dollars, you must invest now is given by the formula $P = 5000(1.029)^{-3}$ How much must you invest now to have \$5000 in three years? $\$4589.06$

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Chapter 5 Review Answers

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Learning Goal 5.3	Apply order of operations to radical expressions.

Proficient	**Extending**
1. Simplify **without using a calculator**. Your answers should contain only positive, whole number exponents.	
a. $2m^2 \times 2m^3 = 4m^5$	b. $(x^{-2}x^{-3})^4 = \frac{1}{x^{20}}$
c. $m^4 \times 2m^{-3} = 2m$	d. $(n^4)^{-1/3} \times 2n^{-1} = \frac{2 \times \sqrt[3]{n^2}}{n^3}$
e. $\frac{a^3}{a^5} \times a^{-2} = \frac{1}{a^4}$	f. $x^2y^{-4} \times (xy)^2 = \frac{x^4}{y^2}$
g. $4n^4 \times 2n^{-3} = 8n$	h. $(2x^4y^{-3})^{-1} = \frac{y^3}{2x^4}$
i. $\frac{2x^4y^{-4}z^{-3}}{3x^2y^{-3}z^4} = \frac{2x^2}{3yz^7}$	j. $\frac{(20a^2b^5)^{-1/2}}{2ab^3} = \frac{\sqrt{5b}}{20a^2b^6}$
k. $2x^3y^{-3} \times 2x^{-1}y^3 = 4x^2$	l. $\left(\frac{x^2y}{y^{-2}}\right)^{-2} = \frac{1}{x^4y^6}$
m. $2y^{5/2} \times 3y^{-3} = \frac{6 \times \sqrt{y}}{y}$	n. $ba^4 \times (2b^6a^3)^{-3/2} = \frac{\sqrt{2a}}{4ab^8}$
o. $4v^3 \times v^{-1/3}u^{-2} = \frac{4v^2 \times \sqrt[3]{v^2}}{u}$	p. $\frac{(2x^{-3}z^2)^3}{x^3y^4z^2 \times x^{-4}z^3} = \frac{8z}{x^8y^4}$
q. $4a^3b^2 \times 3a^{-4}b^{-3} = \frac{12}{ab}$	r. $\frac{(32pm^{-1})^{-1/4} \times 2m^{-1}p^3}{2pq^2} = \frac{p \times \sqrt[4]{8mp^3}}{4mq^2}$
s. $\frac{2y^3 \times 3xy^3}{3x^2y^4} = \frac{2y^2}{x}$	t. $(m \times m^{-2} \times n^{5/3})^2 = \frac{n^3 \times \sqrt[3]{n}}{m^2}$
u. $4r^{-3} \times 2r^2 = \frac{8}{r}$	v. $\left(\frac{x^{1/2}y^{-2}}{x^2y^{1/2}}\right)^4 = \frac{1}{x^6y^{10}}$
w. $\frac{3m^{-4}}{m^3} = \frac{3}{m^7}$	x. $\frac{(x^3y^2)^{3/2}}{(x^{-1}y^{-2/3})^{1/4}} = x^4y^3\sqrt[4]{x^3}\sqrt[6]{y}$ $= x^4y^3 \times \sqrt[12]{x^9y^2}$
y. $2k^4 \times 4k = 8k^5$	z. $\frac{(x^{-1/2}y^2)^{-5/4}}{x^2y^{1/2}} = \frac{\sqrt[8]{x^5}}{x^2y^3}$

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Chapter 5 Review Answers

Developing			
4. Simplify each expression **without a calculator**. Your answers should contain only positive, whole number exponents.			
a. $0.5x^{-2} = \frac{1}{2x^2}$	b. $\left(\frac{a^2}{9}\right)^{-1/2} = \frac{3}{a}$	c. $(-8q^6)^{-2/3} = \frac{1}{4q^4}$	d. $(-0.027m^3)^{-4/3} = \frac{10\,000}{81m^4}$
Proficient			
e. $(12x^3y^2)^{1/2} = 2xy \times \sqrt{3x}$	f. $(18a^2b^5)^{2/3} = 3ab^3 \times \sqrt[3]{12ab}$	g. $(32m^2n^8)^{3/4} = 8mn^6 \times \sqrt[4]{8m^2}$	h. $(81^{-3} \times 27^5)^{-2} = \frac{1}{3^6}$
i. $(64p^5q^9)^{4/3} = 2^8p^6q^{12} \times \sqrt[3]{p^2}$		j. $3xy\left(\frac{x^2}{y^2}\right)^{-1/2} = 3y^2$	
Extending			
k. $\frac{(9a^3b^6)^{-1/2}}{(3a^3b^6)^{-2}} = 3a^4b^9 \times \sqrt{a}$		l. $(8x^{n+2}y^{n+1})^{2/n} = x^2y^2 \times \sqrt[n]{2^6x^4y^2}$	

Developing	Proficient	Extending
1. Simplify the products/quotients where possible. State any restrictions on the variable, if any.		
a. $\sqrt{6}(\sqrt{5}+2) = \sqrt{30}+2\sqrt{6}$	b. $\frac{2}{\sqrt{3}} = \frac{2\sqrt{3}}{3}$	c. $\frac{2\sqrt{5}+4}{\sqrt{5}} = \frac{10+4\sqrt{5}}{5}$
d. $\sqrt{5}(\sqrt{2}-4) = \sqrt{10}-4\sqrt{5}$	e. $\frac{1}{5\sqrt{3}} = \frac{\sqrt{3}}{15}$	f. $\frac{5\sqrt{8}-2\sqrt{5}}{\sqrt{6}} = \frac{10\sqrt{3}-\sqrt{30}}{3}$
g. $\sqrt{2}(-7+\sqrt{2}) = -7\sqrt{2}+2$	h. $(\sqrt{3}+8)(2\sqrt{3}-1)-\sqrt{3}(7\sqrt{3}) = 15\sqrt{3}-23$	i. $\frac{-3\sqrt{12}+2\sqrt{3}}{\sqrt{18}} = \frac{-2\sqrt{3}}{3}$
j. $-\sqrt{3}(3+\sqrt{8}) = -3\sqrt{3}+2\sqrt{6}$	k. $(\sqrt{5}-2)^2 = 9-4\sqrt{5}$	l. $\frac{4\sqrt{2}-6\sqrt{5}}{2\sqrt{3}} = \frac{2\sqrt{6}-3\sqrt{15}}{3}$
m. $\sqrt{6}(\sqrt{3}+\sqrt{2}) = 3\sqrt{2}+2\sqrt{3}$	n. $(2\sqrt{x}-3\sqrt{y})(4\sqrt{y}-3\sqrt{x}) = 17\sqrt{xy}-6x-12y$	o. $\frac{1}{\sqrt{5}}-\frac{1}{\sqrt{3}} = \frac{3\sqrt{5}-5\sqrt{3}}{15}$
p. $\sqrt{w}(2\sqrt{w}+3) = 2w+3\sqrt{w}$	q. $(3\sqrt{m}-3\sqrt{n})(3\sqrt{m}+3\sqrt{n}) = 9m-9n$	r. $\frac{\sqrt{2}}{\sqrt{12}}-\frac{5\sqrt{3}}{\sqrt{8}} = \frac{-13\sqrt{6}}{12}$
s. $5(2\sqrt{7}-3\sqrt{5}) = 10\sqrt{7}-15\sqrt{5}$	t. $\frac{\sqrt{40}}{2\sqrt{4}} = \frac{\sqrt{10}}{2}$	u. $\frac{2\sqrt{x}+3\sqrt{y}}{\sqrt{x}-\sqrt{y}} = \frac{2x+5\sqrt{xy}+3y}{x-y}$

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For each type of question, the achievement level is indicated. Showing work is an important strategy in communicating your knowledge and ideas so please be thorough.

Learning Goal 5.4	Solve radical equations, identifying extraneous roots and restrictions to the domain.

Proficient		
1. Solve each equation. Verify the solution(s).		
a. $3\sqrt{x} = 5, x \geq 0$ $x = \frac{25}{9}$	b. $4\sqrt{x+1} - 5 = 3, x \geq -1$ $x = 3$	c. $3 = 4\sqrt{x}, x \geq 0$ $x = \frac{9}{16}$
d. $13 = 2\sqrt{x+1} - 7,$ $x \geq -1$ $x = 99$	e. $3\sqrt{x} - 4 = 2\sqrt{x} + 1, x \geq 0$ $x = 25$	f. $4\sqrt{x} + 3 = 5\sqrt{x} + 1, x \geq 0$ $x = 4$
g. $\sqrt{x-2} = 5, x \geq 2$ $x = 25$	h. $3 = \sqrt{2x+1}, x \geq -\frac{1}{2}$ $x = 4$	i. $9 = \sqrt{121 - 2x}, x \leq \frac{121}{2}$
Extending		
j. $\sqrt{5x+3} = \sqrt{3x} + 1, x \geq 0$ No real solutions	k. $\sqrt{-3x+7} = \sqrt{-2x+9},$ $x \leq \frac{7}{3}$ $x = -2$	l. $4 - 5\sqrt{6x} = -5 - 4\sqrt{6x},$ $x \geq 0$ $x = \frac{27}{2}$
m. $\sqrt{2x+4} - \sqrt{x} = 2,$ $x \geq 0$ $x = 0, 16$	n. $\sqrt{x-5} - \sqrt{x+10} = -3,$ $x \geq 5$ $x = 6$	o. $\sqrt{y+12} - 2 = \sqrt{y}, y \geq 0$ $y = 4$

Extending
2. John solves the equation $\sqrt{x+6} - x = 4$. He determines two solutions: $x = -2$ and $x = -5$. Identify whether either of these values is extraneous. $x = 5$
3. The equation $t = \sqrt{\frac{d}{4.9}}$ describes the time, *t*, in seconds, for an object to fall from a height of *d* metres. Determine the original height of an object that takes 4.3 s to reach the ground. Express the answer to the nearest tenth of a metre. 86.9 m

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