Name: _____ Date: _____

Chapter 4 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 4.1	Identify and order irrational numbers.

- Tell whether each number is rational or irrational.
- For those that are irrational, estimate the value of the radical to **one decimal place, without a calculator**.
- For those that are rational, evaluate the radical **without a calculator**. You may use your sheet of perfect numbers (from Section 4.1)

Developing	**Proficient**	
1. $\sqrt{81}$ • rational • $= 9$	2. $\sqrt[5]{100}$ • irrational • ≈ 2.5	3. $\sqrt[4]{2000}$ • irrational • ≈ 6.7
4. $\sqrt{169}$ • rational • $= 13$	5. $\sqrt[3]{64}$ • rational • $= 4$	6. $\sqrt[3]{1\,738}$ • irrational • ≈ 12.0
7. $\sqrt{150}$ • irrational • ≈ 12.2	8. $\sqrt[4]{16}$ • rational • $= 2$	9. $\sqrt[5]{1864}$ • irrational • ≈ 4.5
10. $\sqrt{125}$ • irrational • ≈ 11.2	11. $\sqrt[3]{81}$ • irrational • ≈ 4.3	12. $\sqrt[3]{100}$ • irrational • ≈ 4.6
13. $\sqrt{121}$ • rational • $= 11$	14. $\sqrt[3]{216}$ • rational • $= 6$	15. $\sqrt[4]{1\,296}$ • rational • $= 6$
16. $\sqrt{49}$ • rational • $= 7$	17. $\sqrt[4]{75}$ • irrational • ≈ 2.9	18. $\sqrt[7]{128}$ • rational • $= 2$
19. $\sqrt{200}$ • irrational • ≈ 14.1	20. $\sqrt[4]{81}$ • rational • $= 3$	21. $\sqrt[5]{248\,832}$ • rational • $= 12$

Developing	
State the index and the radicand of each radical.	
1. $\sqrt[3]{64}$ $3, 64$	2. $\sqrt[4]{20\,000}$ $4, 20\,000$
3. $\sqrt[4]{16}$ $4, 16$	4. $\sqrt{1\,738}$ $2, 1\,738$

Name: _____ Date: _____

Chapter 4 Review Answers

5. $\sqrt[3]{216}$ $3, 216$	6. $\sqrt[5]{1\,864}$ $5, 1\,864$
7. $\sqrt[4]{81}$ $4, 81$	8. $\sqrt[3]{10\,000}$ $3, 10\,000$

Proficient/Extending
Use a number line to order these numbers from least to greatest, **without a calculator**.
1. $\sqrt{25}, \sqrt[3]{30}\ \sqrt[3]{-8}, \sqrt[4]{20}, \sqrt{\frac{144}{9}}$ $\sqrt[3]{-8}, \sqrt[4]{20}, \sqrt[3]{30}, \sqrt{\frac{144}{9}}, \sqrt{25}$
2. $\sqrt[5]{-243}, \sqrt{4}, \sqrt[3]{\frac{27}{216}}, \sqrt{12}, \sqrt[3]{6}$ $\sqrt[5]{-243}, \sqrt[3]{\frac{27}{216}}, \sqrt[3]{6}, \sqrt{4}, \sqrt{12}$

Name: _____ Date: _____

Chapter 4 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 4.2	Express an entire radical as a simplified mixed radical and vice versa.

Developing	**Proficient**	**Extending**
Write each radical in simplest form, **without a calculator**.		
1. $\sqrt{125}$ $5\sqrt{5}$	2. $\sqrt[3]{216}$ 6	3. $\sqrt{216k^3}$ $6k\sqrt{6k}$
4. $\sqrt{512}$ $2^4\sqrt{2} = 16\sqrt{2}$	5. $\sqrt[4]{405}$ $3\sqrt[4]{5}$	6. $\sqrt[3]{-96xy^4}$ $2y\sqrt[3]{-12xy}$
7. $\sqrt{80}$ $4\sqrt{5}$	8. $\sqrt[3]{-100}$ $\sqrt[3]{-100}$	9. $\sqrt[4]{48m^5n^4}$ $2mn\sqrt[4]{3m}$
10. $\sqrt{147}$ $7\sqrt{3}$	11. $\sqrt[3]{80}$ $2\sqrt[3]{10}$	12. $\sqrt[5]{a^7b^{10}c^2d^{12}}$ $ab^2d^2\sqrt[5]{a^2c^2d^2}$

Developing	**Proficient**	**Extending**
Write each mixed radical as an entire radical, **without a calculator**.		
1. $2\sqrt{3}$ $\sqrt{2^2 \times 3} = \sqrt{12}$	2. $-2\sqrt[3]{8}$ $\sqrt[3]{-2^3 \times 8} = \sqrt[3]{-64}$	3. $12\sqrt{k^3}$ $\sqrt{12^2k^3} = \sqrt{144k^3}$
4. $3\sqrt{5}$ $\sqrt{3^2 \times 5} = \sqrt{45}$	5. $5\sqrt[4]{2}$ $\sqrt[4]{2 \times 5^4} = \sqrt[4]{1250}$	6. $-xy\sqrt[3]{9xy^4}$ $\sqrt[3]{(-xy)^3 \times 9xy^4} = \sqrt[3]{-9x^4y^7}$
7. $6\sqrt{3}$ $\sqrt{3 \times 6^2} = \sqrt{108}$	8. $6\sqrt[3]{10}$ $\sqrt[3]{6^3 \times 10} = \sqrt[3]{2\,160}$	9. $-3m\sqrt[4]{4mn^4}$ $\sqrt[4]{(-3m)^2 \times 4mn^4} = \sqrt[4]{36m^3n^4}$
10. $4\sqrt{2}$ $\sqrt{2 \times 4^2} = \sqrt{32}$	11. $-8\sqrt[3]{8}$ $\sqrt[3]{8 \times -8^3} = \sqrt[3]{-4\,096}$	12. $a^2d^3\sqrt[5]{a^3b^5c^2}$ $\sqrt[5]{(a^2d^3)^5 \times a^3b^5c^2} = \sqrt[5]{a^{13}b^5c^2d^{15}}$

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

Name: _____ Date: _____

Chapter 4 Review Answers

Name: _____ Date: _____

Chapter 4 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 4.3	Evaluate expressions with fractional and negative exponents. Connect fractional exponents to radicals, and negative exponents to reciprocals.

Developing		
Simplify each power, to a mixed radical where appropriate, **without a calculator**.		
1. $20^{1/2}$ $2\sqrt{5}$	2. $12^{1/2}$ $2\sqrt{3}$	3. $15^{1/3}$ $\sqrt[3]{15}$
4. $18^{1/3}$ $\sqrt[3]{18}$	5. $32^{1/2}$ $4\sqrt{2}$	6. $\left(\frac{2}{3}\right)^{-4}$ $\frac{81}{16}$
7. $\left(\frac{1}{10}\right)^{-2}$ 100	8. $\left(\frac{5}{2}\right)^{-3}$ $\frac{8}{125}$	9. $\left(\frac{6}{2}\right)^{-4}$ $\frac{1}{81}$
Proficient		
10. $18^{2/3}$ $3\sqrt[3]{2^2 \times 3} = 3\sqrt[3]{12}$	11. $32^{4/3}$ $2^6\sqrt[3]{2^2} = 64\sqrt[3]{4}$	12. $50^{3/2}$ $2 \times 5^3\sqrt{2} = 250\sqrt{2}$
13. $125^{2/3}$ $5^2 = 25$	14. $27^{5/3}$ $3^5 = 243$	15. 0.5^{-2} $2^2 = 4$
16. $\left(\frac{1}{4}\right)^{-1/2}$ 2	17. $(-1000)^{-2/3}$ $\frac{1}{100}$	18. $(-0.008)^{-4/3}$ $5^4 = 625$

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

Name: _____ Date: _____

Chapter 4 Review Answers

Proficient			
Simplify each expression **without a calculator**. Your answers should contain only positive, whole number exponents.			
1. $\dfrac{0.5x^{-2}}{2x^2}$	2. $\left(\dfrac{a^2}{9}\right)^{-1/2}$ $\dfrac{3}{a}$	3. $\dfrac{(-8q^6)^{-2/3}}{4q^4}$	4. $\dfrac{(-0.027m^3)^{-4/3}}{81m^4}$
Extending			
5. $\dfrac{(12x^3y^2)^{1/2}}{2xy\sqrt{3x}}$	6. $\dfrac{(18a^2b^5)^{2/3}}{3ab^3\sqrt[3]{12ab}}$	7. $\dfrac{(32m^2n^8)^{3/4}}{8mn^6\sqrt[4]{8m^2}}$	8.
9. $\dfrac{(64p^5q^9)^{4/3}}{2^8p^6q^{12}\sqrt[3]{p^2}}$	10. $3xy\left(\dfrac{x^2}{y^2}\right)^{-1/2}$ $3y^2$	11. $\dfrac{(9a^3b^6)^{-1/2}}{(3a^3b^6)^{-2}}$ $3a^4b^9\sqrt{a}$	12. $\dfrac{(8x^{n+2}y^{n+1})^{2/n}}{x^2y^2\sqrt[n]{2^6x^4y^2}}$

Proficient	**Extending**
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**.
1. $26^{2/5}$ $\sqrt[5]{26^2} = \left(\sqrt[5]{26}\right)^2$	2. $20^{2/3}$ $\sqrt[3]{20^2} = \left(\sqrt[3]{20}\right)^2 = 2\sqrt[3]{50}$
3. $19^{3/4}$ $\sqrt[4]{19^3} = \left(\sqrt[4]{19}\right)^3$	4. $25^{2/3}$ $\sqrt[3]{25^2} = \left(\sqrt[3]{25}\right)^2 = 5\sqrt[3]{5}$
5. $6^{5/2}$ $\sqrt{6^5} = \left(\sqrt{6}\right)^5$	6. $(9n^4)^{3/2}$ $\sqrt{(9n^4)^3} = \left(\sqrt{9n^4}\right)^3 = 27n^6$
7. $40^{2/3}$ $\sqrt[3]{40^2} = \left(\sqrt[3]{40}\right)^2$	8. $(40a^3b^4)^{2/3}$ $\sqrt[3]{(40a^3b^4)^2} = \left(\sqrt[3]{40a^3b^4}\right)^2 = 4a^2b^2\sqrt[3]{25b^2}$
9. $3^{5/4}$ $\sqrt[4]{3^5} = \left(\sqrt[4]{3}\right)^5$	10. $(72p^3q)^{5/2}$ $\sqrt{(72p^3q)^5} = \left(\sqrt{72p^3q}\right)^5 = 2^7 3^5 p^7 q^2\sqrt{2pq}$

Extending
Arrange these numbers in order from least to greatest, **without using a calculator**.
$\sqrt[3]{9}, 9^{3/2}, 9, (\sqrt[5]{9})^4, 9^{1/2}$
$\sqrt[3]{9}, 9^{1/2}, (\sqrt[5]{9})^4, 9, 9^{3/2}$
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

Name: _____ Date: _____

Chapter 4 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 4.4	Use exponent laws to simplify expressions with rational exponents.

Proficient	**Extending**
Simplify **without using a calculator**. Your answers should contain only positive, whole number exponents.	
1. $2m^2 \cdot 2m^3 = 4m^5$	2. $(x^{-2}x^{-3})^4 = \frac{1}{x^{20}}$
3. $m^4 \cdot 2m^{-3} = 2m$	4. $(n^3)^{-1/3} \cdot 2n^{-1} = \frac{2}{n^2}$
5. $\frac{a^3}{a^5} \cdot a^{-2} = \frac{1}{a^4}$	6. $x^2y^{-4} \cdot (xy)^2 = \frac{x^4}{y^2}$
7. $4n^4 \cdot 2n^{-3} = 8n$	8. $(2x^4y^{-3})^{-1} = \frac{y^3}{2x^4}$
9. $\frac{2x^4y^{-4}z^{-3}}{3x^2y^{-3}z^4} = \frac{2x^2}{3yz^7}$	10. $\frac{(16a^2b^6)^{-1/2}}{2ab^3} = \frac{1}{8a^2b^6}$
11. $2x^3y^{-3} \cdot 2x^{-1}y^3 = 4x^2$	12. $\left(\frac{x^2y}{y^{-2}}\right)^{-2} = \frac{1}{x^4y^6}$
13. $2y^{5/2} \cdot 3y^{-3} = \frac{6\sqrt{y}}{y}$	14. $ba^4 \cdot (2b^6a^4)^{-3/2} = \frac{\sqrt{2}}{4a^2b^8}$
15. $4v^3 \cdot v^{-1/3}u^{-2} = \frac{4v^2\sqrt[3]{v^2}}{u}$	16. $\frac{(2x^{-3}z^2)^3}{x^3y^4z^2 \cdot x^{-4}z^3} = \frac{8z}{x^8y^4}$
17. $4a^3b^2 \cdot 3a^{-4}b^{-3} = \frac{12}{a^4b^3}$	18. $\frac{(16pm^{-1})^{-1/4} \cdot 2m^{-1}p^3}{2pq^2} = \frac{p\sqrt[4]{mp^3}}{2mq^2}$

Name: _____ Date: _____

Chapter 4 Review Answers

19. $\frac{2y^3 \cdot 3xy^3}{3x^2y^4} = \frac{2y^2}{x}$	20. $(m \cdot m^{-2} \cdot n^{5/3})^2 = \frac{n^3\sqrt[3]{n}}{m^2}$
21. $4r^{-3} \cdot 2r^2 = \frac{8}{r}$	22. $\left(\frac{x^{1/2}y^{-2}}{x^2y^{1/2}}\right)^4 = \frac{1}{x^6y^{10}}$
23. $\frac{3m^{-4}}{m^3} = \frac{3}{m^7}$	24. $\frac{(x^3y^2)^{3/2}}{(x^{-1}y^{-2/3})^{1/4}} = x^4y^3\sqrt[4]{x^3}\sqrt[6]{y} = x^4y^3\sqrt[12]{x^9y^2}$
25. $2k^4 \cdot 4k = 8k^5$	26. $\frac{(x^{-1/2}y^2)^{-5/4}}{x^2y^{1/2}} = \frac{\sqrt[8]{x^5}}{x^2y^3}$

Extending

Write 3 different expressions for each result.

1. $x^{3/2}$ as the product of two powers with rational exponents.

$$x \times x^{1/2} = x^{-1} \times x^{5/2} = x^{-3/2} \times x^3$$

2. $x^{3/2}$ as the quotient of two powers with rational exponents.

$$\frac{x^2}{x^{1/2}} = \frac{x}{x^{-1/2}} = \frac{x^{5/2}}{x}$$

3. $x^{3/2}$ as the result of raising a power with a rational exponent to a rational exponent.

$$\left(x^{1/2}\right)^3 = (x^3)^{1/2} = \left(x^{3/5}\right)^{5/2}$$

Simplify and write as both a power and a radical.

$\left(\sqrt[3]{x^4}\right)\left(\sqrt[5]{x^2}\right)$ $x^{26/15} = \left(\sqrt[15]{x}\right)^{26}$	$\left(\sqrt{y^3}\right)\left(\sqrt[5]{y^4}\right)$ $x^{23/10} = \sqrt[10]{x^{23}}$	$\sqrt{\sqrt[3]{a^5b^6}}$ $a^{5/6}b = b\sqrt[6]{a^5}$

Name: _____ Date: _____

Chapter 4 Review Answers

Extending
Scientists use the formula $$d = 0.099m^{9/10}$$ to calculate the volume of water, *d* litres, that a mammal with mass *m* kilograms should drink in one day. Calculate how much water a 550 kg moose should drink in 3 days. 86.9 litres