

13. a) $\frac{1}{8}$ c) $\frac{9}{4}$ e) 6 g) $\frac{1}{6}$ i) $-\frac{1}{9}$
 b) $\frac{1}{6}$ d) $\frac{17}{4}$ f) $\frac{1}{26}$ h) $\frac{57}{34}$

14. a) 4 c) $\frac{1}{9}$ e) 9 g) 9
 b) 9 d) $\frac{2}{3}$ f) $\frac{1}{81}$ h) 9

15. a) $(-10)^3$ is -10 multiplied by itself three times. 10^{-3} is the reciprocal of 10 cubed.
 b) $(-10)^4$ is -10 multiplied by itself four times. -10^4 is the negative of 10^4 .

16. a) $x = -1$ c) $x = 0$ e) $n = -2$
 b) $x = -2$ d) $n = -2$ f) $w = -2$

17. $10^{-y} = \frac{1}{5}$

18. a) x^{10-2r} c) b^{m+4n} e) a^{10-2p}
 b) b^{4m-n} d) x^{21-2r} f) $3^{6-m}x^{24-5m}$

Lesson 4.3, pp. 229–230

1. a) $\sqrt{49} = 7$ c) $\sqrt[3]{-125} = -5$ e) $\sqrt[4]{81} = 3$
 b) $\sqrt[4]{100} = 10$ d) $\sqrt[4]{16} = 2$ f) $\sqrt{-144} = -12$
2. a) $512^{\frac{1}{5}} = 2$ d) $(-216)^{\frac{5}{3}} = 7776$
 b) $(-27)^{\frac{1}{3}} = -3$ e) $\left(\frac{-32}{243}\right)^{\frac{1}{3}} = \frac{-2}{3}$
 c) $27^{\frac{2}{3}} = 9$ f) $\left(\frac{16}{81}\right)^{\frac{-1}{4}} = \frac{3}{2}$
3. a) $8^{\frac{1}{3}}$ c) $(-11)^{\frac{11}{4}}$ e) $9^{\frac{-13}{15}}$
 b) $8^{\frac{1}{3}}$ d) 7^{-1} f) $10^{-\frac{7}{5}}$
4. a) 5 b) -2 c) 4 d) 3
5. a) 11 c) $\frac{47}{3}$ e) $\frac{253}{4}$
 b) -18 d) $-\frac{255}{32}$ f) 3
6. a) $4^{\frac{1}{2}} = 2$ c) $64^{\frac{1}{3}} = 4$ e) $16^{-\frac{1}{4}} = \frac{1}{2}$
 b) $100^{-\frac{1}{2}} = \frac{1}{10}$ d) $27^{-\frac{1}{3}} = \frac{1}{3}$ f) $8^2 = 64$
7. a) 4.996 c) 1.262 e) 5.983
 b) 6.899 d) 2.999 f) 98.997
8. 0.25 m
9. $27^{\frac{4}{3}} = 81$, $27^{1.3333} \doteq 80.991\ 101\ 73$ The values are not equal as $\frac{4}{3} \neq 1.3333$.
10. $0.2 = \frac{1}{5}$, an odd root, $0.5 = \frac{1}{2}$, an even root. Even root of a negative number is not real.
11. $125^{-\frac{2}{3}} = \frac{1}{125^{\frac{2}{3}}} = \frac{1}{(125^{\frac{1}{3}})^2} = \frac{1}{5^2} = \frac{1}{25}$
12. a) -8 c) 0.0081 e) 0.008
 b) 39.0625 d) 2.25 f) 1 679 616
13. $4^{2.5} = 4^{\frac{5}{2}} = (\sqrt{4})^5$. Change 2.5 to a fraction as $\frac{5}{2}$. This is the same as taking the square root of the four and then taking the fifth power of that result.
14. a) false c) false e) false
 b) false d) true f) true
15. a) Answers may vary. For example, $m = 1$, $n = 2$. b) $n = 0$

16. The value of x can equal the value of y . Also $x = 4$ and $y = 2$.

17. Yes this works. The value of i is approximately 0.017.

18. a) $x = \frac{1}{6}$ b) $x = \frac{27}{2}$

Lesson 4.4, pp. 235–237

1. a) x^7 c) m^8 e) y^6
 b) p^2 d) $\frac{1}{a^2}$ f) $\frac{1}{k^{12}}$
2. a) $\frac{1}{y^2}$ c) $\frac{1}{n^{24}}$ e) 1
 b) x^4 d) $\frac{1}{w}$ f) $\frac{1}{b^{19}}$
3. a) 36 b) $x^2y^2 = 36$
 c) Usually it is faster to substitute numbers into the simplified form.
4. a) p^2q c) $\frac{1}{a^2b^7}$ e) wx^4
 b) $\frac{y^2}{x^6}$ d) $\frac{n^6}{m^4}$ f) $\frac{a^6}{b^4}$
5. a) $72x^8y^{11}$ c) $\frac{y^6}{150x^4}$ e) $\frac{r^4}{p^7}$
 b) $\frac{a^5}{b^2}$ d) $\frac{3m^{10}}{4n^2}$ f) $\frac{y^4}{x^5}$
6. a) 1 c) $\frac{5}{6m^{11}}$ e) $\frac{1}{4}$
 b) $\frac{9c}{2}$ d) $10x^4$ f) $\frac{1}{x}$
7. a) $4x^3y^2 = 32$ c) $\frac{9y^2}{8x} = \frac{45}{16}$
 b) $\frac{1}{2p^3} = \frac{1}{54}$ d) $\frac{1}{35b} = \frac{1}{350}$
8. a) $1000x^{\frac{3}{4}} = 8000$ c) $\frac{-5}{8a^4} = \frac{-5}{8}$
 b) $\frac{x^3}{16} = \frac{125}{16}$ d) $\frac{12n^3}{m^2} = \frac{3}{25}$
9. a) $18m^5n^5$ b) $\frac{27y}{2}$ c) $4a^{10}$ d) $\frac{1}{\sqrt[3]{3x^{\frac{5}{2}}}}$
10. $M = \frac{x^4}{16y^9}$
- a) Answers may vary. For example, $x = 2$, $y = 1$
 b) Answers may vary. For example, $x = 3$, $y = 1$
 c) Answers may vary. For example, $y = 1$, $x = 1$
 d) $y < 0$
11. a) $\frac{2b + 2r}{hr}$ b) $\frac{SA}{V} = \frac{8}{3} \doteq 2.67\text{ cm}^{-1}$
12. These simplify to $\frac{y}{x} = -\frac{3}{2}, \frac{x^2}{y^2} = \frac{4}{9}, \frac{x}{y^3} = \frac{4}{27}$, respectively. Switch second and third for proper order.
13. Algebraic and numerical expressions are similar in the following way: when simplifying algebraic or numerical expressions, you have to follow the order of operations. When simplifying algebraic expressions, you can only add or subtract like terms—while unlike terms may be multiplied. In this way algebraic expressions are different than numerical expressions.
14. a) $r = \sqrt[3]{\frac{3V}{4\pi}} = \left(\frac{3V}{4\pi}\right)^{\frac{1}{3}}$ b) 4 m
15. x