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Study Guide

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Powers and Exponents

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S

The product of a number with itself is called a **perfect square.** For example, 64 is a perfect square because $64 = 8 \times 8$. The **exponent** 2 can be used to write 8×8 as 8^2. Likewise, the exponent 4 can be used to write $8 \times 8 \times 8 \times 8$ as 8^4. Numbers that are expressed using exponents are called **powers**.

$$\text{base} \longrightarrow 8^4 \longleftarrow \text{exponent}$$

Example 1: Write $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$ using exponents.
The base is 3. There are 5 factors of 3, so the exponent is 5.
$3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 3^5$

Example 2: Write $x \cdot x \cdot x \cdot x$ using exponents.
The base is x. There are 4 factors of x, so the exponent is 4.
$x \cdot x \cdot x \cdot x = x^4$

Example 3: Write $5x^2y^3$ as a multiplication expression.
There is 1 factor of 5, 2 factors of x, and 3 factors of y.
$5 \cdot x \cdot x \cdot y \cdot y \cdot y$

Write each expression using exponents.

1. $4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 = 4^6$
2. $(-3)(-3)(-3)(-3)$
3. $x \cdot x \cdot x \cdot x \cdot x = x^5$
4. $(-2)\, a \cdot a \cdot a \cdot a \cdot b = -2A^4b$
5. $(10) \cdot (10) \cdot (10) \cdot (10)$
6. $5 \cdot x \cdot x \cdot x \cdot x \cdot x \cdot y \cdot y \cdot y$

Write each power as a multiplication expression.

7. $7^3 = 7 \cdot 7 \cdot 7$
8. $-5y^4$
9. d^4e^3
10. $9ab^3$
11. wx^2y^3
12. $(-2)^5 = (-2)\cdot(-2)\cdot(-2)\cdot(-2)\cdot(-2)$
$\cancel{-2 -2 \ 2 \ 2 -2}$

Evaluate each expression if $x = -3$, $y = 2$, and $z = -1$.

13. zx^3y^2
$(-1)(-3)^3(2)^2$
$\underbrace{(-1)(-3)}\underbrace{(-3)(-3)}\underbrace{(2)(2)}$
$\underbrace{(+3) \cdot (+9)} \cdot (+4)$
$(+27) \cdot (+4)$
$$\begin{array}{r} 27 \\ \times\ 4 \\ \hline +108 \end{array}$$
$+108$

14. $y(x^2 - z)$

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Practice

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Powers and Exponents

Write each expression using exponents.

1. $6 \cdot 6 \cdot 6 \cdot 6 \cdot 6$
2. 8
3. $10 \cdot 10 \cdot 10 \cdot 10$
4. $7 \cdot 7 \cdot 7$
5. $(-4) \cdot (-4) \cdot (-4) \cdot (-4)$
6. $b \cdot b \cdot b \cdot b \cdot b \cdot b$
7. $x \cdot x$
8. $m \cdot m \cdot m \cdot m \cdot m \cdot m \cdot m$
9. $3 \cdot 3 \cdot 5 \cdot 5 \cdot 5$
10. $a \cdot a \cdot a \cdot a \cdot c \cdot c \cdot c \cdot c$
11. $7 \cdot 7 \cdot 9 \cdot 7 \cdot 9 \cdot 2 \cdot 2 \cdot 2$
12. $(6)(x)(x)(x)(y)(y)(y)(y)$

Write each power as a multiplication expression.

13. 9^3
14. 13^5
15. 7^2
16. p^4
17. n^6
18. $(-5)^5$
19. $4 \cdot 8^6$
20. $7^3 \cdot 5^2$
21. ab^2
22. m^5n^3
23. $-4c^3$
24. $3x^2y^4$

Evaluate each expression if $a = -1$, $b = 3$, and $c = 2$.

25. b^4
26. a^6
27. $4c^5$
28. $-3b^3$
29. a^5b^2
30. $2bc^3$
31. $-4a^4c^2$
32. $a^2 + b^2$
33. $2(b^2 - c^3)$
$2((3)^2 - (2)^3)$
$2[(3)^2 - (2)^3]$
$2 \cdot [9 - 8]$
$2 \cdot (1)$
2

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Multiplying and Dividing Powers

You can multiply powers by using the following rules.

Product of Powers	Examples
To ~~multiply powers~~ with the ~~same base~~, add the exponents. + $a^m \cdot a^n = a^{m+n}$	$3^2 \cdot 3^4 = 3^{2+4}$ or 3^6 $x^3 \cdot x^2 = x^{3+2}$ or x^5 $(ab^2) \cdot (a^3b^4) =$ $(a \cdot a^3)(b^2 \cdot b^4)$ or a^4b^6

You can divide powers by using the following rules.

Quotient of Powers	Examples
To ~~divide powers~~ with the ~~same base~~, subtract the exponents. − $\frac{a^m}{a^n} = a^{m-n}$	$\frac{10^4}{10^3} = 10^{4-3}$ or 10^1 $\frac{x^5}{x^2} = x^{5-2}$ or x^3 $\frac{b^8c^4}{b^2c} = b^{8-2} \cdot c^{4-1}$ or b^6c^3

Simplify each expression.

1. $6^3 \cdot 6^2 = 6^5$
   $6\cdot6\cdot6\cdot6\cdot6$
2. $(-3)\cdot x^2 \cdot x^3 = -3x^5$
3. $y^8 \cdot y^9 = y^{17}$
4. $(5m^3)(3m^2n^4) = 15m^5n^4$
5. $(ab^2)(a^2b^3)$
6. $(-10x^4y^2)(3x^2y)$
7. $\frac{8^9}{8^7} = 8^2$
8. $\frac{w^6}{w^3} = w^3$
9. $\frac{a^7b^2}{a^6b} = A\cdot b$
10. $\frac{9j^5}{3j^2} = 3j^3$
11. $\frac{36x^9y^5}{18x^3y^2}$
12. $\frac{-24m^6n^3}{6m^2n^2}$

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Practice

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Multiplying and Dividing Powers

Simplify each expression.

1. $6^3 \cdot 6^2$
2. $7^6 \cdot 7^4$
3. $y^4 \cdot y^8$
4. $b \cdot b^4$
5. $(g^2)(g^3)(g)$
6. $m(m^8)$
7. $(a^2b^3)(a^4b)$
8. $(xy^5)(x^3y^3)$
9. $(2c^3)(2c)$
10. $(-3x^2)(6x^2)$
11. $(-7xy)(-2x)$
12. $(5m^3n^2)(4m^2n^3)$
13. $(-8ab)(a^2b^5)$
14. $\frac{9^2}{9}$
15. $\frac{12^8}{12^3}$
16. $\frac{y^4}{y^2}$
17. $\frac{k^6}{k^6}$
18. $\frac{x^4y^5}{x^3y^2}$
19. $\frac{a^9b^6}{a^2b}$
20. $\frac{mn^3}{n^2}$
21. $\frac{15a^3}{3a}$
22. $\frac{8x^5y^4}{4x^2y^2}$
23. $\frac{m^2n}{m^2}$
24. $\frac{6a^5b^7}{-2a^3b^7}$
25. $\frac{-20x^3y^2}{-5x^3y}$
26. $\frac{-\cancel{16}^{\,4}ab^4}{\cancel{4}_{\,1}b^3}$ $\frac{b\cdot\cancel{b}\cdot\cancel{b}\cdot\cancel{b}}{\cancel{b}\cdot\cancel{b}\cdot\cancel{b}}$
    $\frac{-4A\cdot b}{1}$
    $-4Ab$
27. $\frac{12x^2y}{2x^2y}$

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Negative Exponents

In science and technology, negative exponents are sometimes used to represent very small numbers. For example, the diameter of an atom is expressed as 10^{-10} meter. This is the decimal 0.0000000001. This number expressed as a fraction is $\frac{1}{10{,}000{,}000{,}000}$.

When simplifying an expression with a negative exponent, you may need to use the Quotient of Powers rule.

Negative Exponents	Examples
$\frac{a^{-n}}{1} = \frac{1}{a^n}$	$3^{-2} = \frac{1}{3^2}$ or $\frac{1}{9}$ $x^{-3} = \frac{1}{x^3}$ $\frac{b^2}{b^{-3}} = b^{2-(-3)}$ or b^5

Remember that a negative exponent is used to write a reciprocal, not to represent a negative number. (means really small number) positive

Simplify each expression.

1. $\frac{5^{-3}}{1} = \frac{1}{5^3} = \frac{1}{125}$
2. $\frac{3^{-2}}{1} = \frac{1}{3^2} = \frac{1}{9}$
3. $\frac{y^{-8}}{1} = \frac{1}{y^8}$
4. * $\frac{5m^{-3}}{1} = \frac{5}{m^3}$
5. $(a^{-2})(b^3)$
6. $-6x^{-4}y^6$
7. $\frac{3^4}{3^{-2}}$
8. $\frac{k^{-3}}{k^5}$
9. $\frac{12x^5}{4x^{-2}}$
10. $\frac{a^2b^{-2}c^{-1}}{1} = \frac{A^2}{b^2c^1}$
11. $\frac{-24m^6n^3}{3m^2n} = \frac{-8m^4n^2}{1}$

$\frac{m \cdot m \cdot m \cdot m \cdot m \cdot m \cdot n \cdot n \cdot n}{m \cdot m \cdot n}$

12. $\frac{36x^5y^6z^{-2}}{9x^3y^2}$

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Practice

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Negative Exponents

Write each expression using positive exponents. Then evaluate the expression.

1. $\frac{2^{-6}}{1} = \frac{1}{2^6}$ $\frac{1}{2\cdot2\cdot2\cdot2\cdot2\cdot2} = \frac{1}{64}$
2. 5^{-1}
3. 8^{-2}
4. $\frac{10^{-3}}{1} = \frac{1}{10^3} = \frac{1}{1000}$

$10^6 = 1{,}000{,}000$

Simplify each expression.

5. g^{-6}
6. s^{-1}
7. q^0
8. $a^{-2}b^2$
9. m^5n^{-1}
10. $p^{-1}q^{-6}r^3$
11. $\frac{x^{-3}y^2z^{-4}}{1} = \frac{y^2}{x^3z^4}$
12. $a^{-2}b^0c^{-1}$
13. $12m^{-6}n^4$
14. $7xy^{-8}z$
15. $x^{-3}(x^2)$
16. $b^3(b^{-5})$
17. $\frac{b^3}{b^6}$
18. $\frac{y^3}{y^{-2}}$
19. $\frac{m^5n^3}{m^6n^2}$
20. $\frac{xy^2}{xy^3}$
21. $\frac{a^7b^4}{a^9b^2}$
22. $\frac{rs^{-3}}{r^2s^4}$
23. $\frac{16c^8}{4c^{10}}$
24. $\frac{9x^{-5}y^5}{36x^4y^3}$
25. $\frac{7p^2q^8}{21p^{-3}q^7}$
26. $\frac{-6m^5n^0q^{-1}}{36m^{-2}n^2q^{-1}}$ $\frac{n \cdot n}{n \cdot n \cdot n \cdot n}$ $\frac{-6 \cdot 1 \cdot m^7 \cdot q^1}{36 \cdot n^2 \cdot 1 \cdot q^1}$ $= \frac{-1m^7}{6n^2}$
27. $\frac{4a^3b^2c^2}{6a^5b^5c}$
28. $\frac{28x^6y^{-3}z}{-4x^4yz^3}$

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Scientific Notation

In science and in other applications, **scientific notation** is often used to represent very small or very large numbers. For example, the speed of light is about 3×10^8 meters per second. This represents the number 300,000,000 meters per second.

In scientific notation, a number is expressed in the form $a \times 10^n$, where a is a number greater than 1 and less than 10 and n is an integer.

Scientific Notation	Examples
1. Place the decimal point after the first non-zero digit in the given number. 2. Find the power of 10 by counting decimal places. When the given number is one or greater, the power of 10 is positive. When the given number is between zero and one, the exponent of 10 is negative.	$6{,}200{,}000 = 6.2 \times 10^6$ $0.000056 = 5.6 \times 10^{-5}$

Express each number in standard form.

1. 6.1×10^4
2. 4.8×10^{-2}
3. 8.12×10^3
4. 5×10^7
5. 9×10^{-5}
6. 1.1×10^{-7}
7. 2.15×10^5
8. 5.1651×10^3

Express each number in scientific notation.

9. 8400 $= 8.4 \times 10^{+3}$
10. 3,000,000
11. 0.05
12. 14.2
13. 0.00048
14. 82,000,000,000
15. 0.0000725

7.25×10^{-5}

16. 6

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Practice

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Express each measure in standard form.

1. 4 gigabytes (10^9)

$4 \times 10^9 = 4{,}000{,}000{,}000$ bytes

2. 78 kilowatts
3. 9 megahertz
4. 7.5 milliamperes
5. 2.3 nanoseconds
6. 3.7 micrograms (10^{-6})

3.7×10^{-6}

0.0000037

→ 0.0000037 grams

Express each number in scientific notation.

7. 6300
8. 4,600,000
9. 92.3
10. 51,200
11. 776,000
12. 68,200,000
13. 0.00013
14. 0.000009
15. 0.026
16. 0.04
17. 0.0055
18. 0.000031

Evaluate each expression. Express each result in scientific notation and in standard form.

19. $(4 \times 10^3)(2 \times 10^4)$
20. $(3 \times 10^2)(1.5 \times 10^{-5})$
21. $(6 \times 10^{-7})(1.5 \times 10^9)$

$9 \times 10^{+2}$

900 → 900

22. $(7 \times 10^{-3})(2.1 \times 10^{-3})$
23. $\frac{5.1 \times 10^5}{1.7 \times 10^7}$
24. $\frac{3.6 \times 10^6}{2 \times 10^2}$
25. $\frac{8.5 \times 10^{-3}}{2.5 \times 10^6} = \frac{3.4}{10^9}$

$$\begin{array}{r} 3.4 \\ 25\,\overline{)\,85.0} \\ -75 \\ \hline 100 \\ -100 \\ \hline 0 \end{array}$$

3.4×10^{-9}

0.0000000034

→ 0.0000000034

26. $\frac{2.7 \times 10^2}{3 \times 10^{-4}}$
27. $\frac{3.9 \times 10^4}{3 \times 10^7}$

Name: ____________________ Squares and Square Roots Date: __________

n	Squared^2 n^2	Square Root $\sqrt{n}$	n	Squared^2 n^2	Square Root $\sqrt{n}$	n	Square Root $\sqrt{n}$	n	Square Root $\sqrt{n}$	n	Square Root $\sqrt{n}$
1	1	1.000	51	2601	7.141	101	10.050	151	12.288	201	14.177
2	4	1.414	52	2704	7.211	102	10.100	152	12.329	202	14.213
3	9	1.732	53	2809	7.280	103	10.149	153	12.369	203	14.248
4	16	2.000	54	2916	7.348	104	10.198	154	12.410	204	14.283
5	25	2.236	55	3025	7.416	105	10.247	155	12.450	205	14.318
6	36	2.449	56	3136	7.483	106	10.296	156	12.490	206	14.353
7	49	2.646	57	3249	7.550	107	10.344	157	12.530	207	14.387
8	64	2.828	58	3364	7.616	108	10.392	158	12.570	208	14.422
9	81	3.000	59	3481	7.681	109	10.440	159	12.610	209	14.457
10	100	3.162	60	3600	7.746	110	10.488	160	12.649	210	14.491
11	121	3.317	61	3721	7.810	111	10.536	161	12.689	211	14.526
12	144	3.464	62	3844	7.874	112	10.583	162	12.728	212	14.560
13	169	3.606	63	3969	7.937	113	10.630	163	12.767	213	14.595
14	196	3.742	64	4096	8.000	114	10.677	164	12.806	214	14.629
15	225	3.873	65	4225	8.062	115	10.724	165	12.845	215	14.663
16	256	4.000	66	4356	8.124	116	10.770	166	12.884	216	14.697
17	289	4.123	67	4489	8.185	117	10.817	167	12.923	217	14.731
18	324	4.243	68	4624	8.246	118	10.863	168	12.961	218	14.765
19	361	4.359	69	4761	8.307	119	10.909	169	13.000	219	14.799
20	400	4.472	70	4900	8.367	120	10.954	170	13.038	220	14.832
21	441	4.583	71	5041	8.426	121	11.000	171	13.077	221	14.866
22	484	4.690	72	5184	8.485	122	11.045	172	13.115	222	14.900
23	529	4.796	73	5329	8.544	123	11.091	173	13.153	223	14.933
24	576	4.899	74	5476	8.602	124	11.136	174	13.191	224	14.967
25	625	5.000	75	5625	8.660	125	11.180	175	13.229	225	15.000
26	676	5.099	76	5776	8.718	126	11.225	176	13.266	226	15.033
27	729	5.196	77	5929	8.775	127	11.269	177	13.304	227	15.067
28	784	5.292	78	6084	8.832	128	11.314	178	13.342	228	15.100
29	841	5.385	79	6241	8.888	129	11.358	179	13.379	229	15.133
30	900	5.477	80	6400	8.944	130	11.402	180	13.416	230	15.166
31	961	5.568	81	6561	9.000	131	11.446	181	13.454	231	15.199
32	1024	5.657	82	6724	9.055	132	11.489	182	13.491	232	15.232
33	1089	5.745	83	6889	9.110	133	11.533	183	13.528	233	15.264
34	1156	5.831	84	7056	9.165	134	11.576	184	13.565	234	15.297
35	1225	5.916	85	7225	9.220	135	11.619	185	13.601	235	15.330
36	1296	6.000	86	7396	9.274	136	11.662	186	13.638	236	15.362
37	1369	6.083	87	7569	9.327	137	11.705	187	13.675	237	15.395
38	1444	6.164	88	7744	9.381	138	11.747	188	13.711	238	15.427
39	1521	6.245	89	7921	9.434	139	11.790	189	13.748	239	15.460
40	1600	6.325	90	8100	9.487	140	11.832	190	13.784	240	15.492
41	1681	6.403	91	8281	9.539	141	11.874	191	13.820	241	15.524
42	1764	6.481	92	8464	9.592	142	11.916	192	13.856	242	15.556
43	1849	6.557	93	8649	9.644	143	11.958	193	13.892	243	15.588
44	1936	6.633	94	8836	9.695	144	12.000	194	13.928	244	15.620
45	2025	6.708	95	9025	9.747	145	12.042	195	13.964	245	15.652
46	2116	6.782	96	9216	9.798	146	12.083	196	14.000	246	15.684
47	2209	6.856	97	9409	9.849	147	12.124	197	14.036	247	15.716
48	2304	6.928	98	9604	9.899	148	12.166	198	14.071	248	15.748
49	2401	7.000	99	9801	9.950	149	12.207	199	14.107	249	15.780
50	2500	7.071	100	10000	10.000	150	12.247	200	14.142	250	15.811

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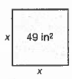
Square Roots

Suppose you know that the area of the square below is 49 square inches. What is the length of a side? Since 7 × 7 = 49, each side is 7 inches long.



Also, since 7 × 7 = 49, we say that the **square root** of 49 is 7. A shorter way to write this is with the symbol $\sqrt{}$, a **radical sign**. Write $\sqrt{49} = 7$. Use the following rules to simplify square roots.

Square Roots	Examples
1. The square root of a number is one of its equal factors.	$\sqrt{49} = 7$
2. The square root of a product is equal to the product of each square root. $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$	$\sqrt{225} = \sqrt{9} \cdot \sqrt{25} = 3 \cdot 5 = 15$
3. The square root of a quotient is equal to the quotient of each square root. $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$	$\sqrt{\frac{25}{144}} = \frac{\sqrt{25}}{\sqrt{144}} = \frac{5}{12}$

Simplify.

1. $\sqrt{81} = 9$

2. $-\sqrt{25} = -5$

3. $\sqrt{100} = 10$

4. $-\sqrt{400} = -20$

5. $\sqrt{625} = 25$

6. $-\sqrt{1156} = -34$

7. $\sqrt{\frac{81}{49}} = \frac{\sqrt{81}}{\sqrt{49}} = \frac{9}{7}$

8. $\sqrt{\frac{25}{36}} = \frac{\sqrt{25}}{\sqrt{36}} = \frac{5}{6}$

9. $-\sqrt{\frac{16}{100}} = -\frac{\sqrt{16}}{\sqrt{100}} = -\frac{4 \div 2}{10 \div 2} = \frac{-2}{5}$

10. $\sqrt{0.25} = 0.5$

11. $-\sqrt{0.0016}$

12. $-\sqrt{\frac{0.16}{0.09}}$

$$\begin{array}{r} 0.5 \\ \times\ 0.5 \\ \hline 0.25 \end{array}$$

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Practice

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Square Roots

Simplify.

1. $\sqrt{36}$ 2. $-\sqrt{16}$ 3. $\sqrt{81}$ 4. $-\sqrt{144}$

5. $-\sqrt{100}$ 6. $-\sqrt{121}$ 7. $\sqrt{169}$ 8. $-\sqrt{25}$

9. $-\sqrt{529}$ 10. $\sqrt{256}$ 11. $\sqrt{324}$ 12. $-\sqrt{289}$

13. $\sqrt{441}$ 14. $-\sqrt{225}$ 15. $\sqrt{196}$ 16. $\sqrt{400}$

17. $\sqrt{484}$ 18. $\sqrt{729}$ 19. $-\sqrt{625}$ 20. $\sqrt{1225}$

27

21. $\sqrt{\frac{49}{81}}$ 22. $-\sqrt{\frac{16}{25}}$ 23. $\sqrt{\frac{4}{16}}$ 24. $-\sqrt{\frac{25}{36}}$

$\sqrt{\frac{4\div4}{16\div4}} = \sqrt{\frac{1}{4}} = \frac{\sqrt{1}}{\sqrt{4}} = \frac{1}{2}$

$\frac{\sqrt{4}}{\sqrt{16}} = \frac{2\div2}{4\div2} = \frac{1}{2}$

$-\frac{\sqrt{25}}{\sqrt{36}}$

$-\frac{5}{6}$

25. $-\sqrt{\frac{100}{121}}$ 26. $\sqrt{\frac{1}{64}}$ 27. $\sqrt{\frac{36}{64}}$ 28. $-\sqrt{\frac{144}{36}}$

$\frac{\sqrt{1}}{\sqrt{64}} = \frac{1}{8}$

29. $-\sqrt{\frac{121}{289}}$ 30. $-\sqrt{\frac{225}{625}}$ 31. $\sqrt{\frac{400}{100}}$ 32. $\sqrt{\frac{196}{256}}$

$-\frac{\sqrt{225}}{\sqrt{625}} = -\frac{15\div5}{25\div5} = -\frac{3}{5}$

$-\sqrt{\frac{225}{625}} = -\sqrt{\frac{9}{25}} = -\frac{\sqrt{9}}{\sqrt{25}} = -\frac{3}{5}$

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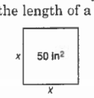
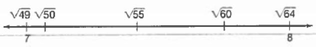
Estimating Square Roots

Suppose you know that the area of the square below is 50 square inches. What is the length of a side?



Since there is no rational number whose square is 50, you need to estimate the answer. If you use a calculator to find $\sqrt{50}$, it will return an approximate value of 7.071067812. This represents an **irrational number**, a decimal number that does not repeat or terminate.

You can use perfect squares to estimate irrational square roots. Since 50 is close to 49, $\sqrt{50} \approx 7$, so the length of the side of the square is about 7 inches. Likewise, if the area of a square is 60 square inches, the side length would be $\sqrt{60} \approx 8$ inches, since the actual value is close to $\sqrt{64}$, or 8.



Estimate each square root to the nearest whole number.

$\sqrt{81}$ +9 1. $\sqrt{90}$ +10 $\sqrt{100}$ 2. $\sqrt{134}$ 3. $\sqrt{17}$

9 ≈ 9 10

4. $\sqrt{500}$ 5. $\sqrt{1000}$ 6. $\sqrt{98}$

$\sqrt{289}$ +31 7. $\sqrt{320}$ +4 $\sqrt{324}$ 8. $\sqrt{5}$ 9. $\sqrt{75}$

17 ≈ 18 18

+8 ≈ 129 +15

10. $\sqrt{84.5}$ $\sqrt{121}$ 11. $\sqrt{128.9}$ $\sqrt{144}$ 12. $\sqrt{0.025} \approx \sqrt{0} = 0$

11 ≈ 11 12

13. $\sqrt{0.0075}$ 14. $\sqrt{10.01}$ 15. $\sqrt{0.9988}$

$\approx \sqrt{1} = 1$

8-6

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Practice

Student Edition Pages 362–365

Estimating Square Roots

Estimate each square root to the nearest whole number.

1. $\sqrt{10}$	2. $\sqrt{14}$	3. $\sqrt{32}$
4. $\sqrt{19}$	5. $\sqrt{40}$	6. $\sqrt{6}$
7. $\sqrt{53}$	8. $\sqrt{23}$	9. $\sqrt{30}$
10. $\sqrt{21}$	11. $\sqrt{90}$	12. $\sqrt{73}$
13. $\sqrt{72}$	14. $\sqrt{56}$	15. $\sqrt{89}$
16. $\sqrt{135}$	17. $\sqrt{152}$	18. $\sqrt{110}$
19. $\sqrt{162}$	20. $\sqrt{129}$	21. $\sqrt{181}$
22. $\sqrt{174}$	23. $\sqrt{223}$	24. $\sqrt{195}$
25. $\sqrt{240}$	26. $\sqrt{271}$	27. $\sqrt{312}$
28. $\sqrt{380}$	29. $\sqrt{335}$	30. $\sqrt{300}$

8-7

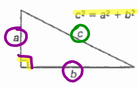
NAME ______________ DATE ______ PERIOD ______

Study Guide

Student Edition Pages 366–371

The Pythagorean Theorem

One of the most famous theorems in mathematics gives the relationship among the sides of a right triangle. The Pythagorean Theorem states that the square of the length of the hypotenuse of a right triangle is equal to the sum of the squares of the lengths of the other two sides, also known as legs. Use the model shown for a right triangle with hypotenuse c.



$A^2 + B^2 = C^2$

This relationship is powerful because it is true for *any* right triangle.

Example 1: Find the length of the hypotenuse of a right triangle with side lengths 5 centimeters and 12 centimeters.

$c^2 = a^2 + b^2$
$c^2 = 5^2 + 12^2$
$c^2 = 25 + 144 = 169$
$c = \sqrt{169}$
$c = 13$

The length of the hypotenuse is 13 centimeters.

Example 2: Find the length of a side of a right triangle if the length of the hypotenuse is 25 feet and the length of one leg is 7 feet.

$c^2 = a^2 + b^2$
$25^2 = 7^2 + b^2$
$625 = 49 + b^2$
$625 - 49 = 49 + b^2 - 49$
$576 = b^2$
$b = \sqrt{576}$
$b = 24$

The length of the leg is 24 feet.

If c is the measure of the hypotenuse of a right triangle and a and b are the measures of the legs, find each missing measure.

1. $a = 3, b = 4, c = ?$ see notes	2. $a = 7, b = 24, c = ?$ see notes	3. $a = 9, b = 40, c = ?$
4. $a = 5, b = ?, c = 13$	5. $a = 20, b = ?, c = 29$ see notes	6. $a = ?, b = 8, c = 10$
7. $a = ?, b = 48, c = 50$	8. $a = 9, b = ?, c = 15$	9. $a = 60, b = 80, c = ?$
10. $a = ?, b = 36, c = 45$	11. $a = 40, b = 42, c = ?$	12. $a = 25, b = ?, c = 65$ see notes

1)

$A = 3$
$B = 4$
$C = ?$

$A^2 + B^2 = C^2$

$(3)^2 + (4)^2 = C^2$

$\underbrace{9 + 16}_{\sqrt{25}} = C^2$

$\sqrt{25} = \sqrt{C^{\cancel{2}}}$

$5 = C$

$C = 5$ units

2)

$A = 7$
$B = 24$
$C = ?$

$A^2 + B^2 = C^2$

$(7)^2 + (24)^2 = C^2$

$49 + 576 = C^2$

$$\begin{array}{r} 576 \\ +49 \\ \hline 625 \end{array} = C^2$$

$\sqrt{625} = \sqrt{C^{\cancel{2}}}$

$25 = C$

$C = 25$ units

5)

A= 20 units

B= ?

C= 29units

$$20^2+b=29^2$$

$$400+b^2=841$$

$$+-400 \qquad +-400$$

$$\sqrt{b^2}=\sqrt{441}$$

$$b=21 \text{ units}$$

12)

A= 25

B= ?

C= 65

$$A^2+B^2=C^2$$

$$(25)^2+B^2=(65)^2$$

$$\cancel{625}+B^2=4225$$

$$\cancel{+-625} \qquad = +-625$$

$$\sqrt{B^2}=\sqrt{3600}$$

$$B = 60 \text{ units}$$

8-7

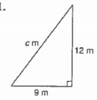
NAME ______ DATE ______ PERIOD ______

Practice

Student Edition Pages 366–371

The Pythagorean Theorem

If c is the measure of the hypotenuse and a and b are the measures of the legs, find each missing measure. Round to the nearest tenth if necessary.

1.


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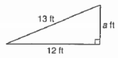

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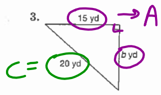

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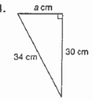

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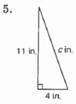

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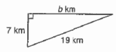

7. $a = 8, b = 10, c = ?$

8. $b = 20, c = 22, a = ?$
see notes

9. $c = 26, a = 10, b = ?$

10. $a = 21, c = 35, b = ?$

The lengths of three sides of a triangle are given. Determine whether each triangle is a right triangle.

11. 12 m, 16 m, 20 m

12. 8 cm, 12 cm, 14 cm

13. 6 in., 15 in., 16 in.

14. 7 ft, 24 ft, 25 ft

$A^2+B^2=C^2$

$15^2+6^2 \stackrel{?}{=} 16^2$

$\underbrace{225+36}_{} \stackrel{?}{=} 256$

$225 + 36 = 261 \quad \stackrel{?}{\neq} 256$

It is not a right triangle because $A^2+B^2 \neq C^2$.

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8) $A^2+B^2=C^2$

A = ?
B = 20 units
C = 22 units

$A^2 + 20^2 = 22^2$

$A^2 + \cancel{400} = 484$

$\quad + -\cancel{400} = + -400$

$\sqrt{A^2} = \sqrt{84}$

$A \approx 9$ units

or

≈ 9.165 units (see chart)

≈ 9.2 units