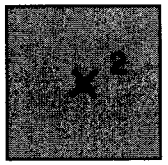
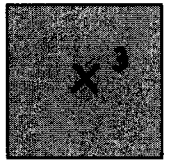
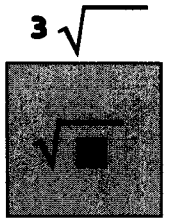
INDICES and STANDARD FORM

Square, square root, cube and cube root

Calculator keys







Work out the following

1) 5^2

2) 8^2

3) 8^3

4) 10^3

5) $\sqrt{81}$

6) $\sqrt{289}$

7) $\sqrt[3]{2744}$

8) 0.5^2

9) 4^3

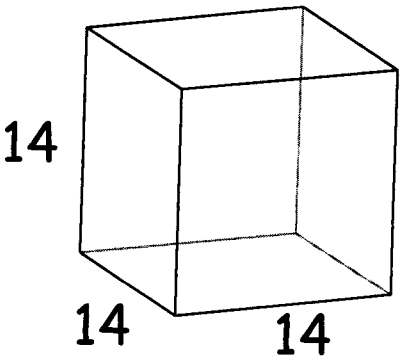
10) $\sqrt[3]{1728}$

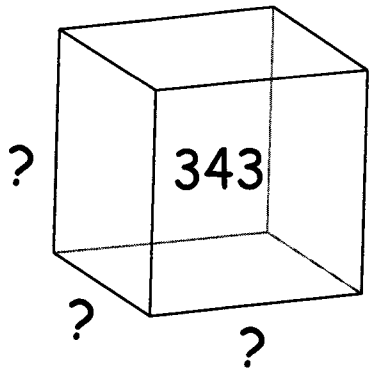
Fill in the gaps in these tables

number	number²
11	121
13	
	361
21	
	841
18	

number	number³
4	64
7	
	1331
12	
	9261
18	

How many 1 centimetre cubes would it take to make this big cube measuring 14 cm by 14 cm by 14 cm?





It took 343 small 1 cm cubes to make this big cube. What are the lengths of the side of the big cube?

INDICES

Complete this table

Number	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Square														
Cube					x	x	x	x		x	x	x	x	x

Square and square root NOTE to square a negative number on your calculator use brackets

5^2 = _____ $(-5)^2$ = _____ so the $\sqrt{25}$ = _____ or _____

6^2 = _____ $(-6)^2$ = _____ so the $\sqrt{36}$ = _____ or _____

7^2 = _____ $(-7)^2$ = _____ so the $\sqrt{49}$ = _____ or _____

Key Fact - Every number greater than 0 has _____ square roots. One positive, one negative

The power of 0

3^0 = _____ 5^0 = _____ 9^0 = _____ m^0 = _____

Key Fact - Any number to the power of 0 is _____

Cube Root $2^3 = 8$ so the cube root of 8, written $\sqrt[3]{8}$ = _____

$\sqrt[3]{1000}$ = _____ $\sqrt[3]{125}$ = _____ $\sqrt[3]{64}$ = _____

The power of $\frac{1}{2}$ Using your calculator investigate

$4^{\frac{1}{2}}$ = _____ $25^{\frac{1}{2}}$ = _____ $64^{\frac{1}{2}}$ = _____ $100^{\frac{1}{2}}$ = _____

Key Fact - The power of $\frac{1}{2}$ is the same as _____

The power of $\frac{1}{3}$ Using your calculator investigate

$125^{\frac{1}{3}}$ = _____ $8^{\frac{1}{3}}$ = _____ $1000^{\frac{1}{3}}$ = _____ $64^{\frac{1}{3}}$ = _____

Key Fact - The power of $\frac{1}{3}$ is the same as _____

Fractional Indices

$8^{\frac{2}{3}}$

Key Fact – for a index that is a fraction, the numerator = _____
the denominator =

$4^{\frac{3}{2}}$ = _____ $25^{\frac{3}{2}}$ = _____ $1000^{\frac{4}{3}}$ = _____

Negative Index

$4^{-2} = \frac{1}{4^2} =$ $2^{-3} = \frac{1}{2^3} =$ $2^{-1} = \frac{1}{2^1} =$

Key Fact – For a negative index, just write it as 1 over the equivalent positive index

Index Laws

Multiplication – add the index numbers

$2^3 \times 2^5 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^8$ $2^3 \times 2^5 = 2^{3+5} = 2^8$

Division – subtract the index numbers

$2^5 \div 2^3 = \frac{2 \times 2 \times 2 \times 2 \times 2}{2 \times 2 \times 2} = 2^2$ $2^5 \div 2^3 = 2^{5-3} = 2^2$

To the power of – multiply the index numbers

$(2^3)^2 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^6$ $(2^3)^2 = 2^{3 \times 2} = 2^6$

Further examples

1) $a^2 \times a^4 = a$ 2) $b^7 \div b^3 = b$ 3) $(y^3)^4 =$

4) $3b^2 \times 4b^5 =$ 5) $(a^4)^2 =$ 6) $\frac{x^7 \times x^2}{x^2 \times x^3} = \frac{x}{x} = x$

Simplifying Expressions involving Indices

1) $a^2 \times a^3 =$

2) $a^4 \times a^5 =$

3) $2a^3 \times 4a =$

4) $2a^2 \times 3a^3 =$

5) $(a^4)^2 =$

6) $(a^3)^4 =$

7) $(2a^2)^3 =$

8) $(3a^4)^2 =$

9) $\frac{a^5}{a^2} =$

10) $\frac{a^7}{a^3} =$

11) $\frac{4a^6}{2a^2} =$

12) $\frac{9a^5}{3a} =$

13) $\frac{2a^5 \times 6a^3}{3a^2} =$

14) $3a^3b^2 \times 5ab^3 =$

15) $4a^2b^5 \times 3a^2b^4 =$

16) $(3a^3b^2)^2 =$

17) $(2a^2b^3)^4 =$

18) $\frac{12a^5b^3}{4a^3b^2} =$

19) $\frac{9a^7b^4}{6a^5b} =$

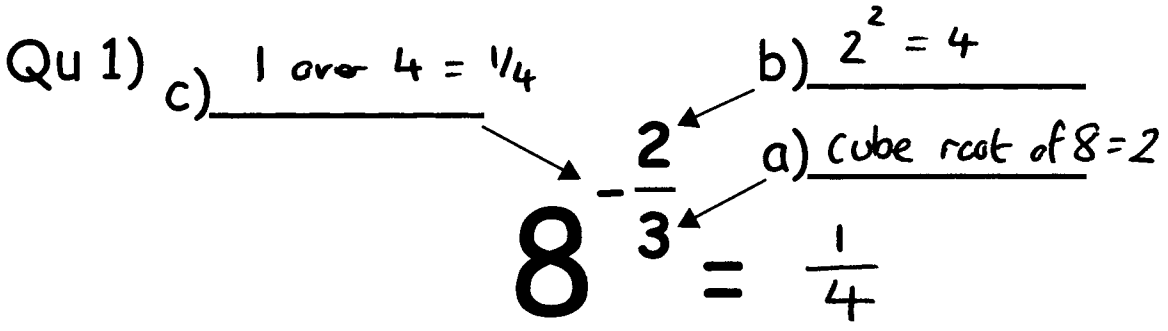
20) $\frac{8a^4b^2}{6a^4b^3} =$

Indices

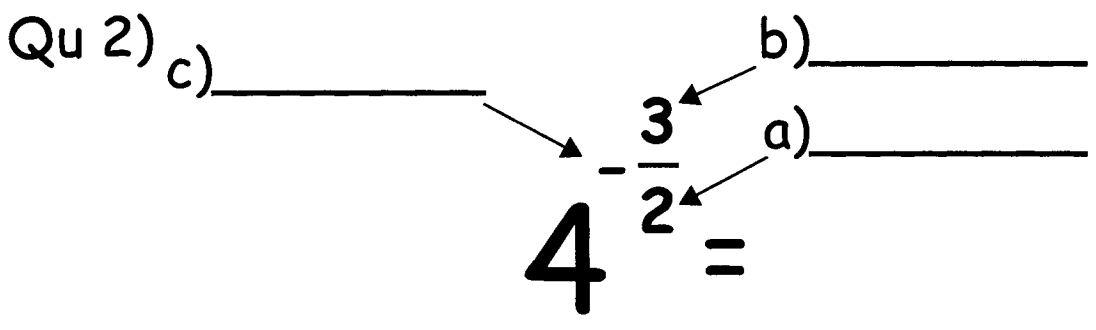
Index	Meaning	Example	Questions		
0	Always = 1	$2^0 = 1$	$4^0 =$	$5^0 =$	$a^0 =$
1	Just the number	$2^1 = 2$	$5^1 =$	$8^1 =$	$a^1 =$
-1	1 over the number	$2^{-1} = \frac{1}{2}$	$5^{-1} =$	$8^{-1} =$	$a^{-1} =$
2	Square	$2^2 = 2x2 = 4$	$3^2 =$	$4^2 =$	$10^2 =$
-2	1 over the number squared	$2^{-2} = \frac{1}{2^2} = \frac{1}{4}$	$3^{-2} =$	$4^{-2} =$	$10^{-2} =$
3	Cube	$2^3 = 2x2x2 = 8$	$3^3 =$	$4^3 =$	$10^3 =$
-3	1 over the number cubed	$2^{-3} = \frac{1}{2^3} = \frac{1}{8}$	$3^{-3} =$	$4^{-3} =$	$10^{-3} =$
$\frac{1}{2}$	Square root	$4^{\frac{1}{2}} = \sqrt{4} = 2$	$16^{\frac{1}{2}} =$	$49^{\frac{1}{2}} =$	$9^{\frac{1}{2}} =$
$-\frac{1}{2}$	1 over the square root	$4^{-\frac{1}{2}} = \frac{1}{\sqrt{4}} = \frac{1}{2}$	$16^{\frac{1}{2}} =$	$49^{-\frac{1}{2}} =$	$9^{-\frac{1}{2}} =$
$\frac{1}{3}$	Cube root	$8^{\frac{1}{3}} = \sqrt[3]{8} = 2$	$27^{\frac{1}{3}} =$	$64^{\frac{1}{3}} =$	$1000^{\frac{1}{3}} =$
$-\frac{1}{3}$	1 over the cube root	$8^{-\frac{1}{3}} = \frac{1}{\sqrt[3]{8}} = \frac{1}{2}$	$27^{-\frac{1}{3}} =$	$64^{-\frac{1}{3}} =$	$1000^{-\frac{1}{3}} =$
$\frac{3}{2}$	Square root then cube	$4^{\frac{3}{2}} = (\sqrt{4})^3 = 8$	$9^{\frac{3}{2}} =$	$16^{\frac{3}{2}} =$	$25^{\frac{3}{2}} =$
$-\frac{3}{2}$	1 over the square root then cube	$4^{-\frac{3}{2}} = \frac{1}{(\sqrt{4})^3} = \frac{1}{8}$	$9^{-\frac{3}{2}} =$	$16^{-\frac{3}{2}} =$	$25^{-\frac{3}{2}} =$
$-\frac{2}{3}$	1 over the cube root then square	$8^{-\frac{2}{3}} = \frac{1}{(\sqrt[3]{8})^2} = \frac{1}{4}$	$27^{-\frac{2}{3}} =$	$64^{-\frac{2}{3}} =$	$1000^{-\frac{2}{3}} =$

Reminder $3^3 = 27, \sqrt[3]{27} = 3;\ 4^3 = 64, \sqrt[3]{64} = 4;\ 10^3 = 1000, \sqrt[3]{1000} = 10$

Qu 1)



Qu 2)



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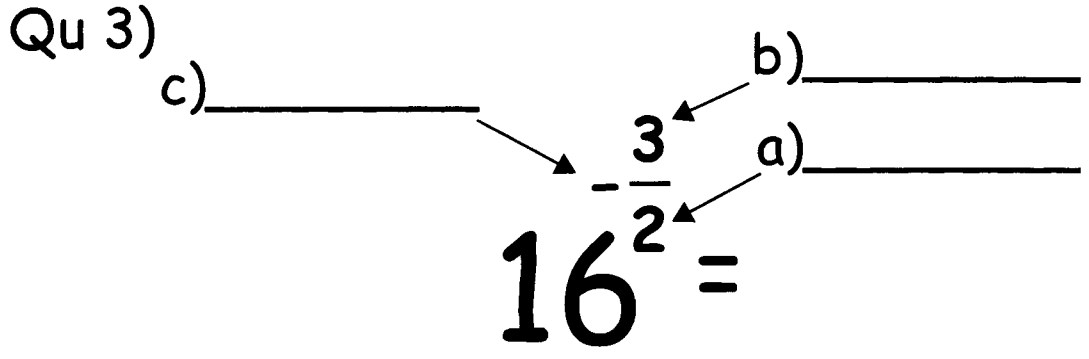

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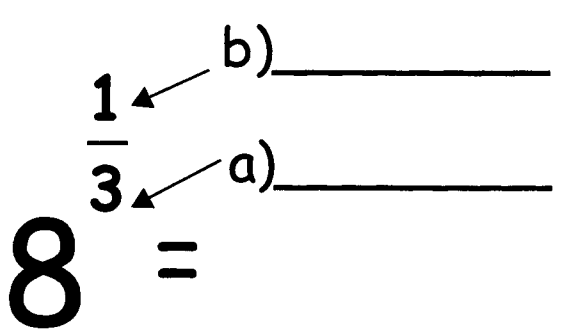

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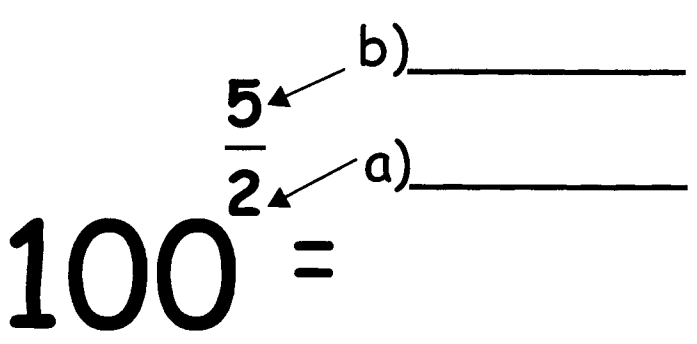

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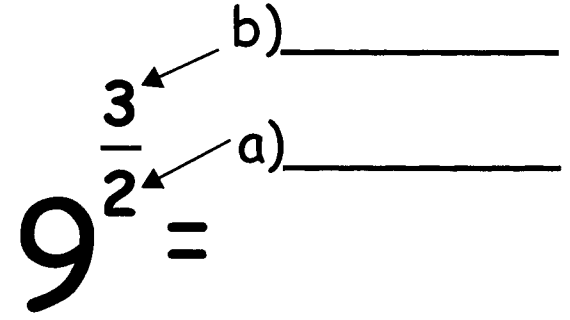

Indices

Section 1 Workout the numerical answer. E.g. $2^3 = 8$

1) 7^2
2) 2^5
3) 3^4
4) 5^1
5) 4^6
6) 12^0
7) 1^2
8) 110^0
9) 3^{-1}
10) 2^{-3}
11) 10^{-2}
12) 100^{-1}

Section 2 Simplify the following, giving your answer in index form.

E.g. $y^2 \times y^3 = y^5$

13) $5^6 \times 5^2$
14) $\frac{4^7}{4^3}$
15) $a^2 \times a^7$
16) $(b^3)^2$
17) $(9^2)^5$
18) $\frac{a^4}{a^6}$
19) $p^{10} \div p^6$
20) $2^6 \div 2^4$
21) $2b^3 \times 4b^4$
22) $\frac{a^4 \times a^3}{a^2}$
23) $(3x^2)^3$
24) $10b^7 \div 2b^3$

Section 3 Workout the numerical answer. E.g. $4^{\frac{1}{2}} = 2$

25) $49^{\frac{1}{2}}$
26) $121^{\frac{1}{2}}$
27) $64^{\frac{1}{3}}$
28) $8^{\frac{2}{3}}$
29) $4^{\frac{3}{2}}$
30) $9^{-\frac{1}{2}}$
31) $27^{-\frac{1}{3}}$
32) $16^{\frac{3}{4}}$
33) $32^{\frac{2}{5}}$
34) $(-8)^{\frac{1}{3}}$
35) $(-4)^{\frac{1}{2}}$
36) $100^{\frac{3}{2}}$

STANDARD FORM KEY SKILLS

1) Which number is not in standard form?

4.3×10^{4} 43×10^{4} 4.3×10^{-2}

2) Write these numbers in standard form

a) 45600 b) 8000 c) 0.0206

3) Write these numbers in normal form

a) 2.09×10^{4} b) 1.7×10^{3} c) 7.956×10^{-2}

4) Write these numbers in order of size, smallest to biggest

3×10^{-2} 3×10^{4} 2.7×10^{-2}

5) Without using a calculator work out the following.
Give your answer in standard form.

a) $2 \times 10^{4} \times 3 \times 10^{3}$

b) $4 \times 10^{5} \times 3 \times 10^{3}$

c) $4 \times 10^{4} \div 2 \times 10^{2}$

d) $4 \times 10^{5} \div 8 \times 10^{3}$

6) Using a calculator work out the following.
Give your answer in standard form.

Remember use the $\times 10^{x}$ button

a) $4.3 \times 10^{-2} \times 7.8 \times 10^{8}$

b) $4 \times 10^{9} \times 4 \times 10^{6}$

c) $6 \times 10^{9} \div 1.2 \times 10^{-2}$

d) $(6 \times 10^{3})^{2}$

e) $4 \times 10^{6} + 4 \times 10^{5}$

f) $1.3 \times 10^{5} - 4 \times 10^{3}$

Standard Form

Write these numbers in standard form

1) 0.0000365

2) 7300

3) 210

4) 0.0000201

Write these numbers in normal form

5) 2.7×10^4

6) 1.6×10^{-3}

7) 4.07×10^5

8) 2.06×10^{-4}

9) Write these numbers in order of size smallest to largest.

2.07×10^5, 2.3×10^{-5}, 2.1×10^5, 2.07×10^4

Without a calculator work out the answers

10) $3 \times 10^4 \times 4 \times 10^3$

11) $\frac{8 \times 10^5}{2 \times 10^2}$

With a calculator work out the answers.
Give your answers in standard form to 1dp

12) $(2.07 \times 10^7)^2$

13) $\frac{2.3 \times 10^5 + 5.7 \times 10^6}{2.4 \times 10^{-2} - 1.07 \times 10^{-3}}$

Revision on Indices and Standard Form

1) $3^6 \times 3^7 = 3^?$ 1 mark

2) $\frac{3^7}{3^2} = 3^?$ 1 mark

3) $(3^2)^4 = 3^?$ 1 mark

4) Simplify $5c^4d^2 \times c^2d^3$ 2 marks

5) Simplify $(3x^2y^4)^2$ 2 marks

6) Simplify $(2x^5y^4z^6) \times (7x^2y^3z)$ 3 marks

7) Solve $x^2 = 36$ 2 marks

8) Simplify $(2a^3b)^4$ 2 marks

9) Write these in order of size. Smallest first

$27^{\frac{2}{3}}$, $64^{\frac{1}{3}}$, $4^{\frac{3}{2}}$

10) $(2a^2)^3$

Write these numbers in standard form

11) 0.0025

12) 630

13) 5003

14) 0.00002

Write these numbers in normal form

15) 5.7×10^3

16) 2.6×10^{-2}

17) 2.07×10^5

18) 1.06×10^{-4}

19) Write these numbers in order of size smallest to largest.

2.07×10^5, 2.3×10^{-5}, 2.1×10^5, 2.07×10^4

Without a calculator work out the answers

21) $3 \times 10^4 \times 4 \times 10^3$

22) $\frac{8 \times 10^5}{2 \times 10^2}$

With a calculator work out the answers.
Give your answers in standard form to 1dp

23) $(2.07 \times 10^7)^2$

24) $\frac{2.3 \times 10^5 + 5.7 \times 10^6}{2.4 \times 10^{-2} - 1.07 \times 10^{-3}}$