Warm Up

Bedmas

1) $12 - 6 \times 7 - (5-3)^2 + 24 \div 3$

$= 12 - 6 \times 7 - (2)^2 + 24 \div 3$

$= 12 - 6 \times 7 - 4 + 24 \div 3$

$= 12 - 42 - 4 + 24 \div 3$

$= 12 - 42 - 4 + 8$

$= -26$

2) To attend the local fair the cost for admission is $5.25. If you plan to go on rides it is an additional $2.00 per ticket. How many rides could you go on if you have $47.00?

Key words

per / for every / for each → this # goes with variable

$2t + 5.25 = \$47$

$2t + 5.25 - 5.25 = \$47 - 5.25$

$\frac{2t}{2} = \frac{\$41.75}{2}$

$t = 20.87$

How many tickets?

Buy 20 tickets

x^2

$6 \quad \boxed{x^2} \quad \Rightarrow 36$

4.1 Estimating Roots

MATH LAB

LESSON FOCUS Explore decimal representations of different roots of numbers.

Make Connections

Since $3^2 = 9$, 3 is a square root of 9.

We write: $3 = \sqrt{9}$

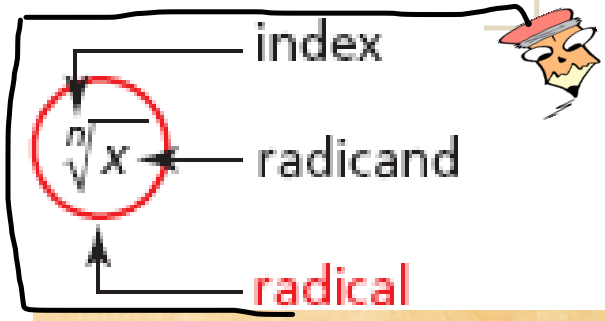
Since $3^3 = 27$, 3 is the cube root of 27.

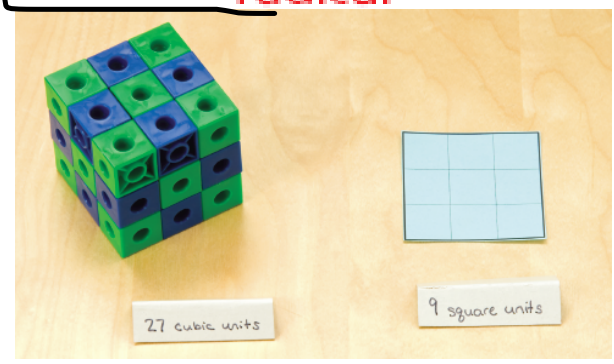
We write: $3 = \sqrt[3]{27}$

Since $3^4 = 81$, 3 is a fourth root of 81.

We write: $3 = \sqrt[4]{81}$

How would you write 5 as a square root? A cube root? A fourth root?





What do you know???

dot means multiply

$x^2 = x \cdot x$

Exponents
↳ repeated multiplication

$x^3 = x \cdot x \cdot x$

$x^4 = x \cdot x \cdot x \cdot x$

Let's try some examples:

a) $3^2 = 3 \cdot 3$
$= 9$

b) $4^3 = 4 \cdot 4 \cdot 4$
$= 64$

c) $\sqrt{81} = 9$
$\sqrt{9 \times 9}$

d) $\sqrt{49} = 7$

Exponent button

x^y or y^x or $\wedge$

exponent

$6\ y^x\ 2 = 36$

x^2 x^3

$\sqrt{\ }$

6^2

$6\ x^2 \Rightarrow 36$

$\sqrt{36}$

$36\ \sqrt{\ } \Rightarrow 6$

$\sqrt{\ }\ 36 \Rightarrow 6$


Power
exponent
8^3
base

Exponents

Exponents are shorthand for multiplication:

$(5)\,(5) = 5^2$, $(5)\,(5)\,(5) = 5^3$.

The "exponent" stands for however many times the term is being multiplied.

5^3 (3 times) $5 \times 5 \times 5 = 125$

Repeat Base

The term that's being multiplied is called the "base".

Base → 5^3

#1

Write each power as a product, then evaluate.

a) 3^4

$3 \cdot 3 \cdot 3 \cdot 3$

81

b) 5^3

$= 5 \cdot 5 \cdot 5$

$= 125$

c) $\left(\frac{2}{3}\right)^3$

$\left(\frac{2}{3}\right) \cdot \left(\frac{2}{3}\right) \cdot \left(\frac{2}{3}\right)$

$= \frac{2 \times 2 \times 2}{3 \times 3 \times 3}$

$= \frac{8}{27}$

d) $\left(\frac{4}{5}\right)^2$

$= \frac{4}{5} \times \frac{4}{5}$

$= \frac{16}{25}$

Write each product as a power, then evaluate.

#2

a) (4)(4)(4)

$= 4^3$

$= 64$

b) (-6)(-6)(-6)(-6)(-6)

$= (-6)^5$

$= -7776$

-3^2

$-(3)^2$ vs $(-3)^2$

$-3 \cdot 3$ $(-3)(-3)$

-9 $+9$

a^n

POWERS

x^t

$1^0 = 1$
$1^1 = 1$
$1^2 = 1$
$1^3 = 1$
$1^4 = 1$
$1^5 = 1$

$2^0 = 1$
$2^1 = 2$
$2^2 = 4$
$2^3 = 8$
$2^4 = 16$
$2^5 = 32$

$3^0 = 1$
$3^1 = 3$
$3^2 = 9$
$3^3 = 27$
$3^4 = 81$
$3^5 = 243$

$4^0 = 1$
$4^1 = 4$
$4^2 = 16$
$4^3 = 64$
$4^4 = 256$
$4^5 = 1024$

$5^0 = 1$
$5^1 = 5$
$5^2 = 25$
$5^3 = 125$
$5^4 = 625$
$5^5 = 3125$

$6^0 = 1$
$6^1 = 6$
$6^2 = 36$
$6^3 = 216$
$6^4 = 1296$
$6^5 = 7776$

$7^0 = 1$
$7^1 = 7$
$7^2 = 49$
$7^3 = 343$
$7^4 = 2401$
$7^5 = 16807$

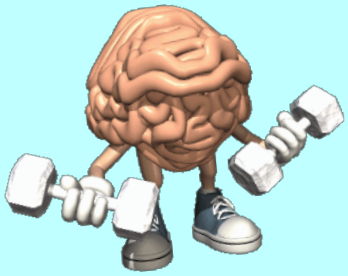
$8^0 = 1$
$8^1 = 8$
$8^2 = 64$
$8^3 = 512$
$8^4 = 4096$
$8^5 = 32768$

$9^0 = 1$
$9^1 = 9$
$9^2 = 81$
$9^3 = 729$
$9^4 = 6561$
$9^5 = 59049$

$10^0 = 1$
$10^1 = 10$
$10^2 = 100$
$10^3 = 1000$
$10^4 = 10000$
$10^5 = 100000$

51^7

$(2x)^n$



Warm Up

Review From Grade 9

1) $(2 + (5+1)^3 + (-2)^7) \div [2(-1+4^2)]$

2) $\frac{(6x14)}{7} + 100 \times 4 \div 5^2$

3) A taxi driver charges a flat fee of $9.00 and $3.00 for ever kilometre travelled.

a) Write an equation that represents the scenario.

b) If you travel 18 km how much would you have to pay the taxi driver? (use your equation from part a)

b) If you have $66.00 how far can you travel in the taxi? (use your equation from part a)

Powers with a Twist

Can you see the difference?

-4^2

Negative is not being repeated only the #4

-4×4

-16

$(-4)^2$

Here both (-) and (4) are repeated

$(-4)(-4)$

$+16$

THINK

$(-1)^2 = (-1)(-1) = +1$

$(-1)^3 = (-1)(-1)(-1) = -1$

$(-1)^4 = (-1)(-1)(-1)(-1) = +1$

$(-1)^5 =$

.
.
.

Did you see a pattern??

$(-1)^{10247} = -1$ ← odd exponent

$(-1)^{29584} = +1$ ← even

Will this answer be ⊕ or ⊖?

$(-7)^{35} = \ominus$ odd exponent

$(-1)^{10247} = -1$ $(-1)^{29584} = 1$

Evaluating powers when the base is negative...

If the exponent is even the answer will be positive.

If the exponent is odd the answer will be negative.

Perfect Squares

$(1)^2 = 1 \times 1 = 1$

$(2)^2 = 2 \times 2 = 4$

$(3)^2 = 3 \times 3 = 9$

$(4)^2 = 4 \times 4 = 16$

$(5)^2 = 5 \times 5 = 25$

$(6)^2 = 6 \times 6 = 36$

$(7)^2 = 7 \times 7 = 49$

$(8)^2 = 8 \times 8 = 64$

$(9)^2 = 9 \times 9 = 81$

$(10)^2 = 10 \times 10 = 100$

$(11)^2 = 11 \times 11 = 121$

$(12)^2 = 12 \times 12 = 144$

$(13)^2 = 13 \times 13 = 169$

$(14)^2 = 14 \times 14 = 196$

$(15)^2 = 15 \times 15 = 225$

$(16)^2 = 16 \times 16 = 256$

$(17)^2 = 17 \times 17 = 289$

$(18)^2 = 18 \times 18 = 324$

$(19)^2 = 19 \times 19 = 361$

$(20)^2 = 20 \times 20 = 400$

$(21)^2 = 21 \times 21 = 441$

$(22)^2 = 22 \times 22 = 484$

$(23)^2 = 23 \times 23 = 529$

Perfect Cubes

$(1)^3 = 1 \times 1 \times 1 = \mathbf{1}$

$(2)^3 = 2 \times 2 \times 2 = \mathbf{8}$

$(3)^3 = 3 \times 3 \times 3 = \mathbf{27}$

$(4)^3 = 4 \times 4 \times 4 = \mathbf{64}$

$(5)^3 = 5 \times 5 \times 5 = \mathbf{125}$

$(6)^3 = 6 \times 6 \times 6 = \mathbf{216}$

$(7)^3 = 7 \times 7 \times 7 = \mathbf{343}$

$(8)^3 = 8 \times 8 \times 8 = \mathbf{512}$

$(9)^3 = 9 \times 9 \times 9 = \mathbf{729}$

$(10)^3 = 10 \times 10 \times 10 = \mathbf{1000}$

$(11)^3 = 11 \times 11 \times 11 = \mathbf{1331}$

$(12)^3 = 12 \times 12 \times 12 = \mathbf{1728}$

$(13)^3 = 13 \times 13 \times 13 = \mathbf{2197}$

$(14)^3 = 14 \times 14 \times 14 = \mathbf{2744}$

$(15)^3 = 15 \times 15 \times 15 = \mathbf{3375}$

$(16)^3 = 16 \times 16 \times 16 = \mathbf{4096}$

$(17)^3 = 17 \times 17 \times 17 = \mathbf{4913}$

$(18)^3 = 18 \times 18 \times 18 = \mathbf{5832}$

$(19)^3 = 19 \times 19 \times 19 = \mathbf{6859}$

$(20)^3 = 20 \times 20 \times 20 = \mathbf{8000}$

$(21)^3 = 21 \times 21 \times 21 = \mathbf{9261}$

$(22)^3 = 22 \times 22 \times 22 = \mathbf{10648}$

$(23)^3 = 23 \times 23 \times 23 = \mathbf{12167}$

$(24)^3 = 24 \times 24 \times 24 = \mathbf{13824}$

$(25)^3 = 25 \times 25 \times 25 = \mathbf{15624}$

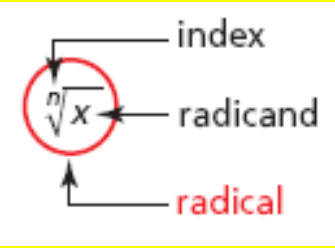
What do you know???

$\sqrt[2]{64}$

understood "2"

$\sqrt{64} = 8$

$\sqrt[3]{27} = 3$



$\sqrt[4]{64}$

$\sqrt{98}$

closer

$\sqrt{81}$ $\sqrt{100}$

$\Downarrow$ $\Downarrow$

9 10

≈ 9.9

$\sqrt[4]{64}$

TRY THIS

Write the two consecutive perfect squares closest to 20.

Fill in the table until the square of the estimate is within 1 decimal place of 20.

Estimated value of $\sqrt{20}$	Square of estimate

$\sqrt{20}$

$\sqrt{16}$ $\sqrt{25}$

4 5

≈ 4.4

4.1 Math Lab: Estimating Roots

TRY THIS

1) Determine the value of each radical. Do for Homework

Radical	Value	Is the Value Exact or Approximate?
$\sqrt{16}$	$= 4$	Exact
$\sqrt{27}$ $\sqrt{2}\,\sqrt{3}\,\sqrt{6}$	≈ 5.1	Approximate
$\sqrt{\frac{16}{81}}$	$\frac{\sqrt{16}}{\sqrt{81}} = \frac{4}{9}$	Exact
$\sqrt{0.64}$		
$\sqrt[3]{16}$		
$\sqrt[3]{27}$		
$\sqrt[3]{\frac{16}{18}}$		

2) a) Make a list of the perfect 4th up to 25

B) Make a list of the perfect 5th

$1^4 = 1$

$2^4 = 16$

$3^4 =$

4^4

5^4

.

.

.

.

$$\sqrt{\frac{16}{81}} = \frac{\sqrt{16}}{\sqrt{81}} = \frac{4}{9}$$ Exact

List of Perfect 4ths

Use Calculators

$1^4 = 1 \times 1 \times 1 \times 1 = 1$

$2^4 = 2 \times 2 \times 2 \times 2 = 16$

3^4

4^4

5^4

.

.

.

.

25^4

then do perfect 5ths