

4.1

MATH LAB

Estimating Roots



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.

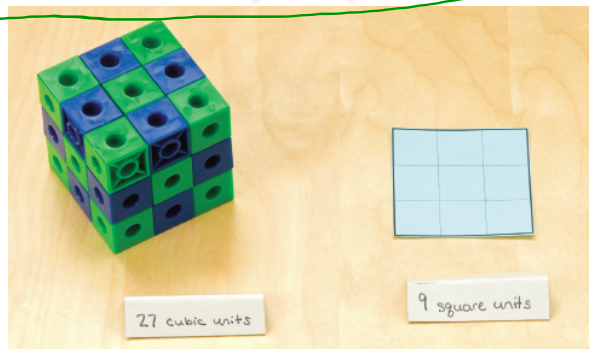
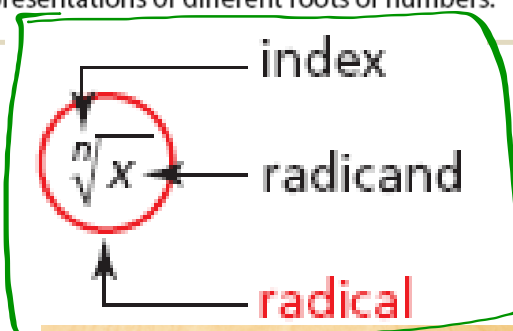
We write: $3 = \sqrt[3]{27}$

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?



$$\sqrt{25} = 5$$

$$\sqrt[3]{125} = 5$$

$5 \times 5 \times 5$

$$\sqrt[4]{425} = 5$$

$5 \times 5 \times 5 \times 5$
 $\checkmark \quad \checkmark$
 25×25



Warm Up

BEDMAS

$$\begin{aligned}
 1) & 12 - 6 \times 7 - (5-3)^2 + 24 \div 3 \\
 & 12 - 6 \times 7 - (\underline{2})^2 + 24 \div 3 \\
 & 12 - \underline{6 \times 7} - 4 + 24 \div 3 \\
 & 12 - \underline{42} - 4 + \underline{24 \div 3} \\
 & \underline{12 - 42} - 4 + \underline{8} \\
 & \underline{-30} - 4 + 8 \\
 & \underline{-34} + 8 \\
 & \underline{-26}
 \end{aligned}$$

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?

let t represent
of tickets

$$5.25 + 2t = \$47.00$$

$$\cancel{5.25}^{-5.25} + 2t = 47 - 5.25$$

$$2t = \$41.75$$

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

$$t = 20.875$$

Can only buy 20 tickets

What do you know???

In Math \times , \cdot , $()()$
all means multiply



$$x^2 = x \cdot x$$

$$\text{Ex) } 4^2 = 4 \times 4 = 16$$

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

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

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

$$4^4 = 4 \cdot 4 \cdot 4 \cdot 4 = 256$$

Power Button on Calculator

$$y^x$$



$$5^4 = 625$$

$$\square^x$$

$$\square^{\square}$$

5 button 4

Let's try some examples:

$$\text{a) } 3^2 = 3 \times 3 \\ = 9$$

$$\text{b) } 4^3 = 4 \times 4 \times 4 \\ = 64$$

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

$$\text{d) } \sqrt{49} = \sqrt{7 \times 7} \\ = 7$$

A handwritten diagram of the expression 8^3 . The number 8 is written in red, and the number 3 is also in red. A blue arrow points from the word "exponent" to the 3. Another blue arrow points from the word "base" to the 8. A black bracket underneath the 8 is labeled "Power".

Read
8 to the exponent 3

Base is the number being repeated

Exponent tells you how many times the base is repeated.

power
8³
base exponent

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.

Exponent

5³

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

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

Base → 5³

Write each power as a product, then evaluate.

#1

a) 3^4
 $= 3 \times 3 \times 3 \times 3$
 $= 81$

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

c) $\left(\frac{2}{3}\right)^3$
 $= \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3}$
 $= \frac{2 \times 2 \times 2}{3 \times 3 \times 3}$
 $= \frac{8}{27}$

d) $\left(\frac{4}{5}\right)^2$
 $= \frac{4}{5} \times \frac{4}{5}$
 $= \frac{4 \times 4}{5 \times 5}$
 $= \frac{16}{25}$

Write each product as a power, then evaluate.

#2

a) $(4)(4)(4)$

$$= 4^3$$

$$= 64$$

$$= (-7)(-7)(-7)(-7)$$

$$(-7)^4$$

$$= 2401$$

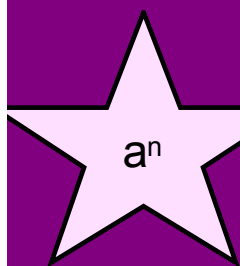
b) $(-6)(-6)(-6)(-6)(-6)$

$$= (-6)^5$$

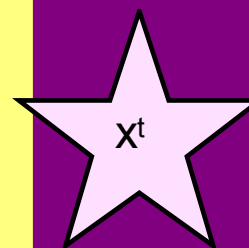
$$= -7776$$

-7^4 ← not tied to neg sign
 $= -7 \times 7 \times 7 \times 7$

$$-2401$$



POWERS



$$1^0 = 1$$

$$1^1 = 1$$

$$1^2 = 1$$

$$1^3 = 1$$

$$1^4 = 1$$

$$1^5 = 1$$

$$2^0 = 1$$

$$2^1 = 2$$

$$2^2 = 4$$

$$2^3 = 8$$

$$2^4 = 16$$

$$2^5 = 32$$

$$3^0 = 1$$

$$3^1 = 3$$

$$3^2 = 9$$

$$3^3 = 27$$

$$3^4 = 81$$

$$3^5 = 243$$

$$4^0 = 1$$

$$4^1 = 4$$

$$4^2 = 16$$

$$4^3 = 64$$

$$4^4 = 256$$

$$4^5 = 1024$$

$$5^0 = 1$$

$$5^1 = 5$$

$$5^2 = 25$$

$$5^3 = 125$$

$$5^4 = 625$$

$$5^5 = 3125$$

$$6^0 = 1$$

$$6^1 = 6$$

$$6^2 = 36$$

$$6^3 = 216$$

$$6^4 = 1296$$

$$6^5 = 7776$$

$$7^0 = 1$$

$$7^1 = 7$$

$$7^2 = 49$$

$$7^3 = 343$$

$$7^4 = 2401$$

$$7^5 = 16807$$

$$8^0 = 1$$

$$8^1 = 8$$

$$8^2 = 64$$

$$8^3 = 512$$

$$8^4 = 4096$$

$$8^5 = 32768$$

$$9^0 = 1$$

$$9^1 = 9$$

$$9^2 = 81$$

$$9^3 = 729$$

$$9^4 = 6561$$

$$9^5 = 59049$$

$$10^0 = 1$$

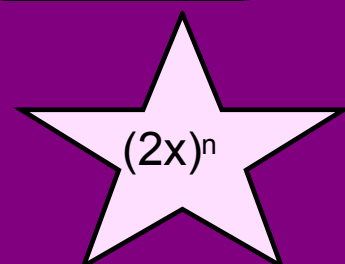
$$10^1 = 10$$

$$10^2 = 100$$

$$10^3 = 1000$$

$$10^4 = 10000$$

$$10^5 = 100000$$



$$\begin{array}{ccc} (-7)^4 & \text{diff} & (-7^4) \\ \swarrow & & \downarrow \\ (-7)(-7)(-7)(-7) & & (-7 \times 7 \times 7 \times 7) \end{array}$$