1st Experimental Middle School of Athens

CLIL: Mathematics

2nd Grade

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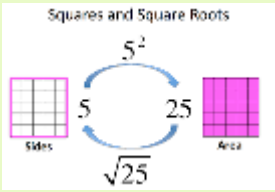
SAMPLE PAGES

Powers and Square Roots



Here are two online dictionaries with mathematical terms and a lot of activities for your own reference:

https://www.mathsisfun.com/definitions/letter-a.html

http://www.mathwords.com/a_to_z.htm

And this the vocabulary we will need for the first unit. Study and practise the vocabulary:

quizlet.com/_2juden

Watch the video (Introduction to exponents)

https://www.khanacademy.org/math/in-seventh-grade-math/exponents-powers/in-exponents/v/introduction-to-exponents

Examples

https://www.khanacademy.org/math/in-seventh-grade-math/exponents-powers/in-exponents/v/understanding-exponents-2

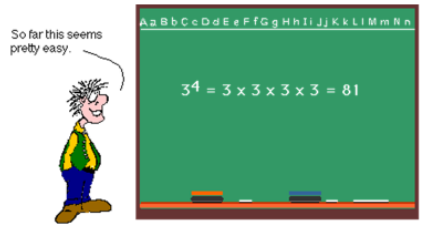
https://www.khanacademy.org/math/in-seventh-grade-math/exponents-powers/in-exponents/v/understanding-exponents

Practice

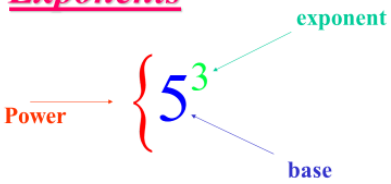
https://www.khanacademy.org/math/pre-algebra/pre-algebra-exponents-radicals/pre-algebra-exponents/e/positive_and_zero_exponents

PPT: The laws of exponents

The Laws of Exponents



Exponents



Example: $125 = 5^3$ means that 5^3 is the exponential form of the number 125.

5^3 means 3 factors of 5 or 5 x 5 x 5

The Laws of Exponents:

#1: Exponential form: *The exponent of a power indicates how many times the base multiplies itself.*

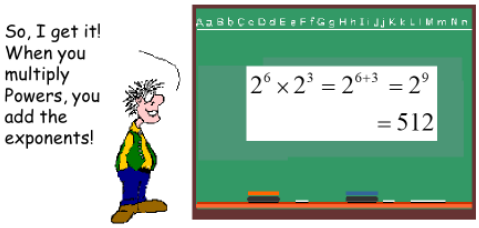
$$x^n = \underbrace{x \cdot x \cdot x \cdot \cdots \cdot x \cdot x \cdot x \cdot x}_{n-times}$$

n factors of x

Example: $5^3 = 5 \cdot 5 \cdot 5$

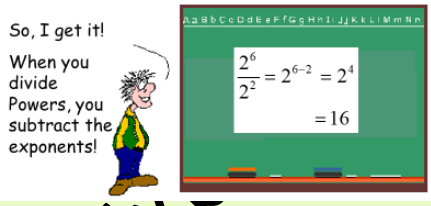
#2: Multiplying Powers: *If you are multiplying Powers with the same base, KEEP the BASE & ADD the EXPONENTS!*

$$x^m \cdot x^n = x^{m+n}$$



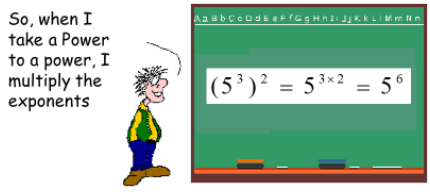
#3: Dividing Powers: *When dividing Powers with the same base, KEEP the BASE & SUBTRACT the EXPONENTS!*

$$\frac{x^m}{x^n} = x^m \div x^n = x^{m-n}$$



#4: Power of a Power: *If you are raising a Power to an exponent, you multiply the exponents!*

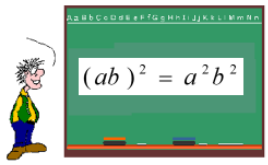
$$\left(x^m\right)^n = x^{mn}$$



#5: Product Law of Exponents: *If the product of the bases is powered by the same exponent, then the result is a multiplication of individual factors of the product, each powered by the given exponent.*

$$(xy)^n = x^n \cdot y^n$$

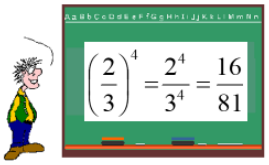
So, when I take a Power of a Product, I apply the exponent to all factors of the product.



#6: Quotient Law of Exponents: *If the quotient of the bases is powered by the same exponent, then the result is both numerator and denominator , each powered by the given exponent.*

$$\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}$$

So, when I take a Power of a Quotient, I apply the exponent to all parts of the quotient.



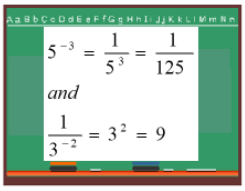
#7: Negative Law of Exponents: *If the base is powered by the negative exponent, then the base becomes reciprocal with the positive exponent.*

$$x^{-m} = \frac{1}{x^m}$$

So, when I have a Negative Exponent, I switch the base to its reciprocal with a Positive Exponent.

Ha Ha!

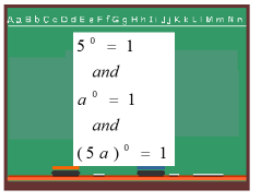
If the base with the negative exponent is in the denominator, it moves to the numerator to lose its negative sign!



#8: Zero Law of Exponents: *Any base powered by zero exponent equals one.*

$$x^0 = 1$$

So zero factors of a base equals 1. That makes sense! Every power has a coefficient of 1.



Powers Theory: for reference

A power is an abbreviated form of writing a multiplication formed by several equal factors.

$5 \cdot 5 \cdot 5 \cdot 5 = 5^4$

Base

The base of a power is the number that multiplies by itself, in this case, 5.

Exponent

The exponent of a power indicates the number of times to multiply the base by itself, in this case, 4.

Properties of the Powers of Natural Numbers

1. $a^0 = 1$

2. $a^1 = a$

3. Product of powers with the same base:

It is another power with the same base and the exponent is the sum of the exponents.

$a^m \cdot a^n = a^{m+n}$

$2^5 \cdot 2^2 = 2^{5+2} = 2^7$

4. Division of powers with the same base:

It is another power with the same base and whose exponent is the difference between the exponents.

$a^m : a^n = a^{m-n}$

$2^5 : 2^2 = 2^{5-2} = 2^3$

5. Power of a power:

It is another power with the same base and the exponent is the product of the exponents.

$(a^m)^n = a^{m \cdot n}$

$(2^5)^3 = 2^{15}$

6. Multiplication of powers with the same exponent:

It is another power with the same exponent, whose base is the product of the bases.

$a^n \cdot b^n = (a \cdot b)^n$

$2^3 \cdot 4^3 = 8^3$

7. Division of powers with the same exponent:

It is another power with the same exponent and whose base is the quotient of the bases.

$a^n : b^n = (a : b)^n$

$6^3 : 3^3 = 2^3$

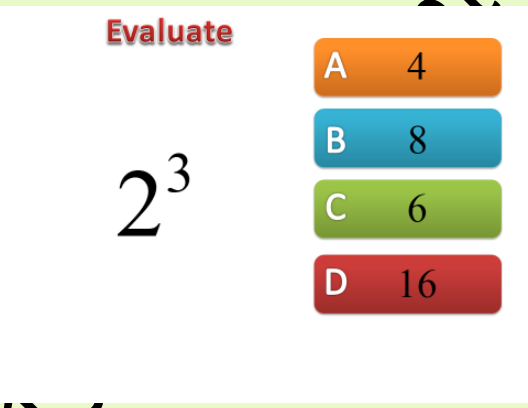
Polynomial Decomposition of a Number

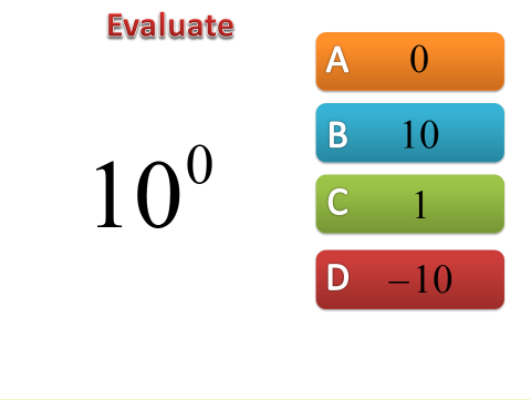
A natural number can be decomposed using powers with the base of 10.

The number 3,658 can be decomposed as follows:

$3{,}658 = 3 \cdot 10^3 + 6 \cdot 10^2 + 5 \cdot 10^1 + 8$

PPT: Powers_Practice





Evaluate

3^4

A 12
B 64
C 27
D 81

Simplify

$x^4 \times x^3$

A x^{12}
B $2x^7$
C x^7
D $12x$

Simplify

$\dfrac{x^5}{x^2}$

A x^3
B x^{-3}
C $x^{2.5}$
D x^2

Simplify

$(x^3)^4$

A x^7
B $x^{\frac{3}{4}}$
C x^{12}
D $x^{\frac{4}{3}}$

Simplify

$(x^3)^4$

A x^7
B $x^{\frac{3}{4}}$
C x^{12}
D $x^{\frac{4}{3}}$

Evaluate

4^{-1}

A 3
B -4
C $\frac{1}{4}$
D $-\frac{1}{4}$

Evaluate

3^{-2}

A 1
B -6
C $\frac{1}{3}$
D $\frac{1}{9}$

Evaluate

2^{-3}

A $\frac{1}{6}$
B $\frac{1}{5}$
C $\frac{1}{4}$
D $\frac{1}{8}$

Task: (in pairs) Imagine that one of you is Archimedes and the other one Eratosthenes. Write a dialogue between them in which Archimedes is explaining how he invented the beast number and how powers work. You can use the two sites below for information. The best dialogue will be performed and filmed in class.

http://www.famousscientists.org/archimedes/

http://www.famousscientists.org/how-archimedes-invented-the-beast-number/

Rational Numbers

1. Logos: meaning
2. Warm up: Write the word 'Numbers' on board and ask them to say what kinds of number they know (whole, natural, rational, irrational, integers, positive, negative) and then ask if they know the definition of each one.
3. The etymology of the word Rational and its equivalent in Greek
   https://www.vocabulary.com/dictionary/rational
4. Ask them if they know the difference between ratio and fraction.
   http://www.factmonster.com/ipka/A0876704.html
   Watch the video. After the video ask questions:
   a) Give a definition of the word 'ratio'.
   b) Is a ratio the same as a fraction?
   c) What is a unit rate?
   d) Give examples of your own.
   Show the videos to understand the difference (what do you think? Are they worth watching or are they unnecessary?)
   https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-ratios-intro/v/ratios-intro
   https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-ratios-intro/v/ratios-as-fractions
5. Mathematics 3-Rarional Numbers (Appendix II)

Look at the definitions of rational numbers:

https://www.vocabulary.com/dictionary/rational

Revision Game: Who wants to be a millionaire?

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5
$100	$100	$100	$100	$100
$200	$200	$200	$200	$200
$300	$300	$300	$300	$300
$400	$400	$400	$400	$400

www.eslgamesworld.com

$100

exponent

$200

What's a ratio?

$300

What does the exponent of a power indicate?

$400

What happens if the quotient of a power is powered by the same exponent?

$100

Numerator

$200

An irrational number can be written as a …….

$300

$5^0 = 1$ What's the rule?

$400

What do we mean when we say that the aspect ration of your computer screen is 16:9

Athens

$100

Denominator

$200

What is a radical?

$300

What is a rational number?

$400

What's the difference between a ratio and a fraction?

$100

$\frac{1}{2}$

Fraction

$200

What does a square root mean?

$300

What happens if we square a negative number?

$400

What do you do when dividing powers with the same base?

$100

$5 \times 3 = 15$

Product

$200

What's the square root of 9 and why?

$300

What is the square root of a number?

$400

What do you do when you are raising a power to an exponent?

Lesson Plan Cover page

Outcomes	content	Learners can use vocabulary on powers, rational numbers and square numbers, do simple calculations and give definitions.
	language	Learners can use zero conditional and Simple Present to give definitions and explain rules.
	learning skill	Learners can develop mental computation skills, restate information and add clarity to it, understand the relationship between powers and square roots.
Personal aim	To be able to turn numbers into language and communicate meaning	
Timetable fit	Learners are working on the module of 'Square Roots' together with the content teacher. In previous lessons they worked on 'Powers' and 'Rational Numbers'. After this they will study the Pythagorean theorem.	
Group profile	There are 26 learners in this class, age group 13-14.	
Time	45 minutes	
Assumptions	Learners are of B2 level. They have very good command of the language which they use throughout the lesson. They have worked in groups before and they are very cooperative and communicative. They have practised all skills and used all reading strategies (skimming, scanning, summarising etc).They have done projects and presentations and are used to working effectively.	
Anticipated problems and solutions	Learners may have difficulty using L2 to explain mathematical concepts. To help them, when language is involved, minor mistakes will be overlooked. They may also have forgotten some of the revision questions on powers. To help them, the subject teacher will be present using some L1 if necessary.	
Materials	IWB: Internet site: https://www.khanacademy.org/math/pre-algebra/pre-algebra-exponents-radicals/pre-algebra-square-roots/v/introduction-to-square-roots https://www.khanacademy.org/math/pre-algebra/pre-algebra-exponents-radicals/pre-algebra-square-roots/a/square-roots-of-perfect-squares-art	

Procedure

Stage	Aim	Procedure	Materials	Interaction	Time
Warmer	To recall previously learnt knowledge	T asks learners to recall information from previous lessons. Connections to Powers, Rational Numbers. Ask for definitions and symbols. What is an exponent? What is power?	IWB	T-SS	3-5 min

		What is a whole number? Can you give a definition of a square root? What is a perfect square?			
Input Listening	To listen for understanding To provide visual support Understand the concept of square roots	T presents a video (https://www.khanacademy.org/math/pre-algebra/pre-algebra-exponents-radicals/pre-algebra-square-roots/v/introduction-to-square-roots) with information about the square root symbol and what it means to find a square root and how to solve simple square root equations. After the video they are asked questions: What's the square root symbol called? What's the relationship between a power and a square root? Give examples. What is a principal square root? What happens when we square a negative number? What's the square root of 100?	Internet IWB	T-SS	10-12' min
Practice	To practise solving simple square root equations	T urges learners to solve some square roots and explain how they work https://www.khanacademy.org/math/pre-algebra/pre-algebra-exponents-radicals/pre-algebra-square-roots/a/square-roots-of-perfect-squares-art	Internet IWB	T-SS	5'-7'
Revise	To revise powers and square roots	T divides students into two teams and explains that they are going to play a game called 'Hundred Dollar Questions'. There are questions worth form 100 to 400 dollars depending on the difficulty of the question. Each team chooses level of difficulty and they have 1' to answer the question. The team that gets the most dollars is the winner. There is also a reward for the winner team.	IWB	SS-SS	15 min
Next lesson	Learners will learn how to approximate the decimal value of numbers that are not perfect squares.				