Warmup 1/(The base used in scientific notation)

Created by Mr. Lischwe

1) Which do you think would be a larger number: 22^3 or 3^{22}?
2) Without multiplying it out, estimate the value of 22^3. 10,648
3) Without multiplying it out, estimate the value of 3^{22}. 31,381,059,610
4) Guess: what do you think 2^0 is?
5) Guess: what do you think 4^{-2} is?

p. 19 (1 – 5, 7, 9-12)

1. $(-5)^4$
2. $3^2 \cdot 5 \cdot q^3$
3. m^5
4. 6,561
5. $\frac{1}{81}$
7. 8,000,000,000 (8 billion)
9. -311
10. 37
11. 16
12. 10

9) $g^5 - h^3$

$(2)^5 - (7)^3$

$32 - 343$

-311

10) $c^2 + d^3$

$(8)^2 + (-3)^3$

$64 + (-27)$

37

11) $a^2 \cdot b^6$

$\left(\frac{1}{2}\right)^2 \cdot (2)^6$

$\frac{1}{4} \cdot 64$

16

12) $(r - s)^3 + r^2$

$\left(-3 - (-4)\right)^3 + (-3)^2$

$(1)^3 + 9$

10

Discuss with your group:

The population of Bridgeville triples every decade. Its population in 2000 was 25,000. Which of these expressions would calculate the population in 2040?

×3

4 decades

A) $25,000 \cdot 3 \cdot 4$

B) $25,000 \cdot 3 \cdot 40$

C) $25,000 \cdot 4^3$

D) $25,000 \cdot 3^4$

E) $25,000 \cdot 3^{40}$

$25,000 \cdot 3 \cdot 3 \cdot 3 \cdot 3$

Calculate the exact population of Bridgeville in 2040.

2,025,000

Table of Contents (2nd Semester)

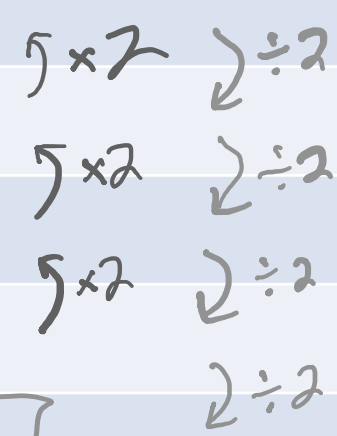
Zero & Negative Exponents

Objective:

Discover how zero & negative exponents work

» Find a pattern and use it to complete the table:

Exponential Form	Standard Form
2^4	16
2^3	8
2^2	4
2^1	2
2^0	1



Finding a pattern

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» Find a pattern and use it to complete the table:

Exponential Form	Standard Form
3^4	81
3^3	27
3^2	9
3^1	3
3^0	1

÷3

÷3

Finding a pattern

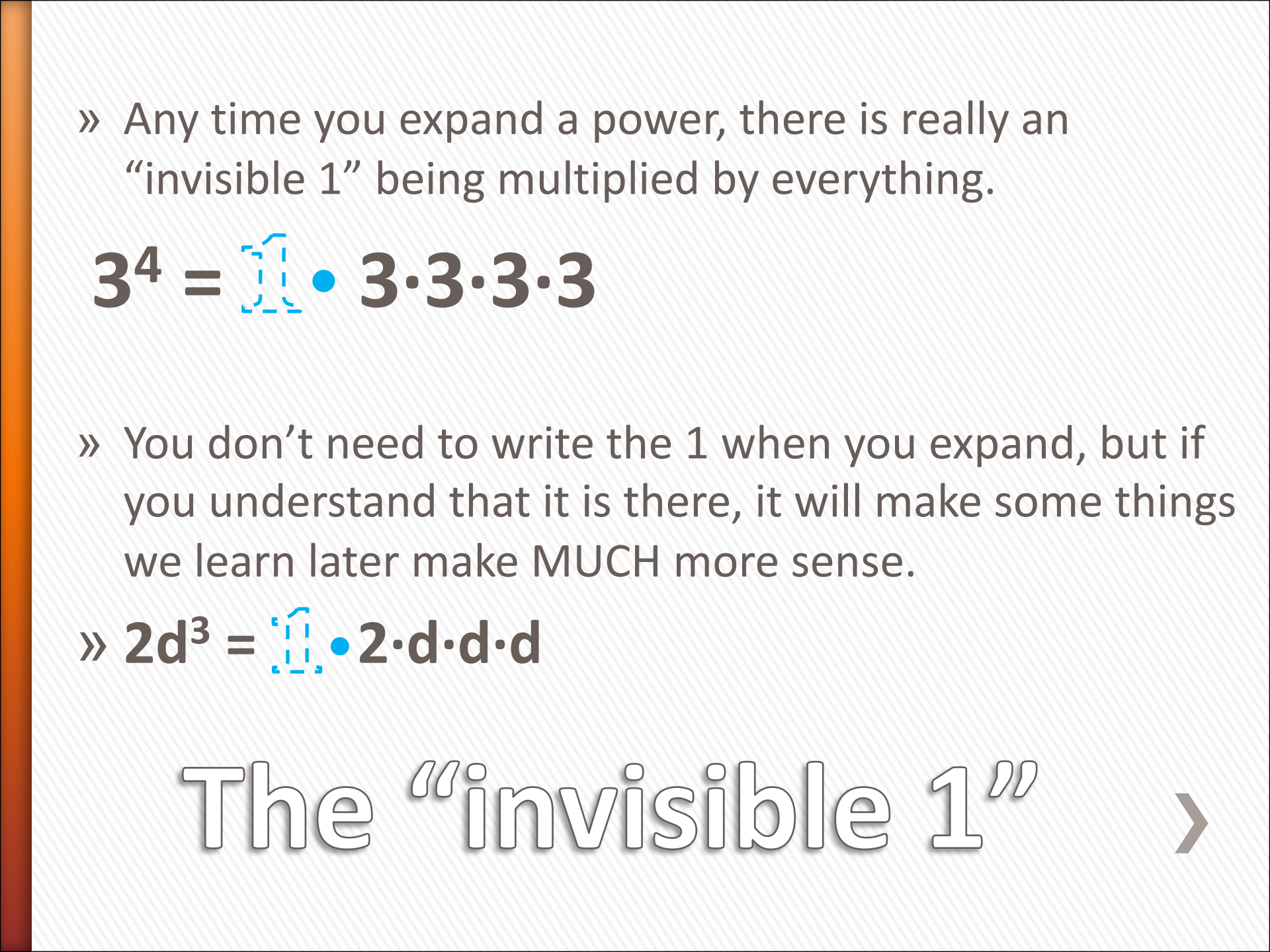
›

The "invisible 1"

- Any time you expand a power, there is really an "invisible 1" being multiplied by everything.

$$3^4 = 1 \cdot 3 \cdot 3 \cdot 3 \cdot 3$$

- You don't need to write the 1 when you expand, but if you understand that it is there, it will make some things we learn later make MUCH more sense.
- $2d^3 = 1 \cdot 2 \cdot d \cdot d \cdot d$



For 5^0, there are no 5's, but the invisible 1 is still there!!!

The "invisible 1"

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Zero Exponents:

» Anything to the zero power is 1!

Examples

1) $9^0 = 1$

2) $a^0 = 1$

3) $4x^0$
$= 4 \cdot 1$
$= 4$

4) $(8x^2 \cdot 3y^{18})^0 = 1$

Zero Exponents

4^{-2} IS DIFFERENT THAN $(-4)^2$!!!

- We know that $\mathbf{4^2 = 16.}$
- We know that $\mathbf{(-4)^2}$ is also **16**.

- But what if the EXPONENT is negative?
- $\mathbf{4^{-2}}$ = ???

» Find a pattern and use it to complete the table:

Exponential Form	Standard Form
2^4	16
2^3	8
2^2	4
2^1	2
2^0	1
2^{-1}	$\frac{1}{2}$
2^{-2}	$\frac{1}{4}$
2^{-3}	$\frac{1}{8}$
2^{-4}	$\frac{1}{16}$

÷2 ÷2 ÷2 ÷2 ÷2 etc.

Finding a pattern

» Find a pattern and use it to complete the table:

Exponential Form	Standard Form
3^4	81
3^3	27
3^2	9
3^1	3
3^0	1
3^{-1}	$\frac{1}{3}$
3^{-2}	$\frac{1}{9}$
3^{-3}	$\frac{1}{27}$
3^{-4}	$\frac{1}{81}$

÷3 ÷3 ÷3 etc.

Finding a pattern

4^{-2} $\frac{1}{16}$

2^{-3} $\frac{1}{8}$

10^{-3} $\frac{1}{1000}$

2^{-4} $\frac{1}{16}$

7^{-1} $\frac{1}{7}$

Examples – Try these in your head!!!

$$x^{-3}$$

$$\frac{1}{x^3}$$

What about with variables?

Negative Exponents:

Rule: $x^{-n} = \frac{1}{x^n}$

» **Negative exponent:**

> 1 over the same power with a positive exponent

Negative Exponents ›

One way to think about positive/negative exponents…

- $3^4 = 1 \cdot 3 \cdot 3 \cdot 3 \cdot 3$
- $3^3 = 1 \cdot 3 \cdot 3 \cdot 3$
- $3^2 = 1 \cdot 3 \cdot 3$
- $3^1 = 1 \cdot 3$
- $3^0 = 1$
- $3^{-1} = \frac{1}{3}$
- $3^{-2} = \frac{1}{3 \cdot 3}$
- $3^{-3} = \frac{1}{3 \cdot 3 \cdot 3}$

(How do you expand a negative exponent? This is how.)

» POSITIVE EXPONENTS:

- > Are 1 TIMES the base that many times
- > $2^4 = 1 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

» NEGATIVE EXPONENTS:

- > Are 1 DIVIDED BY the base that many times
- > $2^{-4} = 1 \div 2 \div 2 \div 2 \div 2$

$$= \frac{1}{2 \cdot 2 \cdot 2 \cdot 2}$$

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

» ZERO EXPONENTS:

- > Are the 1 not multiplied or divided by anything
- > $2^0 = 1$

Basically…

- Positive exponents mean to multiply.
- Negative exponents mean to divide!

Negative Exponents: Examples

1) 4^{-3} $\frac{1}{64}$

2) 10^{-5} $\frac{1}{100,000}$

3) 13^{-1} $\frac{1}{13}$

4) $(-2)^{-3}$ $\frac{1}{-8}$

5) x^{-6} $\frac{1}{x^6}$

6) $2^2 + 2^{-2}$

$4 + \frac{1}{4} = 4\frac{1}{4}$

$$6^{-4}$$

$$6.$$

$$.0006$$

Why doesn't this work?

DO NOT do this:

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$$6\times10^{-4}$$

$$6.$$

$$.0006$$

$$6\times10^{-4}$$

$$=6\times\frac{1}{10^4}$$

$$=\frac{6}{10^4}$$

Why does the "move the decimal" trick work here???

...which means you're starting with 6 and you're dividing by ten 4 times!

Homework

- Finish Corrections
  - Explain your mistake
  - Explain the correct process
- +30 Minutes of ALEKS