

# Warmup 1/(2 · 3<sup>2</sup>)

- 1) Explain why you would multiply the 4's in the blue problem but NOT in the purple problem.

$$4x^6 \cdot 4x^3$$

↑  
These 4's are coefficients.  
They are not connected to the exponents.

$$4^6 \cdot 4^3$$

↑  
These 4's are bases.  
They are connected to the exponents.

- 2) Pretend you are creating a multiple choice test. Using the date problem ( $2 \cdot 3^2$ ), create four answer choices. One choice should be correct, and the other three choices should come from errors a student might make.

- A) 18 (correct)
- B) 36
- C) 12
- D) 1296



4)  $4^{-2}$

Here were some of the answers I got...

-16      16

.04

$\frac{1}{16}$

1

0

Yesterday's Warmup #4...



» 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
$2^0$	<u>1</u>
$2^{-1}$	<u><math>\frac{1}{2}</math></u>
$2^{-2}$	<u><math>\frac{1}{4}</math></u>
$2^{-3}$	<u><math>\frac{1}{8}</math></u>
$2^{-4}$	<u><math>\frac{1}{16}</math></u>

$$2 \div 2$$

$$2 \div 2$$

$$2 \div 2$$

etc.

$$2^4 = 16$$

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

# Finding a pattern



$$\frac{2^3}{2^5}$$

a) Using the dividing powers rule?  $2^{-2}$

b) By expanding/dividing out common factors?  $\frac{\cancel{2} \cdot \cancel{2} \cdot \cancel{2}}{\cancel{2} \cdot \cancel{2} \cdot \cancel{2} \cdot 2 \cdot 2}$

c) By multiplying first, then simplifying?  $\frac{1}{2^2}$

$$\frac{8}{32} \rightarrow \frac{1}{4}$$

# Exploration



$$4^{-2}$$

$$\frac{1}{16}$$

$$2^{-3}$$

$$\frac{1}{8}$$

$$10^{-3}$$

$$\frac{1}{1000}$$

$$2^{-4}$$

$$\frac{1}{16}$$

$$7^{-1}$$

$$\frac{1}{7}$$

Examples – Try these in your head!!! ➤

$$x^{-3}$$

Try to fill in the blanks so that the exponent would be negative 3:

$$\frac{x^{\boxed{3}}}{x^{\boxed{6}}} = \frac{\cancel{x \cdot x \cdot x}}{\cancel{x \cdot x \cdot x \cdot x \cdot x \cdot x}}$$

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

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 >

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

$$3^4 = \boxed{1} \cdot 3 \cdot 3 \cdot 3 \cdot 3$$

The “invisible 1”



## » 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!**



## Examples

$$1) 3^{-2} = \boxed{\frac{1}{9}}$$

$$2) b^{-7} = \boxed{\frac{1}{b^7}}$$

$$3) x^3 \cdot x^{-5} = x^{-2} = \boxed{\frac{1}{x^2}}$$

$$4) \frac{g^4}{g^{10}} = g^{-6} = \boxed{\frac{1}{g^6}}$$

# Negative Exponents >

# Mathematicians say:

**Never** leave your a zero or negative exponent in your answer. It is not simplified yet.



$$6^{-4}$$


$$6. \\ .0006$$

Why doesn't this work?

It's not scientific notation!  
This would be  $6 \times 10^{-4}$ .

**DO NOT do this:**



$$\gg 6x^{-4} \longrightarrow \cancel{\frac{1}{6x^4}}$$

» The six is NOT connected to the exponent.

$$\gg 6 \cdot x^{-4}$$

$$\gg 6 \cdot \frac{1}{x^4}$$

$$\gg \frac{6}{1} \cdot \frac{1}{x^4} \longrightarrow \frac{6}{x^4}$$

What about this? >

Hey  $x^{-3}$ ! I'm lonely!  
Come hang out  
with me!!!

$$\frac{5x^{-3}}{x^4}$$

Sure. But only if I  
turn my exponent  
positive.

$$= \frac{5}{x^4 \cdot x^3}$$

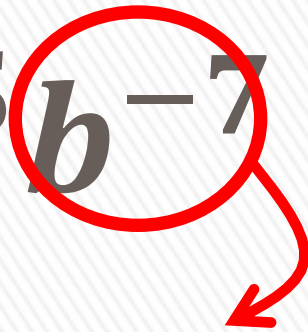
$$= \frac{5}{x^7}$$



You're too negative. Go away.

Believe me, I would love to. But there's no denominator.

Then make one.

$$a^5 b^{-7}$$


$$= \frac{a^5}{b^7}$$



» The negative power only goes under 1 if there's nothing else in the problem. If there's other stuff in the problem, the negative power goes under that.

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

$$a^5 b^{-7} \rightarrow \frac{a^5}{b^7}$$



# What about:

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

» If the negative exponent is already in the denominator, it moves back up to the numerator.

$$\frac{1}{x^{-5}} \rightarrow x^5$$



# What about:

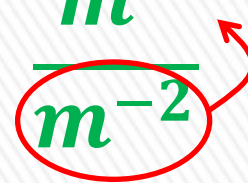
$$\frac{m^4}{m^{-2}}$$

2 Methods:

Shortcut

$$\begin{aligned}\frac{m^4}{m^{-2}} \\&= m^{4-(-2)} \\&= m^6\end{aligned}$$

Moving Neg. Exponent First

$$\frac{m^4}{m^{-2}}$$


$$\frac{m^4 \cdot m^2}{1}$$

$$= m^6$$



» Simplify using the zero & negative exponent properties.

$$\begin{aligned} 3) \frac{q^3 q^2}{q^5} &= \frac{q^5}{q^5} \\ &= \frac{q^0}{q^0} \\ &= 1 \end{aligned}$$

$$\begin{aligned} 4) \frac{n^{-3}}{n^5} &= n^{-3-5} \\ &= n^{-8} \\ &= \frac{1}{n^8} \end{aligned}$$

$$\begin{aligned} 5) a^4 b^4 \cdot a^6 b^{-6} \\ &= a^{10} b^{-2} \\ &= a^{10} \cdot \frac{1}{b^2} \\ &= \frac{a^{10}}{b^2} \end{aligned}$$

$$\begin{aligned} 6) \frac{c^5 d^2}{c^2 d^5} &= \frac{\overset{1}{\cancel{c}} \cdot \overset{1}{\cancel{c}} \cdot c \cdot c \cdot \overset{1}{\cancel{c}} \cdot \overset{1}{\cancel{d}} \cdot d}{\cancel{c} \cdot \cancel{c} \cdot d \cdot d \cdot \cancel{d} \cdot \cancel{d} \cdot d} \\ &= \frac{c^3}{d^3} \end{aligned}$$

CHALLENGE!



- » **Positive exponents mean to multiply.**
- » **Negative exponents mean to divide!!!**
- » **We put them into a fraction because FRACTIONS ARE DIVISION.**

**REMEMBER.....**



- » On Tuesday, we are doing a big review activity called “Levels”
- » I will need 3 or 4 “student checkers.” Instead of doing the activity, they will be checking everyone else’s work.
- » What’s the catch???
- » If you want to be a checker, you must do the activity as homework this weekend.
- » If you are interested in being a checker, come to my desk.

# Tuesday’s Activity...



- » p. 26 (1 – 4)
- » p. 34 (2, 4, 6)
- » p. 49 (31 – 36)
  
- » \*You can do them all on a separate sheet of paper if you don't feel like tearing 3 pages out of your book.

# Homework

