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Warmup $1/(2 \cdot 3^2)$

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

$\boxed{=16x^9}$ $\boxed{=4^9}$

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

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

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	1
2^{-1}	$\frac{1}{2}$
2^{-2}	$\frac{1}{4}$
2^{-3}	$\frac{1}{8}$
2^{-4}	$\frac{1}{16}$

÷2

÷2

÷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? $\frac{\cancel{2}\cdot\cancel{2}\cdot\cancel{2}}{\cancel{2}\cdot\cancel{2}\cdot\cancel{2}\cdot2\cdot2}$

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

c) By multiplying first, then simplifying?

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

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:

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

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

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 6×10^{-4}.

DO NOT do this:

» $6x^{-4}$ → $\cancel{\frac{1}{6x^4}}$

» The six is NOT connected to the exponent.

» $6 \cdot x^{-4}$

» $6 \cdot \frac{1}{x^4}$

» $\frac{6}{1} \cdot \frac{1}{x^4}$ → $\frac{6}{x^4}$

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.

$$= \frac{5}{x^4 \cdot x^3} \qquad = \frac{5}{x^7}$$

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 <u>already</u> 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

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

$$= m^{4-(-2)}$$

$$= m^6$$

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.**

3) $\frac{q^3q^2}{q^5} = \frac{q^5}{q^5} = q^0$

$\boxed{= 1}$

4) $\frac{n^{-3}}{n^5} = n^{-3-5}$

$= n^{-8}$

$\boxed{= \frac{1}{n^8}}$

5) $a^4b^4 \cdot a^6b^{-6}$

$= a^{10}b^{-2}$

$= a^{10} \cdot \frac{1}{b^2}$

$\boxed{= \frac{a^{10}}{b^2}}$

6) $\frac{c^5d^2}{c^2d^5} = \frac{\overset{1}{\cancel{c}} \cdot \overset{1}{\cancel{c}} \cdot c \cdot c \cdot \overset{1}{\cancel{c}} \cdot \overset{1}{\cancel{d}} \cdot d}{c \cdot c \cdot d \cdot d \cdot \cancel{d} \cdot \cancel{d} \cdot d}$

$\boxed{= \frac{c^3}{d^3}}$

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, <u>you must do the activity as homework this weekend.</u>
- 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