Algebra 1   7.2

Use the properties of exponents to divide monomials

Simplify expressions containing negative exponents

Simplify expressions containing zero exponer

Compare measurements using order of magnitude

exponent
base
quotient
factors
negative exponent
order of magnitude
Triangle puzzle

$$\frac{2^7}{2^4}$$

$$\frac{t^4}{t^3}$$

$$\frac{(6wwwww)(6wwwww)}{(7pppp\tilde{r}r)(7ppppp\tilde{r}r)} = \frac{36w^{10}}{49p^{12}r^6}$$

$$z^0 = 1 \qquad \frac{p^3}{p^3} = \frac{\cancel{p}\,\cancel{p}\,\cancel{p}}{\cancel{p}\,\cancel{p}\,\cancel{p}} = 1$$

KeyConcept Quotient of Powers

Words	To divide two powers with the same base, subtract the exponents.
Symbols	For any nonzero number a, and any integers m and p, $\dfrac{a^m}{a^p} = a^{m-p}$.
Examples	$\dfrac{c^{11}}{c^8} = c^{11-8}$ or c^3 $\qquad$ $\dfrac{r^5}{r^2} = r^{5-2} = r^3$

$$n^{-3} = \frac{1}{n^3}$$

Example 1 Quotient of Powers

Simplify $\dfrac{g^3 h^5}{g h^2}$. Assume that no denominator equals zero.

$$\frac{g\,g\,g\,h\,h\,h\,h\,h}{g\,h\,h} = g^2 h^3$$

Simplify each expression. ~~Assume that no denominator equals~~ zero. why?

1A. $\dfrac{x^3 y^4}{x^2 y}$

1B. $\dfrac{k^7 m^{10} p}{k^5 m^3 p}$

$$\dfrac{\cancel{x}\,\cancel{x}\,x\;\cancel{y}\,y\,y\,y}{\cancel{x}\,\cancel{x}\,\cancel{y}}$$

$$x y^3$$

$$\dfrac{\cancel{k}\,\cancel{k}\,\cancel{k}\,\cancel{k}\,k\,k\,k\;\cancel{m}\,m\,m\,m\,m\,m\,m\,\cancel{p}}{\cancel{k}\,\cancel{k}\,\cancel{k}\,\cancel{k}\,\cancel{k}\;\cancel{m}\,\cancel{m}\,\cancel{m}\;\cancel{p}}$$

$$k^2 m^7$$

"Power rule"

KeyConcept Power of a Quotient

Words To find the power of a quotient, find the power of the numerator and the power of the denominator.

Symbols For any real numbers a and $b \neq 0$, and any integer m, $\left(\dfrac{a}{b}\right)^m = \dfrac{a^m}{b^m}$.

Examples $\left(\dfrac{3}{5}\right)^4 = \dfrac{3^4}{5^4}$ $\left(\dfrac{r}{t}\right)^5 = \dfrac{r^5}{t^5}$

$$\left(\frac{r}{t}\right)\left(\frac{r}{t}\right)\left(\frac{r}{t}\right)\left(\frac{r}{t}\right)\left(\frac{r}{t}\right) = \frac{r^5}{t^5}$$

numerator/denominator

Example 2 Power of a Quotient

Simplify $\left(\dfrac{3p^3}{7}\right)^2$.

$\left(\dfrac{3ppp}{7}\right)\left(\dfrac{3ppp}{7}\right) = \dfrac{9p^6}{49}$

whiteboards

Simplify each expression.

2A. $\left(\dfrac{3x^4}{4}\right)^3$

2B. $\left(\dfrac{5x^5y}{6}\right)^2$

2C. $\left(\dfrac{2y^2}{3z^3}\right)^2$

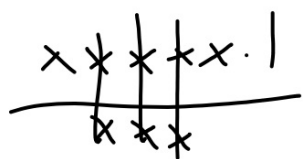**2D.** $\left(\dfrac{4x^3}{5y^4}\right)^3$

replace zero powers with something =
what would that be?

Example 3 Zero Exponent

Simplify each expression. Assume that no denominator equals zero.

a. $-\left(-\dfrac{4n^2 q^5 r^2}{9n^3 q^2 r}\right)^0$ $= 1$

$-1\left(\quad\right) = -1$

b. $\dfrac{x^5 y^0}{x^3}$ $\dfrac{x \cdot x \cdot x \cdot x \cdot x \cdot 1}{x \cdot x \cdot x} = \dfrac{1 \cdot x^2}{x^2}$

3A. $\dfrac{b^4c^2d^0}{b^2c}$

3B. $\left(\dfrac{2f^4g^7h^3}{15f^3g^9h^6}\right)^0$

$$\frac{b \, b \, b \, b \, c \cdot 1}{b \, b \, c}$$

$$1 \cdot b^2 c$$

$$b^2 c$$

KeyConcept **Negative Exponent Property**

Words	For any nonzero number a and any integer n, a^{-n} is the reciprocal of a^n. Also, the reciprocal of a^{-n} is a^n.
Symbols	For any nonzero number a and any integer n, $a^{-n} = \dfrac{1}{a^n}$.
Examples	$2^{-4} = \dfrac{1}{2^4} = \dfrac{1}{16}$ $\qquad \dfrac{1}{j^{-4}} = j^4$

negative exponent = code for reciprocal

Example 4 Negative Exponents

Simplify each expression. Assume that no denominator equals zero.

a. $\dfrac{n^{-5}p^{4}}{r^{-2}} = \dfrac{r^{2}p^{4}}{n^{5}} = \dfrac{p^{4}r^{2}}{n^{5}}$

final answer: exponents positive,
no zero exponents

b. $\left(\dfrac{5r^{-3}t^4}{-20r^2t^7u^{-5}} \right)^{-2}$

final answer: exponents positive
no zero exponents

$\left(\dfrac{-20r^2t^7u^{-5}}{5r^{-3}t^4} \right)^{2}$ = $\left(-4\dfrac{rr\,r}{\cancel{rr}t\cancel{t}\cancel{t}\cancel{t}\cancel{t}t}{}\right)\left(-4 \right)$

$\dfrac{3}{1} = 3$

$\dfrac{1}{3}$

$\left(\dfrac{-4\,r\,r\,r\,t\,t\,t}{uuuuu} \right)\left(-4\,r\,v\,r\,t\,t\,t}{uuuuu} \right)$

$\dfrac{16\,r^6 t^6}{u^{10}}$

GuidedPractice

$$\left(2g^3h^{-2}\right)^2$$

Simplify each expression. Assume that no denominator equals zero.

4A. $\dfrac{v^{-3}wx^2}{wy^{-6}}$

4B. $\dfrac{32a^8b^3c^4c^2}{4a^3b^5c^2}$

abc^4

4C. $\dfrac{5j^{-3}k^2m^{-6}}{25k^{-4}m^{-2}}$

Sq.

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

$$\frac{1}{6}\cdot\frac{1}{6} = \frac{1}{36}$$

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

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

$$\frac{8\ bbb\ cc}{aaaaaaa\ cccc}$$

WB 7.2
odds + 28
prac.

$$22^3 \quad 22^5$$

$$W \qquad R$$

$$\frac{White}{red} \quad \frac{22 \cdot 22 \cdot 22}{22 \cdot 22 \cdot 22 \cdot 22 \cdot 22} = \frac{1}{484}$$

5. $\quad x^3 y^{-9} x^{-8}$

$$\frac{x \, x \, x}{y \, y \, y \, y \, y \, x \, x \, x \, x \, x \, x \, x \, x} = \frac{1}{y^5 x^5}$$