Warm Up

Find the product

$(x-4)^3$

$(x-4)(x-4)(x-4)$

$x^2 - 4x - 4x + 16$

$(x^2 - 8x + 16)(x-4)$

$x^3 - 4x^2 - 8x^2 + 32x + 16x - 64$

$x^3 - 12x^2 + 48x - 64$

Find the quotient

$$\frac{x^4 - 2x^2 + 5}{x-2}$$

$2 \;|\; 1 \quad 0 \quad -2 \quad 0 \quad 5$

$\quad\quad\; +2 \quad +4 \quad +4 \quad +8$

$\quad\quad 1 \quad 2 \quad 2 \quad 4 \;|\; 13$

$1x^3 + 2x^2 + 2x + 4 + \frac{13}{x-2}$

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4) Rewrite the power so that the exponent is positive.

a) 8^{-4} = $\frac{1}{8^4}$

b) $b^{-2} \cdot c^{-3}$ = $\frac{1}{b^2} \cdot \frac{1}{c^3}$

c) $\left(\frac{1}{7^{-3}}\right)$ = 7^3

d) $\left(\frac{a}{b}\right)^{-4}$ = $\frac{b^4}{a^4}$

5) Describe how to rewrite any expression that has a power with a negative exponent.

a) In the numerator:

put that base in the denominator and change the power to a positive

b) In the denominator:

put that base in the numerator and the power changes to a positive

6) Determine if each pair of expressions is equivalent. Explain your reasoning.

a) $2^3 \overset{?}{=} 2^{-3}$ NO $\quad 2^3 = 2^3 \quad 2^{-3} = \frac{1}{2^3}$

b) $\frac{1}{2^3} \overset{?}{=} 2^{-3}$ YES

c) $\frac{1}{2^{-3}} \overset{?}{=} 2^3$ YES

d) $\frac{1}{2^{-3}} \overset{?}{=} 2^{-3}$ NO $\quad \frac{1}{2^{-3}} = 2^3$

7) Simplify each using the properties of powers.

$x \cdot x \cdot x \cdot x \cdot x \cdot x \cdot x \quad 9^{-1} = \frac{1}{9}$

a) $\frac{2^2}{2^6}$ $\frac{2 \cdot 2}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} = \frac{1}{2^4}$	b) $(4x^2)(3x^5)$ $12x^7$	c) $(9^4)(9^{-5})$ $\frac{9^4}{9^5} = \frac{1}{9}$	d) $(8^0)(8^{-2})$ $\frac{1}{8^2} = \frac{1}{64}$	e) $\frac{3^{-3}}{3^{-3}}$ 1
f) $\frac{4^{-2}}{4^{-3}} = \frac{4^3}{4^2}$ 4	g) $\frac{(-3)^2}{(-3)^4}$ $\frac{1}{(-3)^2} = \frac{1}{9}$	h) $\frac{h^3}{h^5}$ $\frac{1}{h^2}$	i) $\frac{x^{-4}}{x^5}$ $\frac{1}{x^4 x^5} = \frac{1}{x^9}$	j) $\frac{m^2 p^{-2}}{m^4 p^3}$ $\frac{m^2}{m^4 p^3 p^2} = \frac{1}{m^2 p^5}$

Summary

8) **Create a model** representation for the Negative Exponent Rule.
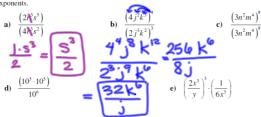
As you are creating your model, consider the following:

- **Definition in your own words:** How would you describe this property to a friend?
- **Facts/Characteristics:** Does this property work the same for variables and numbers? Are there specific characteristics if the numbers are positive or negative?
- **Examples:** Include examples with variables and different types of numbers (e.g., positive, negative, and fractions).
- **General Rule:** Use variables. Be mindful when your variable cannot be zero.

Definition in your own words	Facts / Characteristics
move the base with the negative exponent from one side of the fraction the other... then turn the exponent positive	*negative exponent *negative power

Negative Exponent Rule

Examples:
$$18^{-5} = \frac{1}{18^5}$$
$$\frac{1}{2^{-3}} = 2^3$$
$$\frac{-2x^{-3}}{y} = \frac{-2}{x^3 y}$$

General Rule:
a^{-m} is the reciprocal of a^m
$$a^{-m} = \frac{1}{a^m}$$
$$a \neq 0$$

10) Simplify each expression using the properties of powers. Express your answers using only positive exponents.

a) $\dfrac{(2h^3 s^5)}{(4h^3 s^2)}$

$\dfrac{1 \cdot s^3}{2} = \boxed{\dfrac{s^3}{2}}$

b) $\dfrac{(4j^2 k^5)^4}{(2j^3 k^2)^3}$

$\dfrac{4^4 j^8 k^{12}}{2^3 \cdot 9 k^6} = \dfrac{256 k^6}{8j} = \boxed{\dfrac{32k^6}{j}}$

c) $\dfrac{(3n^2 m^4)^8}{(3n^2 m^4)^8}$

d) $\dfrac{(10^5 \cdot 10^5)}{10^6}$

e) $\left(\dfrac{2x^3}{y}\right)^3 \cdot \left(\dfrac{1}{6x^3}\right)$

11) Determine which student(s) used the properties of powers correctly. Explain why the other expressions are not correct.

a) $\dfrac{g^7 h^4}{g^3 h^9}$

➢ Jack wrote $g^{10} h^{13}$.

➢ Joshua wrote $\dfrac{g^4}{h^5}$.

➢ Jonah wrote $g^4 h^5$.

➢ Who is correct?

b) $\dfrac{2w^{-4}}{x^{-2}}$

➢ Jack wrote $\dfrac{2x^2}{w^4}$.

➢ Joshua wrote $\dfrac{x^2}{2w^4}$.

➢ Jonah wrote $\dfrac{2w^4}{x^2}$.

➢ Who is correct?

HOMEWORK:

#7-9, 14-19

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