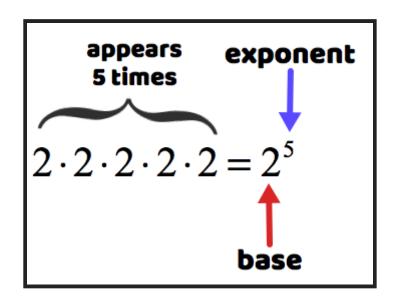
EXPONENTS: THE QUOTIENT RULE

LEARNING GOAL

1. I can divide exponential expressions using the quotient rule.



Exponential Rules

Product Rule

$$a^x \times a^y = a^{x+y}$$

Quotient Rule

$$a^{x} \times a^{y} = a^{x+y}$$
 $a^{x} \div a^{y} = a^{x-y}$
 $a^{2} \times a^{3} = a^{5}$ $a^{7} \div a^{3} = a^{4}$

Power Rule

$$\left(a^{x}\right)^{y} = a^{xy}$$
$$\left(a^{7}\right)^{2} = a^{14}$$

$$\left(a^{7}\right)^{2}=a^{14}$$

Negative Rule

$$a^{-x} = \frac{1}{a^x}$$

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

Zero Rule

$$a^{0} = 1$$

Exponents Dividing Example One

=
$$\frac{2^3}{2^2}$$
 Fully Expand the Powers out

=
$$2 \times 2 \times 2$$
 and then cancel all identical items in the top and bottom

Dividing Rule Example Two

=
$$\frac{k^5}{k^3}$$
 Use the Subtract Powers shortcut Rule

= k⁵⁻³ If Bases are the same, then subtract the Powers, which is the Exponents Divide Rule.

Dividing Rule Example Four

12a⁷b⁵ ÷ 16a²b² Rewrite as a Fraction

=
$$\frac{12a^7b^5}{16a^2b^2}$$
 Separate Numbers & Letters

$$= \frac{3}{4} \frac{12}{16} \times \frac{a^7}{a^2} \times \frac{b^5}{b^2}$$
 Reduce down number Fraction and use Powers Subtract Rule
$$= \frac{3}{4} \times a^{7-2} \times b^{5-2} = \frac{3}{4} \times a^5 \times b^3 = \frac{3a^5b^3}{4} \checkmark$$

$$= \frac{3}{4} \times a^{7-2} \times b^{5-2} = \frac{3}{4} \times a^{5} \times b^{3} = \frac{3a^{5}b^{3}}{4} \checkmark$$

Directions: Complete the chart below.

		Expanded Form	Single Base and a Power
1.	$\frac{x^4}{x^3}$	$\frac{\cancel{x} \cdot \cancel{x} \cdot \cancel{x}}{\cancel{x} \cdot \cancel{x}} \leftarrow 4 \text{ times}$	$X = X_1$
2.	$\frac{x^8}{x^5}$	<u> </u>	%·%% = x3
3.	$\frac{x^5}{x}$	<u>x'xxxx</u>	1 1 1 1
4.	$\frac{x^2}{x^8}$	xx x x x x x x x x x x x x x x x x x x	76
5.	$\frac{x}{x^5}$	X ·X·X·X·X	1 1 1 1

6. Compare the 2^{nd} and 4^{th} columns in the table above. Describe, in words, what you notice about the relationship you see between them.

		Expanded Form	Single Base and a Power
7.	$\frac{x^3y^3}{x^3y}$	XXX 4.8 XXX	y
8.	$\frac{x^2y^5}{x^3y^2}$	X:X Y:Y-Y-Y-Y-Y-Y-Y-Y-Y-Y-Y-Y-Y-Y-Y-Y-Y-Y-Y	2 p. X
9.	$\frac{6x^5}{8x^3}$	2.3 xxxx.x.x. x.4 x.xx	3x ³
10.	$\frac{12x^7y}{6x^3y^6}$	2.2-3·x·x·x·x·x·x·x·x·y·y·y·y·y·y·	2x3 y5

1)
$$\frac{b^6}{b^4} = \boxed{b^2}$$

7)
$$\frac{4k^3z^2}{3kz^4} = \frac{4k^3z^2}{3kz^4} = \frac{4k^3}{3z^2}$$

2)
$$\frac{8n^6z^3}{2n^5z^2} = 4nz$$

8)
$$\frac{w}{w^3} = \frac{w^1}{w^3} = \boxed{\frac{1}{w^3}}$$

3)
$$\frac{5dk^3}{9d^4k^6} = \frac{5}{9d^3k^3}$$

9)
$$\frac{9g^4}{6g^6} = \frac{3.3g^4}{3.2g^5} \frac{3}{3g^2}$$

4)
$$\frac{kh}{7k^4h^5} = \frac{k \cdot h}{7k \cdot k \cdot k \cdot k \cdot k \cdot k \cdot h \cdot h \cdot h \cdot h}$$

=\frac{1}{7k^3h^4}

10)
$$\frac{9^2}{9^4} = \frac{1}{9^2}$$
 or $\frac{1}{81}$

5)
$$\frac{3w}{7w^6} \geq \frac{3w^1}{7w^6} \left[\frac{3}{7w^5}\right]$$

$$\frac{5h^4}{2h^3k^5} = \frac{5h^2}{2k^5}$$

6)
$$\frac{6^3}{6} \approx \frac{6^3}{6^1} \approx 6^2 \approx 36$$

12)
$$\frac{2d^2}{6d} = 2\frac{3}{3} + 3\frac{3}{3} = 3$$