

8.2 Using "Quotient, Product and Zero Rules" for Numeric Exponents

1) EXPLORATION Quotient Rule:

- a) Expand both numeric powers:
- b) Cancel common factors
- c) Then rewrite as a single power:
- d) Evaluate both to see they are equal

$$\frac{4^5}{4^3} = \frac{\overbrace{4 \cdot 4 \cdot 4}^{1 \ 1 \ 1} \cdot 4 \cdot 4}{\cancel{4} \cdot \cancel{4} \cdot \cancel{4}} = 1 \cdot 1 \cdot 1 \cdot 4 \cdot 4 = 4^2 = 16$$

← EQUAL

$$\frac{4^5}{4^3} = 16$$

4^{5-3}

THE "QUOTIENT" RULE:

Words: To **DIVIDE** powers having the same base, subtract exponents.

Example 1: Simplify (SHOW WORK):

$$\frac{2^{15}}{2^{12}} = 2^{15-12} = 2^3 = 8$$

Then Evaluate: = 8 ← EVALUATE

← The power

Example 2: Simplify (SHOW WORK):

$$\frac{2^5}{2} = 2^{5-1} = 2^4 = 16$$

Then Evaluate: = 16

Example 3: Simplify (SHOW WORK):

$$\frac{(-2)^9}{(-2)^5} = (-2)^{9-5} = (-2)^4 = 16$$

Then Evaluate: = 16

← pos #

Example 4: Simplify (SHOW WORK):

$$\frac{25x^{20}}{10x^5} = \frac{25}{10} \cdot x^{20-5} = \frac{5}{2} \cdot x^{15}$$

base = x

Numbers

- Reduce fractions
- Divide

2) EXPLORATION Zero Rule:

- a) Expand both numeric powers:
- b) Cancel common factors
- c) Then rewrite as a single power:
- d) Evaluate both to see they are equal

$$\frac{4^5}{4^5} = \frac{\cancel{4} \cdot \cancel{4} \cdot \cancel{4} \cdot \cancel{4} \cdot \cancel{4}}{\cancel{4} \cdot \cancel{4} \cdot \cancel{4} \cdot \cancel{4} \cdot \cancel{4}} = 4^0 = 1$$

$$\frac{4^5}{4^5} = 4^{5-5} = 4^0 = 1$$

Calc → $4^0 = 4^{\cancel{5}-\cancel{5}} = 1$

THE "ZERO" RULE (Words): ANYTHING RAISED TO THE ZERO POWER IS 1.

Example 5: Simplify: $5^0 = 1$

Example 6: Simplify: $x^0 = 1$

EXCEPT → what is 0^0 → UNDEFINED $\frac{0}{0}$

Algebra 1 Notes...

3) EXPLORATION "Power Rule":

a) **Expand:** $(2^3)^2 = (2^3) \cdot (2^3) = (2 \cdot 2 \cdot 2) \cdot (2 \cdot 2 \cdot 2)$
Repeat 2³ twice

b) **Then rewrite as a single power:** = 2^6

c) **Evaluate both to see they are equal**

CALC $(2^3)^2 = 64$ $2^6 = 64$
 =

THE POWER RULE:

Words: For a power raised to another powers, then multiply the exponents

Example 7: Simplify (SHOW WORK): $(2^2)^3 = 2^{2 \cdot 3} = 2^6$ ← Expressed as a power
Power to Power
Then Evaluate: = 64

Example 8: Simplify (SHOW WORK): $(2x^5)^4 = 2^{1 \cdot 4} x^{5 \cdot 4} = 2^4 x^{20}$ ← power
distribute the exponent (4) to all factors in ()'s
Simplify: = $16x^{20}$

Example 9: Simplify (SHOW WORK): $[(-2)^2]^4 = (-2)^{2 \cdot 4} = (-2)^8$ ← power
** Base is (-2)*
Then Evaluate: = $+ 256$ ← *CALC (-2)^8*

Example 10: Simplify (SHOW WORK): $(-2x^4)^3 = (-2)^3 x^{4 \cdot 3} = (-2)^3 x^{12}$ ← power
DISTRIBUTE 3
Simplify: = $-8x^{12}$

Example 5: Simplify (SHOW WORK): $(2xy^3)^6 = 2^6 x^6 y^{3 \cdot 6} = 2^6 x^6 y^{18}$ ← Power
Simplify: = $64x^6y^{18}$

Example 6: Simplify (SHOW WORK): $\left(\frac{5x^2}{2y^5}\right)^3 = \frac{5^{1 \cdot 3} x^{2 \cdot 3}}{2^{1 \cdot 3} y^{5 \cdot 3}} = \frac{5^3 x^6}{2^3 y^{15}} = \frac{125x^6}{8y^{15}}$ ← Simplify
Distribute 3

Example 7: Simplify (SHOW WORK): $\frac{(10x^4)^2}{(2y^2)^4} = \frac{10^{1 \cdot 2} x^{4 \cdot 2}}{2^{1 \cdot 4} y^{2 \cdot 5}} = \frac{10^2 x^8}{2^4 y^{10}} = \frac{100x^8}{16y^{10}} = \frac{25x^8}{4y^{10}}$ ← Power
Simplify: = $\frac{25x^8}{4y^{10}}$ ← *reduce*

STEPS:

- ① Simplify Num.
- ② Simplify Den.
- ③ Simplify the fraction.