

Concept: The Exponent Rules

Name:

- You should have completed Exponents - Section 3 Part A: The Exponent Rules before beginning this handout.

Warm Up

Complete the following. Show all your steps.

$$\begin{aligned} \text{(a)} \quad 2^3 \times 2^6 &= 2^9 \\ &= \mathbf{512} \end{aligned}$$

$$\begin{aligned} \text{(b)} \quad 4^9 \div 4^7 &= 4^2 \\ &= \mathbf{16} \end{aligned}$$


$$\begin{aligned} \text{(c)} \quad 4^{15} \div 4^5 &= 4^{10} \\ &= \mathbf{1,048,76} \end{aligned}$$

$$\begin{aligned} \text{(d)} \quad (2^2)^4 &= 2^8 \\ &= \mathbf{256} \end{aligned}$$

$$\begin{aligned} \text{(e)} \quad (3^4)^3 &= 3^{12} \\ &= \mathbf{531,441} \end{aligned}$$

$$\begin{aligned} \text{(f)} \quad (4ab)^3 &= 4^3 a^3 b^3 \\ &= \mathbf{64a^3b^3} \end{aligned}$$

COMPUTER COMPONENT

Instructions: In  follow the **Content Menu** path:

Exponents > The Exponent Rules

NOTE: Use the **Menu** button in order to get to the lesson where you left off.



Work through all Sub Lessons of the following Lessons **in order**:

- *A Power with Exponent Zero*
- *A Power with a Negative Exponent*
- *Summary of Exponent Rules*
- *Powers with Rational Bases*
- *Example Questions*

Additional Required Materials: *Scientific calculator*



As you work through the computer exercises, you will be prompted to make notes in your notebook/math journal.

NOTES:
Exponent Rule 5

When calculating a power with exponent zero:

- The base number equals 1 because we cannot divide by zero.

$$x^0 = \underline{1}$$

Practice:

$$4^0 = 1$$

Exponent Rule 6

When calculating a power with a negative exponent:

- When there is a negative exponent, we need to create a fraction and put the exponential expression in the denominator and make the exponent positive. For example,

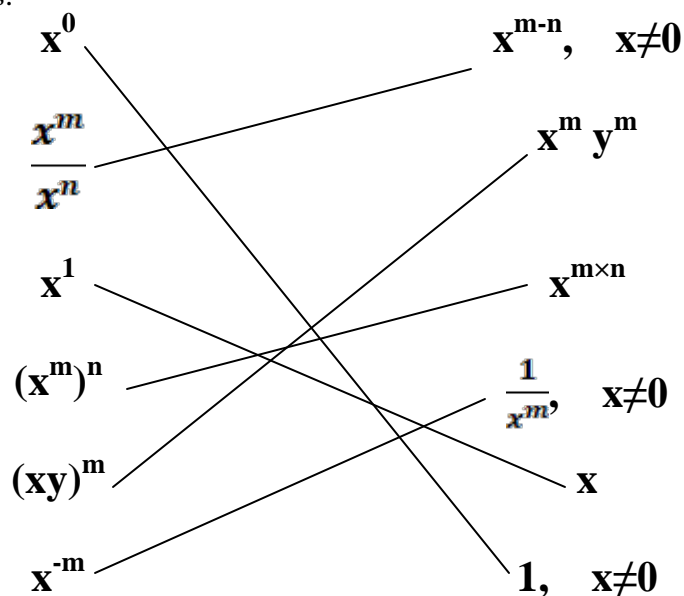
$$x^{-a} = \frac{1}{x^a}$$

Practice:

$$4^{-7} = \frac{1}{4^7}$$

Summary of Rules for Exponents

Match the Rules:



Exponent Rule 7

When raising a rational base to an exponent:

- raise both the numerator and denominator to the exponent

$$\left(\frac{x}{y}\right)^2 = \frac{x}{y} \times \frac{x}{y}$$

Practice:

$$\left(\frac{3}{5}\right)^4 = \frac{3}{5} \times \frac{3}{5} \times \frac{3}{5} \times \frac{3}{5}$$

OFF COMPUTER EXERCISES

1. Simplify. Remember to use the Rules for Exponents.

(a) $(2^5)^3 = 2^{15} = 32,768$

(b) $(-14)^0 = 1$

(c) $2^5 \times 2^4 \div 2^3 = 2^6 = 64$

(d) $3^8 \div 3^2 \times 3^3 = 3^9 = 19,683$

(e) $(6^0)^4 = 1$

(f) $(16m^5) \div (8m^3) = 2m^2$

(g) $2^4 \div 2^5 = \frac{1}{2}$

(h) $3^3 - 2^4 = 11$

(i) $5^2 \div 5^{-3} = 5^5 = 312$

(j) $(z^4)^5 \div (z^1)^4 = z^{16}$

2. A colony of cells triples every hour. The current population is 243 cells.
 Complete the chart below in order to determine:

- (a) The cell population 3 hours from now.
- (b) The cell population 4 hours ago.
- (c) The equation involving P (population) and T (time) that represents the information.

$$P3^T$$

Time (hours) (T)	Population (P)	Population as a Power of 3
-4	3	243×3^{-4}
-3	9	243×3^{-3}
-2	27	243×3^{-2}
-1	81	243×3^{-1}
0	243	243×3^0
1	729	243×3^1
2	2187	243×3^2
3	6561	243×3^3
4	19683	243×3^4

3. Write each as a power with a positive exponent.

Example: $3^{-6} = \frac{1}{3^6}$

(a) $2^{-3} = \frac{1}{2^3} = \frac{1}{8}$

(b) $(-3)^{-2} = \frac{1}{-3^2} = \frac{1}{9}$

(c) $-5^{-3} = \frac{1}{-5^3} = \frac{1}{-125}$

(d) $6^{-2} = \frac{1}{6^2} = \frac{1}{36}$

4. Evaluate.

(a) $(-2)^{-3} = \frac{1}{-2^3} = \frac{1}{-8}$

(b) $-2^{-4} = \frac{1}{-2^4} = \frac{1}{16}$

(c) $8^0 = 1$

(d) $(3)^{-2} = \frac{1}{3^2} = \frac{1}{9}$

(e) $(4^{-3})^{-2} =$
 $(\frac{1}{64})^{-2} = (\frac{1}{64})_2 = 1 \div \frac{1}{4096} = 1 \times 4096$

(f) $15c^{-0} = \frac{15}{c^0} = \frac{15}{1} = 15$

(g) $(15c)^{-0} = \frac{1}{15c^0}$

(h) $5^{-1} = \frac{1}{5}$

(i) $(9)^{-3} \div (9)^{-6} =$

$$\frac{1}{729} \div \frac{1}{531441} = \frac{1}{729} \times \frac{531441}{1} = \frac{531441}{729} = 729$$

(j) $4w^2 \times 5w^6 = 20w^8$

5. Evaluate. Remember the rule to follow when the base is a rational number.

$$\text{Example 1: } \left(\frac{1}{9}\right)^2 = \frac{1^2}{9^2} = \frac{1}{81}$$

$$\text{Example 2: } \left(\frac{3}{4}\right)^{-2} = \frac{1}{\left(\frac{3}{4}\right)^2} = \frac{1}{\left(\frac{9}{16}\right)} = 1 \div \frac{9}{16} = \frac{16}{9}$$

$$(a) \quad \left(\frac{2}{5}\right)^2 = \frac{4}{25}$$

$$(b) \quad \left(\frac{1}{4}\right)^3 = \frac{1}{64}$$

$$(c) \quad \left(\frac{1}{5}\right)^{-3} = \frac{1}{\frac{1}{5^3}} = \frac{1}{\frac{1}{125}} = 1 \times \frac{125}{1} = 125$$

$$(d) \quad \left(\frac{1}{6}\right)^{-1} = \frac{1}{\frac{1}{6}} = 1 \times \frac{6}{1} = 6$$

$$(e) \quad \left(\frac{2}{3}\right)^{-4} = \frac{1}{\frac{2^4}{3^4}} = \frac{1}{\frac{16}{81}} = 1 \times \frac{81}{16} = \frac{81}{16}$$

$$(f) \quad \left(\frac{4}{5}\right)^{-2} = \frac{1}{\frac{4^2}{5^2}} = \frac{1}{\frac{16}{25}} = 1 \times \frac{25}{16} = \frac{25}{16}$$

6. Review the rules of exponents and decide which one you found most difficult. Explain why it was more difficult. *Give examples to support your answer. (Answers will vary)*
