EXPONENTS--EXPRESSIONS AND PATTERNS

BASES, EXPONENTS, AND VALUE

Bases and exponents are used to write a number, or expression, in **exponential form**: a^n. The **BASE**, a, is a factor (number or variable expression) raised to a power. The **EXPONENT**, n, is sometimes called the power and indicates how many times the base is used as a factor.

In general, a^n means a multiplied by itself n times.
For example, 2^4 means $2 \cdot 2 \cdot 2 \cdot 2$. This is called **factored form**. The base is 2 and the exponent is 4. Since $2 \cdot 2 \cdot 2 \cdot 2 = 16$, the value is 16.

Problems

1. Name the base and the exponent, then simplify

   a. 3^7 b. 8^5 c. $5(9 - 6)^3$

2. Compute each value.

   a. 6^5 b. 4^7 c. 1.5^3

   d. 0.04^2 e. $(2 + 3)^4$ f. $2(3 + 4)^3$

EXPONENTS AND PATTERNS

By writing expressions with exponents in factored form and then simplifying, many patterns can be seen. These patterns will be treated formally in future courses.

3. Copy and complete the chart of these cubed numbers.

Exponent Form	Factored Form	Standard Form
2^3	$2 \cdot 2 \cdot 2$	8
3^3		
	$4 \cdot 4 \cdot 4$	
		125
6^3		
7^3		

4. Copy and complete the table below.

Original Form	Factored Form	Simplified Form
$5^2 \cdot 5^5$	$(5 \cdot 5)(5 \cdot 5 \cdot 5 \cdot 5 \cdot 5)$	5^7
$2^2 \cdot 2^4$		
$3^7 \cdot 3^2$		
$x^3 \cdot x^5$		
$x^3y^2 \cdot xy^2$		

a. For each example, compare the bases of the original expression to the base(s) of the simplified expression. What do you notice?

b. For each example, compare the exponents of the original form to the exponent(s) of the simplified form. What do you notice?

c. Simplify $20^{12} \cdot 20^{51}$ without writing the factored form. Describe your process.

5. 

a. Is 3^5 the same as $3 \cdot 5$? Explain.

b. What is the difference between $3^2 + 4^2$ and $(3+4)^2$?

6. Copy and complete the table. Use the Giant **1** to simplify the factored form.

Original Form	Factored Form	Simplified Form
$\frac{5^5}{5^2}$	$\frac{5 \cdot 5 \cdot 5 \cdot 5 \cdot 5}{5 \cdot 5}$	5^3
$\frac{2^4}{2^2}$		
$\frac{3^7}{3^4}$		
$\frac{x^5}{x^3}$		
$\frac{x^3y^2}{xy^2}$		
$\frac{x^5}{x}$		

a. For each example, compare the exponents in the original form to the exponents in the simplified form. What do you notice?

b. Simplify $\frac{20^{51}}{20^{12}}$ without writing the factored form. Describe what you did in detail.

7. Copy and complete the table.

Original Form	Factored Form	Simplified Form
$(5^2)^5$	$(5 \cdot 5)(5 \cdot 5)(5 \cdot 5)(5 \cdot 5)(5 \cdot 5)$	5^{10}
$(2^2)^4$		
$(3^7)^2$		
$(x^3)^5$		
$(x^3y^2)^2$		

a. For each example, compare the exponents in the original form to the exponent(s) in the simplified form. What do you notice?

b. Simplify $(20^2)^{51}$ without writing the factored form. Describe in detail what you did.

8. Complete the <u>first four lines</u> of the table for powers of 2.

a. In the table you have constructed, you should see a pattern. What is it?

b. Use the pattern to predict the answer for 2^0. Check your answer on a calculator.

c. How would you write 2^{-1} as a fraction?

d. Finish completing the table

Powers of 2	Standard Form
2^4	
2^3	
2^2	4
2^1	2
2^0	
2^{-1}	

Answers

1. a. 3, 7, 2187 b. 8, 5, 32768 c. 3, 3, 135

2. a. 7776 b. 16384 c. 3.375

   d. 0.0016 e. 625 f. 686

3. $3 \cdot 3 \cdot 3 = 27$ $4^3 = 64$ $5^3 = 5 \cdot 5 \cdot 5$ $6 \cdot 6 \cdot 6 = 216$ $7 \cdot 7 \cdot 7 = 343$

4. Simplified: 2^6 3^9 x^8 x^4y^4

   a. same base b. add exponents c. 20^{63}

5. a. No, $3^5 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$ and $3 \cdot 5 = 3 + 3 + 3 + 3 + 3$

   b. In the first expression you square first, and in the second you add first

6. Simplified: 2^4 3^3 x^2 x^2 x^4

   a. subtract exponents b. 20^{39} ; same base and subtract exponents

7. Simplified: 2^8 3^{14} x^{15} x^6y^4

   a. multiplied exponents b. 20^{104} ; same base and multiply exponents

8. Powers of 2 Standard Form

2^4	16
2^3	8
2^2	4
2^1	2
2^0	1
2^{-1}	$\frac{1}{2}$
2^{-2}	$\frac{1}{4}$
2^{-3}	$\frac{1}{8}$
2^{-4}	$\frac{1}{16}$

Each time the exponent on the base of two is lowered by one, the standard form is divided by two.