CHAPTER 9 - EXPONENTS

9.1 POSITIVE AND NEGATIVE EXPONENTS

Exponents are used when a factor is repeated more than once. The exponent tells you how many times you must write out the **base** to get the **standard form** or the answer. The examples below show the **exponential form**, the **factored form** and the **standard form** of a question involving exponents.

EXAMPLES WITH POSITIVE EXPONENTS:

1. $7^4 = (7)(7)(7)(7) = 2401$
2. $(^2/_3)^3 = (^2/_3)(^2/_3)(^2/_3) = {}^8/_{27}$
3. $3.5^3 = (3.5)(3.5)(3.5) = 42.875$
4. $5^0 = 1$ ← (Any number or letter with an exponent of zero is always equal to one.)
4. $(-5)^4 = (-5)(-5)(-5)(-5) = +625$
5. $-5^4 = -(5)(5)(5)(5) = -625$

Whenever we have a negative exponent, we first write the reciprocal of the base and change the negative sign on the exponent to positive. We then calculate the answer the same way that is shown above.

EXAMPLES WITH NEGATIVE EXPONENTS:

1. $5^{-2} = (^1/_5)^2 = (^1/_5)(^1/_5) = {}^1/_{25}$
2. $4^{-3} = (^1/_4)^3 = (^1/_4)(^1/_4)(^1/_4) = {}^1/_{64}$
3. $(^3/_4)^{-3} = (^4/_3)^3 = (^4/_3)(^4/_3)(^4/_3) = {}^{64}/_{27}$
4. $(^{-3}/_4)^{-3} = (^{-4}/_3)^3 = (^{-4}/_3)(^{-4}/_3)(^{-4}/_3) = {}^{-64}/_{27}$
5. $(-5)^{-4} = (^{-1}/_5)^4 = (^{-1}/_5)(^{-1}/_5)(^{-1}/_5)(^{-1}/_5) = {}^{+1}/_{625}$

Exponents are also used to represent numbers in **expanded notation** as shown in the examples below.

EXAMPLES: (STANDARD FORM → EXPANDED FORM)

1. $428.56 = [4 \times 10^2] + [2 \times 10^1] + [8 \times 10^0] + [5 \times 10^{-1}] + [6 \times 10^{-2}]$
2. $67\,000.905 = [6 \times 10^4] + [7 \times 10^3] + [9 \times 10^{-1}] + [5 \times 10^{-3}]$
3. $5006.08 = [5 \times 10^3] + [6 \times 10^0] + [8 \times 10^{-2}]$

A. Complete the following chart.

Exponential Form	Base	Exponent	Factored Form	Standard Form
1. 5^2	5	2	(5)(5)	25
2. 7^3	7	3	(7)(7)(7)	343
3. 6^4	6	4	(6)(6)(6)(6)	1296
4. 12^3	12	3	(12)(12)(12)	1728
5. 2^6	2	6	(2)(2)(2)(2)(2)(2)	64
6. 8^2	8	2	(8)(8)	64
7. $7^{-2} = \frac{1}{7^2}$	7	-2	$(\frac{1}{7})(\frac{1}{7})$	$\frac{1}{49}$
8. $3^{-4} = \frac{1}{3^4}$	3	-4	$\frac{1}{(3)(3)(3)(3)}$	$\frac{1}{81}$
9. $(-6)^3$	-6	3	(-6)(-6)(-6)	-216
10. 2^{-4}	2	-4	$(1/2)(1/2)(1/2)(1/2)$	$\frac{1}{16}$

B. Write the following in: (a) factored form and then (b) in standard form. The first one is already done for you.

1. $4^6 = (4)(4)(4)(4)(4)(4) = 4096$
2. $(3/4)^2 = (\frac{3}{4})(\frac{3}{4}) = \frac{9}{16}$
3. $3^7 = (3)(3)(3)(3)(3)(3)(3) = 2187$
4. $(-4)^3 = (-4)(-4)(-4) = -64$
5. $-2^4 = -(2)(2)(2)(2) = -16$
6. $(-2)^4 = (-2)(-2)(-2)(-2) = 16$
7. $(5)^0 = 1$
8. $(5^3)(5^2) = (5)(5)(5)(5)(5) = 3125$
9. $(4^5)(4^3) = (4)(4)(4)(4)(4)(4)(4)(4) = 65536$
10. $4^{-3} = \frac{1}{4^3} = \frac{1}{(4)(4)(4)} = \frac{1}{64}$
11. $(2^5)(2^{-4}) = \frac{2^5}{2^4} = \frac{(2)(2)(2)(2)(2)}{(2)(2)(2)(2)} = 2$
12. $(3^2)(3^1)(3^0) = (3)(3)(3)(1) = 27$
13. $8^3 \cdot 8 = (8)(8)(8)(8) = 4096$
14. $(5^3)(3^2)(2^3) = \underbrace{(5)(5)(5)}_{125} \cdot \underbrace{(3)(3)}_{9} \cdot \underbrace{(2)(2)(2)}_{8} = 9000$

C. Find the missing exponent 'e', or base 'b', in each question below.

1. $5^e = 25$ $e=2$
2. $14^e = 14$ $e=1$
3. $b^2 = 64$ $b=8$
4. $b^5 = 243$ $b=3$
5. $b^4 = 0$ $b=0$
6. $2^e = 128$ $e=7$
7. $17^e = 1$ $e=0$
8. $6^e = 216$ $e=3$
9. $b^3 = 125$ $b=5$
10. $2^e = 256$ $e=8$
11. $10^e = 100$ $e=2$
12. $b^3 = 343$ $b=7$
13. $b^2 = 289$ $b=17$
14. $b^2 = 1764$ $b=42$
15. $25^e = 1$ $e=0$
16. $6^e = 36$ $e=2$
17. $b^4 = 81$ $b=3$
18. $5^e = 125$ $e=3$