

## Section 2.2: Powers of Ten and the Zero Exponent

Table 1:

Power	Repeated Multiplication	Standard Form
$3^5$	$3 \times 3 \times 3 \times 3 \times 3$	243
$3^4$	$3 \times 3 \times 3 \times 3$	81
$3^3$	$3 \times 3 \times 3$	27
$3^2$	$3 \times 3$	9
$3^1$	3	3

The exponent decreases by 1 each time.

Each time the exponent decreases, standard form is divided by 3.

This pattern suggests that  $3^0 =$  1.

Note:

### Zero Exponent Rule

Any base (excluding zero) with the exponent zero is one.

$$a^0 = 1 \text{ where } a \neq 0$$

For the following, identify the base, then evaluate the answer.

1.  $5^0$       The base is 5 and  $5^0 =$  1.

2.  $10^0$       The base is 10 and  $10^0 =$  1.

3.  $(-5)^0$       The base is  $(-5)$   
and  $(-5)^0 =$  1.

Note: The zero exponent applies to the number in the brackets.

4.  $-10^0$       The base is 10 (not -10)  
and  $-10^0 =$   $-1 \times 1 = -1$ .

Note: If there are no brackets, the zero exponent applies ONLY to the base.

Practice. Evaluate the following powers (remember the order of operations – BEDMAS).

$$A. 3 + 2^0$$

$$= 3 + 1$$

$$= 4$$

$$B. 3^0 + 2^0$$

$$= 1 + 1$$

$$= 2$$

$$C. (3 + 2)^0$$

$$= (5)^0$$

$$= 1$$

$$D. -3^0 + 2$$

$$= -1(1) + 2$$

$$= (-1) + 2$$

$$= 1$$

$$E. -3^0 + (-2)^0$$

$$= -1(1) + 1$$

$$= (-1) + 1$$

$$= 0$$

$$F. -(3 + 2)^0$$

$$= -1(5)^0$$

$$= -1(1)$$

$$= (-1)$$

## Writing Numbers Using Powers of Ten

Power	Repeated Multiplication	Standard Form	Words
$10^9$	$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$	1 000 000 000	one billion
$10^8$	$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$	100 000 000	one hundred million
$10^7$	$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$	10 000 000	ten million
$10^6$	$10 \times 10 \times 10 \times 10 \times 10 \times 10$	1 000 000	one million
$10^5$	$10 \times 10 \times 10 \times 10 \times 10$	100 000	one hundred thousand
$10^4$	$10 \times 10 \times 10 \times 10$	10 000	ten thousand
$10^3$	$10 \times 10 \times 10$	1 000	one thousand
$10^2$	$10 \times 10$	100	one hundred
$10^1$	10	10	ten
$10^0$	1	1	one

Note: From the above table, we can see that the exponent is equal to the number of zeros .

When we write numbers in our everyday lives, we are using standard form. When numbers are written using powers of ten, we are using expanded form.

Write the following numbers using powers of ten:

A.  $600 = 6 \times 100$

$$= 6 \times 10^2$$

B.  $100\,000 = 1 \times 100\,000$

$$= 1 \times 10^5$$

C.  $4\,300 = (4 \times 1000) + (3 \times 100)$

$$= (4 \times 10^3) + (3 \times 10^2)$$

D.  $3\,452 = (3 \times 1000) + (4 \times 100) + (5 \times 10) + (2 \times 1)$

$$= (3 \times 10^3) + (4 \times 10^2) + (5 \times 10^1) + (2 \times 10^0)$$

Write the following numbers in standard form:

A.  $6 \times 10^3 = (6 \times 1\,000)$

$$= 6\,000$$

B.  $(5 \times 10^3) + (7 \times 10^2) + (8 \times 10^1) + (8 \times 10^0)$

$$= (5 \times 1\,000) + (7 \times 100) + (8 \times 10) + (8 \times 1)$$

$$= 5000 + 700 + 80 + 8$$

$$= 5\,788$$

Practice Exercises:  
pg. 61 #4, 5, 6, 8, 9, 10 & 13