

Name: KEY

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Math 9Lesson 2.1 ~ What Is A Power?

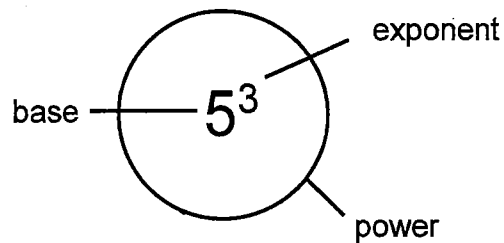
When an integer, other than 0, can be written as a product of equal factors, we can write the integer as a **power**.

For example,  $5 \times 5 \times 5 = 5^3$

5 is the base

3 is the exponent

$5^3$  is the power



We say: five to the power of three (or five cubed)

A power can also be negative or have a base that is a negative integer.

For example,  $(-8) \times (-8) \times (-8) \times (-8) = (-8)^4$

Key Terms in the Instructions:

"Product" or "Repeated Multiplication"	$7 \times 7 \times 7 \times 7$
"Power"	$7^4$
"Standard Form" or "Evaluate"	2401

**Example # 1:** Write each product as a power.

a)  $3 \times 3 \times 3 \times 3 \times 3 \times 3 = 3^6$

b)  $12 = 12^1$

**Example # 2:** Write as a repeated multiplication and in standard form.

a)  $9^5 = 9 \times 9 \times 9 \times 9 \times 9$   
 $= 59049$

b)  $11^4 = 11 \times 11 \times 11 \times 11$   
 $= 14641$

**Example #3:** Identify the base of each power, and then evaluate the power.

a)  $(-3)^4$

Base: -3

$$= (-3)(-3)(-3)(-3)$$

$$= 81$$

b)  $-3^4$

Base: 3

$$= -(3 \times 3 \times 3 \times 3)$$

$$= -81$$

c)  $-(-3)^4$

Base: -3

$$= -(-3)(-3)(-3)(-3)$$

$$= -81$$

## Practice

1. Write as a power.

a)  $\underbrace{8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8}_{7 \text{ factors of } 8}$

$$8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 = 8^7$$

b)  $\underbrace{10 \times 10 \times 10 \times 10 \times 10}_{5 \text{ factors of } 10}$

$$\text{So, } 10 \times 10 \times 10 \times 10 \times 10 = 10^5$$

c)  $\underbrace{(-2)(-2)(-2)}_{3 \text{ factors of } -2}$

$$\text{So, } (-2)(-2)(-2) = (-2)^3$$

d)  $\underbrace{(-13)(-13)(-13)(-13)(-13)(-13)}_{6 \text{ factors of } -13}$

$$\text{So, } (-13)(-13)(-13)(-13)(-13)(-13) = (-13)^6$$

2. Write each expression as a power.

a)  $9 \times 9 \times 9 \times 9 = 9^4$

b)  $(5)(5)(5)(5)(5)(5) = 5^6$

c)  $11 \times 11 = 11^2$

d)  $(-12)(-12)(-12)(-12)(-12) = (-12)^5$

3. Write each power as repeated multiplication.

a)  $3^2 = \underline{3 \times 3}$

b)  $3^4 = \underline{3 \times 3 \times 3 \times 3}$

c)  $2^7 = \underline{2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2}$

d)  $10^8 = \underline{10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10}$

Identify the base first.

4. State whether the answer will be positive or negative.

a)  $(-3)^2$  +

b)  $6^3$  +

c)  $(-10)^3$  -

d)  $-4^3$  -

5. Write each power as repeated multiplication and in standard form.

a)  $(-3)^2 = \underline{(-3)(-3)}$   
 $= \underline{9}$

b)  $6^3 = \underline{6 \times 6 \times 6}$   
 $= \underline{216}$

c)  $(-10)^3 = \underline{(-10)(-10)(-10)}$   
 $= \underline{-1000}$

d)  $-4^3 = \underline{-4 \times 4 \times 4}$   
 $= \underline{-64}$

Predict  
 Will the answer be positive or negative?

6. Write each product as a power and in standard form.

a)  $(-3)(-3)(-3) = \underline{(-3)^3}$   
 $= \underline{-27}$

b)  $(-8)(-8) = \underline{(-8)^2}$   
 $= \underline{64}$

c)  $-(8 \times 8 \times 8) = \underline{-8^3}$   
 $= \underline{-512}$

d)  $-(-1)(-1)(-1)(-1)(-1)(-1)(-1) = \underline{-(-1)^7}$   
 $= \underline{1}$

7. Identify any errors and correct them.

a)  $4^3 = 12$   $4^3 \neq 4 \times 3 = 12$   
 $4^3 = 4 \times 4 \times 4 = 64$

b)  $(-2)^9$  is negative. no error  
 $(-2)(-2)(-2)(-2)(-2)(-2)(-2)(-2)(-2) = -512$

c)  $(-9)^2$  is negative. positive  
 $(-9)(-9) = 81$

d)  $3^2 = 2^3$   $3^2 \neq 2^3$   
 $3^2 = 9$ ,  $2^3 = 8$ ,  $9 \neq 8$

e)  $(-10)^2 = 100$  no error  
 $(-10)(-10) = 100$

## Lesson 2.2 ~ Powers of Ten & the Zero Exponent

Complete the table below.

Exponent	Base	Power	Repeated Multiplication	Standard Form
4	2	$2^4$	$2 \times 2 \times 2 \times 2$	16
3	2	$2^3$	$2 \times 2 \times 2$	8
2	2	$2^2$	$2 \times 2$	4
1	2	2	2	2
0	2	$2^0$		1

$\downarrow \div 2$   
 $\downarrow \div 2$   
 $\downarrow \div 2$   
 $\downarrow \div 2$

**Zero Exponent Law:** A power with an integer base, other than 0, and an exponent 0 is equal to 1.

For example:  $n^0 = 1, n \neq 0$

**Example # 4:** Evaluate each expression.

a)  $4^0 = 1$

b)  $-4^0 = -1$

c)  $(-4)^0 = 1$

Now complete the following table with a base of 10.

Number in Words	Power	Standard Form
One billion	$10^9$	1 000 000 000
One hundred million	$10^8$	100 000 000
Ten million	$10^7$	10 000 000
One million	$10^6$	1 000 000
One hundred thousand	$10^5$	100 000
Ten thousand	$10^4$	10 000
One thousand	$10^3$	1 000
One hundred	$10^2$	100
Ten	$10^1$	10
One	$10^0$	1

**Example # 5:** Write 60 million using powers of 10.

$$\begin{aligned} 60 \text{ million} &= 60\,000\,000 \\ &= 6 \times 10\,000\,000 \\ &= \boxed{6 \times 10^7} \end{aligned}$$

**Example #6:** Write 3452 using powers of 10.

$$\begin{aligned} 3452 &= 3000 + 400 + 50 + 2 \\ &= \boxed{(3 \times 10^3) + (4 \times 10^2) + (5 \times 10^1) + (2 \times 10^0)} \end{aligned}$$

## Practice

1. a) Complete the table below.

Power	Repeated Multiplication	Standard Form
$5^4$	$5 \times 5 \times 5 \times 5$	625
$5^3$	$5 \times 5 \times 5$	125
$5^2$	$5 \times 5$	25
$5^1$	5	5
$5^0$		1

)

$\div 5$

$\div 5$

$\div 5$

$\div 5$

b) What is the value of  $5^1$ ? 5

c) Use the table. What is the value of  $5^0$ ? 1

2. Evaluate each power.

a)  $2^0 = 1$

b)  $9^0 = 1$

c)  $(-2)^0 = 1$

d)  $-2^0 = -1$

e)  $10^1 = 10$

f)  $(-8)^1 = -8$

If there are no brackets, the exponent applies only to the base.

3. Write each number as a power of 10.

a) 10 000 =  $10^4$

b) 1 000 000 =  $10^6$

c) Ten million =  $10^7$

d) One =  $10^0$

e) 1 000 000 000 =  $10^9$

f) 10 =  $10^1$

4. Evaluate each power of 10.

a)  $-10^6 = -1\,000\,000$

b)  $-10^0 = -1$

c)  $-10^8 = -100\,000\,000$

d)  $-10^1 = -10$

5. One trillion is written as 1 000 000 000 000.

Write each number as a power of 10.

a) One trillion =  $1\,000\,000\,000\,000 = 10^{12}$

b) Ten trillion =  $10 \times 1\,000\,000\,000\,000 = 10^{13}$

c) One hundred trillion =  $100 \times 1\,000\,000\,000\,000 = 10^{14}$

6. Write each number in standard form.

a)  $5 \times 10^4 = 5 \times 10\,000$   
 $= 50\,000$

b)  $(4 \times 10^2) + (3 \times 10^1) + (7 \times 10^0) = (4 \times 100) + (3 \times 10) + (7 \times 1)$   
 $= 400 + 30 + 7$   
 $= 437$

c)  $(2 \times 10^3) + (6 \times 10^2) + (4 \times 10^1) + (9 \times 10^0)$   
 $= (2 \times 1000) + (6 \times 100) + (4 \times 10) + (9 \times 1)$   
 $= 2000 + 600 + 40 + 9$   
 $= 2649$

d)  $(7 \times 10^3) + (8 \times 10^0) = (7 \times 1000) + (8 \times 1)$   
 $= 7000 + 8$   
 $= 7008$