Concept: The Meaning of Exponents

Name:

- **You should have completed Exponents – Section 1 Part A: The Meaning of Exponents before beginning this handout.**

Warm Up

Complete the following. Show all your steps.

(a) $2 \times 2 = \mathbf{4}$

(b) $3 \times 3 \times 3 = \mathbf{27}$

(c) $4 \times 4 \times 4 \times 4 = \mathbf{256}$

(d) $5 \times 5 \times 5 \times 5 \times 5 \times 5 = \mathbf{15,\ 625}$

(e) $6 \times 6 \times 6 \times 6 \times 6 \times 6 = \mathbf{46,\ 656}$

f) $7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 = \mathbf{823,\ 543}$

COMPUTER COMPONENT

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

Exponents > **The Meaning of Exponents**

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**:
  - *Exponents, Powers, Bases*
  - *Powerful Explosions*
  - *Introductory Examples*
  - *Examples – Substitution*
  - *Examples – Order of Operations*

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

NOTES:
Fill in the following blanks:

- Exponents are used to write ***number*** expressions that have repeated ***multiplication.***

  2^4

- The base is ***2.*** Use the base as the ***factor.***

- The exponent is ***4.*** The exponent indicates how many ***times*** to use the base as a ***factor.***
- The entire ***expression*** is called a ***power.***

$$2^{10}$$

- is read as "***2*** to the ***exponent*** of ***10*** ."
- is read as " ***2*** to the ***10th***."

It means that you use ***2*** as a factor ***10*** times.

Fill in the chart.

Power	Base	Exponent	Factor	Standard Form
2	2	1	2	2
2^2	2	2	2×2	4
2^3	2	3	$2 \times 2 \times 2$	8
2^4	2	4	$2 \times 2 \times 2 \times 2$	16
2^5	2	5	$2 \times 2 \times 2 \times 2 \times 2$	32
2^6	2	6	$2 \times 2 \times 2 \times 2 \times 2 \times 2$	64
2^7	2	7	$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$	128
2^8	2	8	$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$	256
2^9	2	9	$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$	512
2^{10}	2	10	$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$	1024
2^{11}	2	11	$2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$	2048

Power	Base	Exponent	Factor	Standard Form
3	3	1	3	3
3^2	3	2	3×3	9
3^3	3	3	$3 \times 3 \times 3$	27
3^4	3	4	$3 \times 3 \times 3 \times 3$	81
3^5	3	5	$3 \times 3 \times 3 \times 3 \times 3$	243
Power	**Base**	**Exponent**	**Factor**	**Standard Form**
4	4	1	4	4
4^2	4	2	4×4	16
4^3	4	3	$4 \times 4 \times 4$	64
4^4	4	4	$4 \times 4 \times 4 \times 4$	256
Power	**Base**	**Exponent**	**Factor**	**Standard Form**
5	5	1	5	5
5^2	5	2	5×5	25
5^3	5	3	$5 \times 5 \times 5$	125
5^4	5	4	$5 \times 5 \times 5 \times 5$	625
Power	**Base**	**Exponent**	**Factor**	**Standard Form**
6	6	1	6	6
6^2	6	2	6×6	36
6^3	6	3	$6 \times 6 \times 6$	216

Power	Base	Exponent	Factor	Standard Form
10	10	1	10	10
10^2	10	2	10×10	100
10^3	10	3	$10 \times 10 \times 10$	1000
10^4	10	4	$10 \times 10 \times 10 \times 10$	10000
10^5	10	5	$10 \times 10 \times 10 \times 10 \times 10$	100000
10^6	10	6	$10 \times 10 \times 10 \times 10 \times 10 \times 10$	1000000
10^7	10	7	$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$	10000000

Interesting Fact: ***Descartes invented the exponent notation.***

http://books.google.ca/books?id=7juWmvQSTvwC&pg=PA346&lpg=PA346&dq=exponents+Descartes&source=web&ots=KWflCmK8Ss&sig=eTUkAqRdrQlDf8PUXpqlZCiRCOU&hl=en&sa=X&oi=book_result&resnum=8&ct=result

S^6

- **"S"** is multiplied by itself ***6*** times.

Remember:

- *A power with a negative base is* ***positive*** *when* **exponent** *is* **even.**
- *A power with a negative base is* ***negative*** *when* **exponent** *is* **odd.**

Practice:

Fill in the chart.

Power	Expanded Form	Standard Form
10^2	(10) (10)	*100*
3^3	(3) (3) (3)	*27*
$\left(\frac{2}{3}\right)^2$	$\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)$	$\frac{4}{9}$
$(-7)^3$	(-7) (-7) (-7)	*-343*
$(-7)^4$	(-7) (-7) (-7) (-7)	*2401*
$(-1)^{23}$	(-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1)	*-1*
$(-1)^{44}$	(-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1)	*1*
4^3	(4) (4) (4)	*64*
3^4	(3) (3) (3) (3)	*81*
$(-2)^4$	(-2) (-2)	*16*
$-(2)^4$	-(2) (2) (2) (2)	*-16*

Interesting fact:

Computer Memory

A byte is a unit of storage capable of storing one letter of the alphabet. For example, the word "math" requires four bytes to store in a computer.

Bytes of computer memory are often manufactured in amounts equal to powers of 2.

*1 kilobyte (1K) = 2^{10} = **1024** bytes*

*1 megabyte (1 MB) = 2^{20} = **1, 048, 576** bytes*

*1 gigabyte (1 GB) = 2^{30} = **1, 073, 741, 824** bytes*

http://www.webopedia.com/TERM/b/byte.html

OFF COMPUTER EXERCISES

1. Complete the chart.

Power	Expand the Power	Answer
2^4	(2) (2) (2) (2)	16
$(-2)^{16}$	(-2) (-2) (-2) (-2) (-2) (-2) (-2) (-2) (-2) (-2) (-2) (-2) (-2) (-2) (-2) (-2)	*65536*
-4^4	-(4) (4) (4) (4)	*-256*
$(-4)^4$	(-4) (-4) (-4) (-4)	*256*
$(-1)^{33}$	(-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1)	*-1*
$(0.75)^3$	(0.75) (0.75) (0.75)	*0.421875*
$(-3)^5$	(-3) (-3) (-3) (-3) (-3) (-3)	*-243*
$(-1)^{22}$	(-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1) (-1)	*1*
$(-2)^3$	(-2) (-2) (-2)	*-8*

2. Find the number that makes each expression true.

(a) $2^{(5)} = 32$

(b) $(-4)^{(3)} = -64$

(c) $(\mathbf{-3})^{3} = -27$

(d) $(0.5)^{(2)} = 0.25$

(e) $(\mathbf{10})^{(4)} = 10\,000$

(f) $1^3 + 2^3 + 3^3 + 4^3 = (\mathbf{10})^{(2)}$

3. For each of the following substitute, the given value and then evaluate the expression. (*Use good form.*)

Example: $x^2 + 2y^3$ when $x = 2$ and $y = -1$

$x^2 + 2y^3 = (\underline{2})^2 + 2(\underline{-1})^3$

$= 4 + 2(-1)$

$= 4 + (-2)$

$= 2$

(a) $2x^3$ when $x = -2$

$= 2(-2)^3$

$= \mathbf{2(-8)}$

$= \mathbf{-16}$

(b) $-3x^3 - y^3$ when $x = -1$ and $y = 2$

$= -3(-1)^3 - (2)^3$

$= \mathbf{3 - 8}$

$= \mathbf{-5}$

(c) $2x^3 - 3y$ when $x = -3$ and $y = -4$

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

$= \mathbf{-54 + 12}$

$= \mathbf{-42}$

(d) $-4x^2y^3$ when $x = -3$ and $y = -2$

$= -4\{(-3)^2(-2)^3\}$

$= \mathbf{-4\ (-72)}$

$= \mathbf{288}$

4. Evaluate. *Remember to use **Order of Operations** rules.*

(a) $33 - 3^3 = \boldsymbol{6}$

(b) $21 + 2^3 = \boldsymbol{29}$

(c) $3^4 + 2(-17) = \boldsymbol{47}$

(d) $2^5 - (5)(5) = \boldsymbol{7}$

(e) $(2 + 3)^2 = \boldsymbol{25}$

(f) $(2)^3 + (3)^2 = \boldsymbol{17}$

(g) $(-4)^2 + (-1)^3 = \boldsymbol{15}$

(h) $(3)^4 + (4)^3 = \boldsymbol{145}$

5. Fill in the blanks.

   In an expression $(-5)^3$, 3 is the ***exponent***, *-5* is the base and

   $(-5)^3$ is the ***power.***

6. Is it possible for a person's age to be expressed as an exponent? *Explain your answer*.

   My age is $2^5 = 32$

7. On my first birthday, my parents gave me a dollar. On each birthday after that, they tripled my previous amount.

   (a) How much money did I receive on my 13^{th} birthday?

   You will receive $531, 441 on your 13^{th} birthday. WOW!!!

   (b) If I saved my birthday money, how much money in total will I have on my 13^{th} birthday?

1 + 3 + 9 + 27 + 81 + 243 + 729 + 2,187 + 6, 567 + 19, 683 + 59, 049 + 177, 147 + 531, 441

= $797, 167