

2.1 Powers and Exponents

Difference Between a Subscript and a Superscript

A subscript can be a letter or number that appears smaller than the normal sized text and appears slightly below the text. A superscript can be a letter or number that appears smaller than the normal sized text and appears slightly above the text. Superscripts are commonly used in math to represent exponents. Subscripts are commonly used in formulas to label different variables.

Examples

$$x_2 \quad H_2O \quad 12^5 \quad (y_2 - y_1)^2$$

Notes labeling different parts

$$3^3 = 27$$

Class Notes – Expand each expression.

LP#1 5^4	2^6	7^3
LP#2 $8^2 \cdot 3^4$	$2^4 \cdot 2^2$	$6^3 \cdot 4^2$

Class Notes – Condense each expression using exponents.

LP#3 $5 \cdot 5 \cdot 5 \cdot 7 \cdot 7$	$4 \cdot 4 \cdot 10 \cdot 10 \cdot 10 \cdot 10$	$3 \cdot 2 \cdot 3 \cdot 2 \cdot 3$
LP#4 $x \cdot y \cdot x \cdot x \cdot y \cdot x$	$a \cdot a \cdot b \cdot b \cdot c \cdot a$	$5 \cdot m \cdot m \cdot 5 \cdot 5 \cdot n$

Class Notes – Evaluate the following expressions. Let $w = 2$, $x = 3$, and $y = 4$.

LP#5 9^x	6^y	y^x
---------------	-------	-------

LP#6 $x + 5^w$	$2^x + 3^y$	$50 - w^y$
LP#7 $5y^2$	vs $(5y)^2$	$4x^2$ vs $(4x)^2$

Class Notes – Evaluate the following expressions. Let $x_1 = 5$, $x_2 = 9$, $y_1 = 4$, and $y_2 = 12$.

LP#8 $(x_1)^4$	$(y_1)^3$	$x_2 - x_1$
LP#9 $y_2 + y_1$	$(y_2 - y_1)^2$	$\frac{x_2 + x_1}{2}$

Review – Evaluate the following expressions. Let $w = 2$, $x = 3$, and $y = 4$.

R#1 11^x	$(y - w)^5$	y^y
R#2 w^y	$w^2 + x^2 - y^2$	$\frac{w + y^x}{2}$

Evaluate the following expressions. Let $x_1 = 5$, $x_2 = 9$, $y_1 = 4$, and $y_2 = 12$.

R#3 $(x_2)^4$	$y_2 - y_1$	$(x_2 - x_1)^2$	$\frac{y_2 + y_1}{2}$
------------------	-------------	-----------------	-----------------------

Homework

Evaluate the following expressions. Let $w = 2$, $x = 3$, and $y = 4$.

- 1) 15^w 2) 10^y 3) x^x 4) $w^2 - y^2$ 5) $(y - w)^x$
6) $6w^2$ 7) $(6w)^2$ 8) $10x^3$ 9) $(10x)^3$ 10) $2w^3 + (4x)^2$
11) $4x^2 + (3w - y)^3$ 12) $\frac{w^3 + y}{6}$ 13) $9x^2$ 14) $\frac{w^2 + 10}{7}$ 15) $2(w + y)^3$

Evaluate the following expressions. Let $x_1 = 3$, $x_2 = 7$, $y_1 = 6$, and $y_2 = 10$.

- 16) $(x_1)^4$ 17) $(x_2)^4$ 18) $(y_1)^3$ 19) $x_2 - x_1$ 20) $y_2 - y_1$
21) $y_2 + y_1$ 22) $x_2 + x_1$ 23) $(y_2 - y_1)^2$ 24) $(x_2 - x_1)^2 - (y_2 - y_1)^2$
25) $(x_2 - x_1)^2$ 26) $\frac{x_2 + x_1}{2}$ 27) $\frac{y_2 + y_1}{2}$ 28) $\frac{x_2 + x_1}{2} - \frac{y_2 + y_1}{2}$

Synthesis

- 29) If the measure of a side of a square is represented by b , represent the perimeter and area of the square in terms of b .

Evaluate:

- 30) $\sqrt{9^2}$ 31) $\sqrt{49^2}$ 32) $\sqrt{25^2}$ 33) $\sqrt{16^2}$ 34) $\sqrt{81^2}$
35) $\sqrt{36^2}$ 36) $\sqrt{144^2}$ 37) $\sqrt{100^2}$ 38) $\sqrt{121^2}$ 39) $\sqrt{64^2}$
40) Let $x_1 = 2$, $x_2 = 5$, $y_1 = 7$, and $y_2 = 11$. Find d , if $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
41) Let $x_1 = 5$, $x_2 = 11$, $y_1 = 6$, and $y_2 = 14$. Find d , if $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
42) Let $x_1 = 1$, $x_2 = 6$, $y_1 = 5$, and $y_2 = 17$. Find d , if $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

2.2 Coefficients and Exponents

Difference Between Exponents and Coefficients

A coefficient is a number that is multiplied to a variable. Remember, when expanding an expression that contains multiplication we use addition. Look at the following examples:

Example 1 – two numbers $3 \times 5 = 5 + 5 + 5$	Example 2 – coefficient and variable $3x = 3 \times x = x + x + x$
--	--

Expand the expressions so that it does not contain a coefficient.

LP#1 $6x$	$4y$	$5x^2$
--------------	------	--------

An exponent is a number that is represented by using a superscript at the end of a term or expression. Remember, when expanding an expression that contains an exponent we use multiplication. Look at the following examples:

Example 3 $3^5 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$	Example 4 $x^4 = x \cdot x \cdot x \cdot x$
---	---

Expand each expression so that it does not contain an exponent.

LP#2 x^4	y^7	$7x^3$
---------------	-------	--------

State some differences between a coefficient and an exponent based on the criteria given.

By the looks
By the operation

Class Notes – State the coefficient and exponent to the variable to the following expressions.

LP#3 $5x^4$ coefficient = exponent =	$20y^2$ coefficient = exponent =	$-\frac{1}{2}x^4$ coefficient = exponent =
LP#4 w^6 coefficient = exponent =	$-m^8$ coefficient = exponent =	$0.2g$ coefficient = exponent =

Class Notes – Evaluate the following expressions. Let $a = 5$, $b = -6$, and $c = 4$.

LP#5 $3a$	a^3	$2b$	b^2
LP#6 $5c$	c^5	$2(a + b)$	$(a + b)^2$

Review - State the coefficient and exponent to the variable to the following expressions.

R#1 $5y^8$ coefficient = exponent =	$\frac{4}{5}x^3$ coefficient = exponent =	$11x^7$ coefficient = exponent =	m^3 coefficient = exponent =
R#2 $0.25x^4$ coefficient = exponent =	$-7y^{14}$ coefficient = exponent =	$-\frac{3}{4}x^6$ coefficient = exponent =	$10y^9$ coefficient = exponent =
R#3 $-12y^8$ coefficient = exponent =	y coefficient = exponent =	$3n^{10}$ coefficient = exponent =	$16y^2$ coefficient = exponent =

Homework

State the coefficient and exponent to the variable to the following expressions.

1) $2y^5$ 2) $\frac{3}{4}x^2$ 3) $7x^3$ 4) m^{10} 5) $-\frac{1}{5}x^8$

6) $0.5x$ 7) $-y^7$ 8) $-\frac{5}{6}x^{11}$ 9) $18y^9$ 10) $29g^4$

11) $-9y^{10}$ 12) x 13) $6n^{13}$ 14) $8y^4$ 15) $-\frac{1}{10}p^2$

Evaluate the following expressions. Let $a = 8$, $b = -3$, and $c = 9$.

16) a^2 17) $4b$ 18) $5(a+c)$ 19) $(c+b)^3$

20) $3(a+b)$ 21) $(a+b)^3$ 22) c^3 23) $5c+a^2$

24) b^2 25) $(a+3b)^2$ 26) $(a+b+c)^2$ 27) $3a^2$

28) $10b^2$ 29) $2c^2$ 30) $2(a+b)^2$ 31) $4c^2$

Synthesis

Condense each expression using exponents and/or coefficients.

32) $m+m+m+m+m$ 33) $k \cdot k \cdot k \cdot k$ 34) $w \cdot w \cdot w \cdot w \cdot w \cdot w \cdot w$ 35) $c+c+c+c$

36) $b^4 + b^4 + b^4$ 37) $h^{10} + h^{10}$ 38) $x \cdot x \cdot x + x \cdot x + x \cdot x$ 39) $y \cdot y \cdot y \cdot y + y \cdot y \cdot y \cdot y$

2.3 Multiplying Powers With The Same Base

Remember: Exponents group common bases that are connect by multiplication.

$7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 = 7^5$	$5 \cdot 5 \cdot a \cdot a \cdot a \cdot b = 5^2 a^3 b$
---	---

What happens when we multiply powers connected by multiplication in an expression?

Class Notes – Expand the expression, then condense it.

LP#1 $4^3 \cdot 4^5$	$8^2 \cdot 8^4$
LP#2 $x^2 \cdot x^3$	$y^3 \cdot y^6$
LP#3 $3^3 \cdot m \cdot m^4 \cdot 3^2$	$6^2 \cdot x^4 \cdot x^3 \cdot 6^2 \cdot x$

Use what you observe above to complete the following.

Combine the like powers below into one power.

$x^a \cdot x^b =$	$x^a \cdot y^c \cdot x^b \cdot y^d =$
-------------------	---------------------------------------

The resulting exponents for the expression above are _____.

Class Notes – Simplify the following expressions.

LP#4 $7^6 \cdot 7^8$	$3^8 \cdot 3^{10}$	$x^4 \cdot x^7$	$m^9 \cdot m^3$
LP#5 $a^2 \cdot b^2 \cdot a^4$	$6^5 \cdot y \cdot y^9 \cdot 6^4$	$11^2 \cdot 11 \cdot w^2 \cdot 11^5$	$5^3 \cdot 5^6 \cdot p^3 \cdot p$

Review – Simplify the following expressions.

R#1 $9^8 \cdot 9^{10}$	$5^4 \cdot 5^6$	$b^7 \cdot b^9$	$a \cdot a^4 \cdot a^4$
R#2 $7 \cdot 7^5$	$p^5 \cdot p^2$	$k^2 \cdot k^2 \cdot k^4$	$x^3 \cdot y \cdot y^2 \cdot x^4$
R#3 $12^{11} \cdot 12^9$	$a^8 \cdot b^4 \cdot a^5$	$k^3 \cdot m^5 \cdot m^7$	$3^3 \cdot y \cdot y^5 \cdot 3^4$

Homework – Simplify the following expressions.

- 1) $6^9 \cdot 6^2$ 2) $2^4 \cdot 2^3$ 3) $5^6 \cdot 5^8$ 4) $9 \cdot 9^7$ 5) $13^5 \cdot 13^6$
 6) $b^3 \cdot b^2$ 7) $d^6 \cdot d^8$ 8) $h^{10} \cdot h^5$ 9) $n^4 \cdot n^{10}$ 10) $w \cdot w^7$
 11) $x^2 \cdot x^2 \cdot x^4$ 12) $y^3 \cdot y \cdot y^8$ 13) $v^{11} \cdot v^2 \cdot v^3$ 14) $g^{12} \cdot g^2 \cdot g^4$ 15) $f^2 \cdot f^8 \cdot f$
 16) $a^6 \cdot b^7 \cdot a^9$ 17) $m^2 \cdot n^2 \cdot m^4$ 18) $r^5 \cdot r^3 \cdot s^2$ 19) $c^{12} \cdot d^3 \cdot d^5$ 20) $j \cdot j^4 \cdot k^7$
 21) $4^2 \cdot y \cdot y^7 \cdot 4^3$ 22) $7^5 \cdot x \cdot x^8 \cdot 7^4$ 23) $x^4 \cdot x^2 \cdot y^9 \cdot x^2$ 24) $a^5 \cdot b^2 \cdot b^9 \cdot a^4$ 25) $k^5 \cdot m \cdot n^9 \cdot k^4$
 26) $5^2 \cdot h^3 \cdot h^7 \cdot 5^4$ 27) $w^2 \cdot v^5 \cdot w^9 \cdot v^4$ 28) $k^2 \cdot k \cdot k \cdot m^2$ 29) $g^2 \cdot h^3 \cdot g^3 \cdot j^2$ 30) $w^2 \cdot w \cdot x^2 \cdot y^3$

Synthesis

Simplify the following expressions by expanding and then condensing.

- 31) $(3^4)^2$ 32) $(7^2)^4$ 33) $(6^3)^5$ 34) $(2^6)^2$
 35) $(x^3)^2$ 36) $(y^4)^3$ 37) $(m^2)^5$ 38) $(n^5)^3$
 39) $(xy^3)^2$ 40) $(a^4b^2)^3$ 41) $(v^2w^3)^4$ 42) $(g^2h^2k^4)^2$

2.4 Dividing Powers With The Same Base

Remember: When we multiply powers with the same base we can combine them into a single base and add the exponents.

Hypothesis – When we divide powers with the same base we can combine them into a single base and _____ the exponents. Let’s test this out....

Class Notes – Expand the expression and simplify, then condense it.

LP#1 $\frac{8^7}{8^3}$	$\frac{12^6}{12^4}$
LP#2 $\frac{x^5}{x^2}$	$\frac{y^{10}}{y^5}$
LP#3 $\frac{4^3 \cdot m^6}{4 \cdot m^4}$	$\frac{7^5 \cdot p^4}{7^3 \cdot p}$

Use what you observe above to complete the following.

Combine the like powers below into one power.

$\frac{x^a}{x^b} =$	$\frac{x^a \cdot y^c}{x^b \cdot y^d} =$
---------------------	---

The resulting exponents for the expression above are _____.

Class Notes – Simplify the following expressions.

LP#4 $\frac{13^{11}}{13^7}$	$\frac{20^{19}}{20^{10}}$	$\frac{190^{32}}{190^{14}}$	$\frac{d^{15}}{d^8}$
LP#5 $\frac{g^3 h^{24}}{gh^{16}}$	$\frac{j^4 k^{55}}{j^2 k^{22}}$	$\frac{6^7 \cdot x^{16}}{6^2 \cdot x^{11}}$	$\frac{14^{10} \cdot y^{16}}{14^4 \cdot y^4}$

Review – Simplify the following expressions.

R#1 $\frac{10^8}{10^4}$	$\frac{m^5}{m^2}$	$\frac{k^{14}}{k^{10}}$	$\frac{a^7 \cdot b^{16}}{a^2 \cdot b^{11}}$
R#2 $\frac{5^{12}}{5^6}$	$\frac{g^9}{g^3}$	$\frac{3^6 \cdot x^{11}}{3^2 \cdot x^7}$	$\frac{d^3 e^{10}}{d^2 e^6}$
R#3 $\frac{h^{11}}{h^3}$	$\frac{x^7 \cdot y^{16}}{x^4 \cdot y^{13}}$	$\frac{m^9 \cdot n^{12}}{m^2 \cdot n^{11}}$	$\frac{p^2 q^{16}}{p^2 q^{13}}$

Homework – Simplify the following expressions.

- 1) $\frac{8^6}{8^2}$ 2) $\frac{3^6}{3}$ 3) $\frac{12^7}{12^7}$ 4) $\frac{7^{10}}{7^6}$ 5) $\frac{4^{15}}{4^9}$
- 6) $\frac{x^{11}}{x^7}$ 7) $\frac{y^9}{y^3}$ 8) $\frac{a^{18}}{a^{11}}$ 9) $\frac{b^{28}}{b^{16}}$ 10) $\frac{c^{32}}{c^{21}}$
- 11) $\frac{2^5 \cdot y^{18}}{2^2 \cdot y^{10}}$ 12) $\frac{9^7 \cdot x^7}{9^6 \cdot x^7}$ 13) $\frac{4^2 \cdot p^{18}}{4 \cdot p^{12}}$ 14) $\frac{11^8 \cdot d^{21}}{11^4 \cdot d^{15}}$ 15) $\frac{12^5 \cdot x^{26}}{12^3 \cdot x^{19}}$
- 16) $\frac{g^{10} h^{12}}{g^6 h^7}$ 17) $\frac{k^5 m^{13}}{k^2 m^6}$ 18) $\frac{a^3 b^{10}}{a^3 b^9}$ 19) $\frac{x^3 y^{14}}{xy^6}$ 20) $\frac{m^{13} n^{10}}{m^2 n^8}$
- 21) $\frac{g^9 h^{12} i^8}{g^6 h^{10} i^4}$ 22) $\frac{a^8 b^2 c^{18}}{a^2 bc^{12}}$ 23) $\frac{w^9 x^{12} y^8}{w^2 x^4 y^7}$ 24) $\frac{f^9 g^{12} h^8}{f^9 g^{12} h^7}$ 25) $\frac{r^{19} s^{22} t^{18}}{r^{16} s^{10} t^{14}}$

Synthesis – Simplify the following expressions.

- 26) $\frac{8x^{12}}{2x^8}$ 27) $\frac{9y^9}{3y^4}$ 28) $\frac{20a^{17}}{5a^{10}}$ 29) $\frac{36b^{13}}{9b^{12}}$ 30) $\frac{24c^{22}}{7c^{11}}$
- 31) $\frac{18g^{11}h^{12}}{6g^3h^5}$ 32) $\frac{32k^{15}m^{19}}{8k^{12}m^{16}}$ 33) $\frac{16a^5b^{13}}{4a^2b^9}$ 34) $\frac{7x^3y^{10}}{7xy^6}$ 35) $\frac{24m^7n^{10}}{2m^4n^9}$

2.5 Zero Exponents

Class Notes – Expand the expression, then condense it.

LP#1 $\frac{3^5}{3^5}$	$\frac{5^4}{5^4}$
LP#2 $\frac{x^7}{x^7}$	$\frac{y^{10}}{y^{10}}$
LP#3 $\frac{2^4 \cdot h^2}{2^4 \cdot h^2}$	$\frac{7^5 \cdot p^3}{7^5 \cdot p^3}$

Class Notes – Use the division rule and express your answers using powers.

LP#4 $\frac{3^5}{3^5}$	$\frac{5^4}{5^4}$
LP#5 $\frac{x^7}{x^7}$	$\frac{y^{10}}{y^{10}}$
LP#6 $\frac{2^4 \cdot h^2}{2^4 \cdot h^2}$	$\frac{7^5 \cdot p^3}{7^5 \cdot p^3}$

Complete the rule for zero exponents below by comparing the two sets of class notes above.

$x^0 =$	$(xyz)^0 =$
---------	-------------

Class Notes – Simplify the following expressions.

LP#7 5^0	13^0	$(-11)^0$	$(-13)^0$
LP#8 y^0	m^0	$(3b)^0$	$(-7g)^0$

LP#9 $(xy)^0$	xy^0	$3b^0$	$-7g^0$
------------------	--------	--------	---------

Review – Simplify the following expressions.

R#1 8^0	10^0	$(-3)^0$	$-(7)^0$
R#2 2^0	w^0	$(-6)^0$	$4x^0$
R#3 z^0	$(-13)^0$	$8m^0$	$(-b)^0$

Homework – Simplify the following expressions.

- 1) 14^0 2) 21^0 3) x^0 4) p^0 5) n^0
- 6) $(-2)^0$ 7) $(-8)^0$ 8) $(-q)^0$ 9) $-(11)^0$ 10) $-(k)^0$
- 11) $4d^0$ 12) $-17x^0$ 13) $-20g^0$ 14) $10h^0$ 15) $-25g^0$
- 16) $(7x)^0$ 17) $(mn)^0$ 18) $(abc)^0$ 19) $(-h)^0$ 20) $(-13ab)^0$

Synthesis

- 21) $x^2 \cdot x^4 \cdot y^0$ 22) $a^5 \cdot b^0 \cdot a^7$ 23) $h^7 \cdot j^3 \cdot j^0$ 24) $\frac{x^9 y^0}{x^3}$ 25) $\frac{a^{10} b^0}{a^4}$
- 26) $\frac{m^9}{m^7 n^0}$ 27) $\frac{b^{13} b^3}{c^0}$ 28) $\frac{g^{10} h^0 i^6}{i^2}$ 29) $x^{12} \cdot x^4 \cdot y^{10} \cdot y^0$ 30) $d^2 \cdot e^4 \cdot d^6 \cdot e \cdot f^0$

2.6 Negative Exponents

Class Notes – Expand the expression, then condense it. Express your answer using powers.

LP#1 $\frac{2^3}{2^7}$	$\frac{6^3}{6^5}$
LP#2 $\frac{x^2}{x^7}$	$\frac{y^4}{y^{10}}$
LP#3 $\frac{14}{14^4}$	$\frac{w}{w^6}$

Class Notes – Use the division rule and express your answers as a power.

LP#4 $\frac{2^3}{2^7}$	$\frac{6^3}{6^5}$
LP#5 $\frac{x^2}{x^7}$	$\frac{y^4}{y^{10}}$
LP#6 $\frac{14}{14^4}$	$\frac{w}{w^6}$

Complete the rule for negative exponents below by comparing the two sets of class notes above.

$x^{-a} =$

Class Notes – Express the following expressions using positive exponents.

LP#7 5^{-3}	13^{-2}	2^{-4}	3^{-3}
LP#8 y^{-5}	m^{-8}	15^{-1}	7^{-2}
LP#9 x^{-10}	m^{-1}	9^{-2}	4^{-3}
LP#10 $(3m)^{-4}$	$3m^{-4}$	$(4ab)^{-2}$	$4ab^{-2}$

Review – Express the following expressions using positive exponents.

R#1 3^{-2}	5^{-4}	x^{-2}	y^{-5}
R#2 10^{-2}	6^{-3}	p^{-3}	d^{-6}
R#3 9^{-1}	2^{-3}	k^{-10}	h^{-7}

Homework – Express the following expressions using positive exponents.

- 1) 4^{-2} 2) 8^{-2} 3) 5^{-2} 4) 12^{-2} 5) 11^{-2}
6) 13^{-2} 7) 4^{-4} 8) 8^{-3} 9) 14^{-2} 10) 2^{-5}
11) a^{-3} 12) w^{-7} 13) b^{-5} 14) t^{-2} 15) c^{-1}
16) q^{-4} 17) n^{-8} 18) k^{-2} 19) j^{-6} 20) v^{-11}

Synthesis – Simplify and express the following expressions using positive exponents.

- 21) $3^{-4} \cdot 3^2$ 22) $6^5 \cdot 6^{-8}$ 23) $m^{-1} \cdot m^5$ 24) $k^{-3} \cdot k^{-5}$ 25) $10^{-1} \cdot 10^3$
26) $\frac{5^2}{5^{-1}}$ 27) $\frac{d^{-5}}{d^3}$ 28) $\frac{4^0}{4^{-3}}$ 29) $h^6 \div h^{-4}$ 30) $8^{-3} \div 8^{-5}$

2.7 Multiplying a Single Digit by a Power of 10 – Part 1

Activity 2 - Express each number on the left as a power of ten. You may use the “Power of Ten Bank” for help.

1 =	Power of Ten Bank		
1,000,000 =	10^3		10^9
100 =			
1,000,000,000 =	10^4		
100,000,000 =	10^8	10^1	10^7
10,000 =			
10 =	10^6	10^5	
10,000,000 =			10^0
100,000 =		10^2	
1,000 =			

Explain the pattern that you see above.

Activity 1 - Complete the following.

$\begin{array}{r} 100 \\ \times 3 \\ \hline \end{array}$	$\begin{array}{r} 1,000 \\ \times 5 \\ \hline \end{array}$	$\begin{array}{r} 10,000 \\ \times 9 \\ \hline \end{array}$	$\begin{array}{r} 100,000 \\ \times 6 \\ \hline \end{array}$	$\begin{array}{r} 1,000,000 \\ \times 2 \\ \hline \end{array}$
--	--	---	--	--

What powers of ten are used above?

Activity 3 – Determine the value for the “?” that would make the statement true.

$5 \times 10^7 = 5,000$	$6 \times 10^7 = 600,000$	$9 \times 10^7 = 90,000$	$3 \times 10^7 = 300$	$2 \times 10^7 = 2,000,000$
-------------------------	---------------------------	--------------------------	-----------------------	-----------------------------

Explain how you determined each “?” in Activity 3.

Class Notes – Simplify each of the following.

LP#1 $7 \times 10^4 =$	$5 \times 10^6 =$	$8 \times 10^2 =$
LP#2 $3 \times 10^{10} =$	$6 \times 10^1 =$	$2 \times 10^8 =$
LP#3 $4 \times 10^0 =$	$9 \times 10^3 =$	$1 \times 10^5 =$

Class Notes – Write each number as a product of a whole number and a power of 10.

LP#4 2,000,000	6,000	90
LP#5 70,000	500,000	30,000,000
LP#6 400	8,000,000	2,000

Review – In the **left column** simplify each expression. In the **right column** write each number as a product of a whole number and a power of 10.

R#1 $7 \times 10^9 =$ $4 \times 10^0 =$	200 5,000,000
R#2 $9 \times 10^{11} =$ $2 \times 10^4 =$	9 7,000,000,000

R#3 $6 \times 10^7 =$	3,000
$3 \times 10^0 =$	80,000

Homework – Simplify each of the following.

1) $6 \times 10^8 =$

2) $3 \times 10^2 =$

3) $7 \times 10^5 =$

4) $4 \times 10^9 =$

5) $5 \times 10^3 =$

6) $8 \times 10^4 =$

7) $3 \times 10^5 =$

8) $7 \times 10^6 =$

9) $1 \times 10^6 =$

10) $4 \times 10^0 =$

11) $6 \times 10^0 =$

12) $9 \times 10^0 =$

Write each number as a product of a whole number and a power of 10.

13) 300,000

14) 8,000

15) 400

16) 700,000

17) 60,000

18) 90,000,000

19) 4,000

20) 800,000,000

21) 2,000,000

22) 1,000,000

23) 5

24) 8,000,000,000

Synthesis

a) Simplify and write each number as a product of a whole number and a power of 10.

b) Express each number as a whole number.

25) $(3 \times 10^5)(2 \times 10^3) =$

26) $(2 \times 10^4)(3 \times 10^7) =$

27) $(4 \times 10^2)(2 \times 10^3) =$

28) $(1 \times 10^{11})(7 \times 10^4) =$

29) $(3 \times 10^4)(3 \times 10^7) =$

30) $(5 \times 10^{10})(1 \times 10^2) =$

31) $\frac{9 \times 10^8}{3 \times 10^2} =$

32) $\frac{8 \times 10^7}{4 \times 10^3} =$

33) $\frac{6 \times 10^{13}}{2 \times 10^5} =$

34) $\frac{4 \times 10^{11}}{2 \times 10^7} =$

35) $\frac{8 \times 10^3}{2 \times 10^1} =$

36) $\frac{9 \times 10^6}{9 \times 10^0} =$

2.8 Multiplying a Single Digit by a Power of 10 – Part 2

Activity 1 - Express each number on the left as a power of ten and a decimal. You may use the “Answer Bank” for help.

$\frac{1}{10} =$		=		Answer Bank 0.00001 10^{-3} 10^{-5} 10^{-4} 0.001 0.0001 10^{-1} 0.1 10^{-2} 0.01
$\frac{1}{100,000} =$		=		
$\frac{1}{100} =$		=		
$\frac{1}{10,000} =$		=		
$\frac{1}{1,000} =$		=		

Explain the pattern that you see above in relation to the powers of 10.

Explain the pattern that you see above in relation to the decimals.

Activity 2 - Complete the following.

$\begin{array}{r} 0.0001 \\ \times \quad 9 \\ \hline \end{array}$	$\begin{array}{r} 0.01 \\ \times \quad 4 \\ \hline \end{array}$	$\begin{array}{r} 0.000001 \\ \times \quad \quad 7 \\ \hline \end{array}$
---	---	---

What powers of ten are used above?

Activity 3 – Determine the value for the “?” that would make the statement true.

$3 \times 10^? = 0.0003$	$5 \times 10^? = 0.005$	$8 \times 10^? = 0.8$	$6 \times 10^? = 0.00006$	$2 \times 10^? = 0.0000002$
--------------------------	-------------------------	-----------------------	---------------------------	-----------------------------

Explain how you determined each “?” in Activity 3.

Class Notes – Simplify each of the following.

LP#1 $7 \times 10^{-4} =$	$5 \times 10^{-6} =$	$8 \times 10^{-2} =$
LP#2 $3 \times 10^{-10} =$	$6 \times 10^{-1} =$	$2 \times 10^{-8} =$
LP#3 $4 \times 10^0 =$	$9 \times 10^{-3} =$	$1 \times 10^{-5} =$

Class Notes – Write each number as a product of a whole number and a power of 10.

LP#4 0.00002	0.6	0.009
LP#5 0.0007	0.00005	0.00000003
LP#6 0.04	0.000008	0.002

Review – In the **left column** simplify each expression. In the **right column** write each number as a product of a whole number and a power of 10.

R#1 $7 \times 10^{-9} =$ $4 \times 10^{-1} =$	0.002 0.0000005
R#2 $9 \times 10^{-11} =$ $2 \times 10^{-4} =$	0.9 0.0000000007

R#3 $6 \times 10^{-7} =$	0.0003
$3 \times 10^{-3} =$	0.00008

Homework – Simplify each of the following.

1) $6 \times 10^{-8} =$ 2) $3 \times 10^{-2} =$ 3) $7 \times 10^{-5} =$

4) $4 \times 10^{-9} =$ 5) $5 \times 10^{-3} =$ 6) $8 \times 10^{-4} =$

7) $3 \times 10^{-5} =$ 8) $7 \times 10^{-6} =$ 9) $1 \times 10^{-6} =$

10) $4 \times 10^{-2} =$ 11) $6 \times 10^{-5} =$ 12) $9 \times 10^{-6} =$

Write each number as a product of a whole number and a power of 10.

13) 0.00003 14) 0.008 15) 0.04

16) 0.00007 17) 0.000006 18) 0.000000008

19) 0.00004 20) 0.0000005 21) 0.00000002

22) 0.000001 23) 0.5 24) 0.0000000000009

Synthesis

a) Simplify and write each number as a product of a whole number and a power of 10.

b) Express each number in decimal form.

25) $(4 \times 10^{-5})(2 \times 10^3) =$ 26) $(5 \times 10^4)(1 \times 10^{-7}) =$ 27) $(2 \times 10^2)(3 \times 10^{-3}) =$

28) $(9 \times 10^{-11})(1 \times 10^4) =$ 29) $(3 \times 10^2)(3 \times 10^{-7}) =$ 30) $(2 \times 10^{-10})(4 \times 10^2) =$

31) $\frac{9 \times 10^{-8}}{3 \times 10^2} =$ 32) $\frac{8 \times 10^{-7}}{4 \times 10^{-3}} =$ 33) $\frac{6 \times 10^{-13}}{2 \times 10^5} =$

34) $\frac{4 \times 10^{11}}{2 \times 10^{-7}} =$ 35) $\frac{8 \times 10^3}{2 \times 10^{-1}} =$ 36) $\frac{9 \times 10^{-6}}{9 \times 10^{-4}} =$

37) Create a place value chart that shows the place values as a power of 10.

2.9 Scientific Notation



Go to http://en.wikipedia.org/wiki/Scientific_notation . Read the introduction and the section titled “Normalized Notation”.

Using the expression $a \times 10^b$, where a is any real number and b is an integer, complete the following:

Activity 1 - Circle all values that could be used for a in normalized scientific notation.

6.28	314	-10.4	7.32	13
-4.98	5.12	44	-235	7.99
90	-3.00	897	5	102

Activity 2 - Circle all values that can be used for b in normalized scientific notation.

6.2	3	10	-7.32	-1
4	-5	4.2	2.35	17
9	3.4	8	5.09	102

Activity 3 - Circle all the expressions that are expressed in normalized scientific notation.

6.28×10^5	314×10^{-2}	-10.4×10^8	$7.32 \times 10^{2.5}$	$13 \times 10^{-0.8}$
-4.98×10^3	$5.12 \times 10^{0.09}$	44×10^7	-235×10^{-6}	7.99×10^{15}
90×10^{-2}	$-3.00 \times 10^{8.25}$	897×10^1	5×10^{-5}	102×10^2

Class Notes – Write each expression in decimal form.

LP#1 $7.00 \times 10^4 =$	$5.00 \times 10^6 =$	$8 \times 10^2 =$
LP#2 $7.21 \times 10^4 =$	$5.89 \times 10^6 =$	$8.1 \times 10^2 =$
LP#3 $7.00 \times 10^{-4} =$	$5.00 \times 10^{-6} =$	$8 \times 10^{-2} =$
LP#4 $7.21 \times 10^{-4} =$	$5.89 \times 10^{-6} =$	$8.1 \times 10^{-2} =$

Explain the pattern that you see above in relation to exponents being positive.

Explain the pattern that you see above in relation to exponents being negative.

Class Notes – Express each number using scientific notation.

LP#5 534,000	6,500	985,000,000
LP#6 0.00083	0.0000000121	0.00005732
LP#7 9,310,000,000	0.000000398	443

Review – In the **left column** write each expression in decimal form. In the **right column** express each decimal using scientific notation.

R#1 $6.90 \times 10^3 =$ $4.68 \times 10^{-5} =$	8,350 0.0432
R#2 $7.01 \times 10^4 =$ $2.56 \times 10^{-9} =$	9,210,000 0.000054
R#3 $9.23 \times 10^5 =$ $2.71 \times 10^{-7} =$	360,000 0.000781

Homework – Write each expression in decimal form.

1) $6.02 \times 10^4 =$ 2) $1.46 \times 10^7 =$ 3) $8.00 \times 10^8 =$ 4) $4.66 \times 10^3 =$

5) $4.51 \times 10^8 =$ 6) $3.19 \times 10^5 =$ 7) $7.06 \times 10^3 =$ 8) $6.21 \times 10^9 =$

9) $5.21 \times 10^{-4} =$ 10) $8.39 \times 10^{-7} =$ 11) $1.81 \times 10^{-2} =$ 12) $7.83 \times 10^{-8} =$

13) $2.16 \times 10^{-1} =$ 14) $7.72 \times 10^{-6} =$ 15) $5.03 \times 10^{-9} =$ 16) $1.23 \times 10^{-6} =$

Express each number using scientific notation.

17) 7,240 18) 0.053 19) 8,050,000 20) 0.000624

21) 471,000 22) 0.000175 23) 6,130 24) 0.0756

25) 11,200,000 26) 0.00008 27) 790,000 28) 0.000458

29) 1,300 30) 0.0981 31) 197,000,000 32) 0.000004

Synthesis

Express the following in scientific form.

33) $\frac{5}{1000}$ 34) $\frac{7}{10}$ 35) $\frac{21}{500}$ 36) $\frac{789}{10,000}$ 37) $\frac{56}{2000}$

38) $\frac{123}{1,000,000}$ 39) $\frac{27}{20,000}$ 40) $\frac{423}{100,000}$ 41) $\frac{31}{500,000}$ 42) $\frac{5}{1000}$

2.10 Operations Using Numbers in Scientific Notation

Class Notes – Simplify and express your answer in scientific notation.

LP#1 $(7 \times 10^4) \times (3 \times 10^5) =$	$(4 \times 10^2) \times (8 \times 10^7) =$
LP#2 $(6.23 \times 10^5) \times (9.76 \times 10^3) =$	$(2.38 \times 10^{11}) \times (1.99 \times 10^{10}) =$
LP#3 $(2 \times 10^{10}) \div (8 \times 10^7) =$	$(1 \times 10^{14}) \div (4 \times 10^8) =$
LP#4 $(3.92 \times 10^7) \div (1.12 \times 10^{11}) =$	$(8.04 \times 10^4) \div (2.01 \times 10^{13}) =$
LP#5 $(0.00000072) \div (2.88 \times 10^5) =$	$(6,390,000,000) \times (4.26 \times 10^7) =$

For LP#1 and LP#2, can we use the distributive property to perform the multiplication between the two sets of parenthesis? Explain.

Review – Simplify and express your answer in scientific notation.

R#1 $(5 \times 10^3) \times (1 \times 10^2) =$	$(6 \times 10^9) \div (3 \times 10^5) =$
R#2 $(9 \times 10^6) \times (5 \times 10^7) =$	$(7 \times 10^{17}) \div (2 \times 10^9) =$

R#3 $(4 \times 10^1) \times (6 \times 10^8) =$	$(9 \times 10^2) \div (4 \times 10^6) =$
---	--

Homework – Simplify and express your answer in scientific notation.

1) $(2 \times 10^3) \times (9 \times 10^4) =$ 2) $(4 \times 10^5) \times (2 \times 10^7) =$ 3) $(6 \times 10^7) \times (4 \times 10^9) =$

4) $(3 \times 10^4) \times (4 \times 10^6) =$ 5) $(5 \times 10^6) \times (6 \times 10^8) =$ 6) $(8 \times 10^5) \times (2 \times 10^6) =$

7) $(5 \times 10^{12}) \times (1 \times 10^{13}) =$ 8) $(8 \times 10^7) \times (4 \times 10^2) =$ 9) $(6 \times 10^2) \times (7 \times 10^8) =$

10) $(9 \times 10^8) \div (8 \times 10^3) =$ 11) $(8 \times 10^9) \div (2 \times 10^3) =$ 12) $(7 \times 10^{12}) \div (4 \times 10^8) =$

13) $(6 \times 10^7) \div (3 \times 10^6) =$ 14) $(5 \times 10^{15}) \div (8 \times 10^6) =$ 15) $(3 \times 10^7) \div (4 \times 10^2) =$

16) $(5 \times 10^{11}) \div (4 \times 10^4) =$ 17) $(3 \times 10^8) \div (8 \times 10^{10}) =$ 18) $(8 \times 10^{16}) \div (4 \times 10^9) =$