Name Key Date

Master 2.17

Extra Practice 1

Lesson 2.1: What Is a Power?

1. Identify the base of each power.

	a) 6^3	b) 2^7	c) $(-5)^4$	d) -7^0
Base:	6	2	−5	7
Exponent:	3	7	4	0

2. Use repeated multiplication to show why 3^5 is not the same as 5^3.

(3)(3)(3)(3)(3) = 243 | (5)(5)(5) = 125

3. Complete this table.

Power	Base	Exponent	Repeated Multiplication	Standard Form
4^4	4	4	(4)(4)(4)(4)	256
$(-10)^3$	−10	3	(−10)(−10)(−10)	−1000
$(-6)^2$	−6	2	(−6)(−6)	36
$(1)^5$	1	5	$1 \times 1 \times 1 \times 1 \times 1$	1

4. Write each product as a power, then evaluate.

a) 6×6 $= 6^2$ $= 36$

b) $3 \times 3 \times 3 \times 3 \times 3 \times 3$ $= 3^6$ $= 729$

c) $10 \times 10 \times 10 \times 10$ $= 10^4$ $= 10\,000$

d) $-(8 \times 8 \times 8)$ $= -(8)^3$ $= -512$

e) $(-8)(-8)(-8)$ $= (-8)^3$ $= -512$

f) $-(-8)(-8)(-8)$ $= -(-8)^3$ $= 512$

5. Write each power as repeated multiplication, then evaluate.

a) 7^5: (7)(7)(7)(7)(7) = 16 807

b) 4^6: (4)(4)(4)(4)(4)(4) = 4096

c) -9^3: −(9)(9)(9) = −729

d) $(-5)^5$: (−5)(−5)(−5)(−5)(−5) = −3 125

Name _____ Date _____

6. Evaluate each power. For each power:
   - Are the brackets needed?
   - If your answer is yes, what purpose do the brackets serve?

a) $(-6)^5$ = -7776. Brackets Needed

b) $-(6)^5$ = -7776. Brackets Not Needed

c) $-(-6)^5$ = 7776. Brackets Needed

d) (-6^5) = -7776. Brackets Not Needed

7. Predict whether each answer is positive or negative, then evaluate.

a) $(-3)^2$ (+) = 9

b) $(-3)^3$ (-) = -27

c) -3^2 (-) = -9

d) $-(-3)^3$ (+) = 27

8. Is the value of -2^4 different from the value of $(-2)^4$? Explain.

$-2^4 = -(2)(2)(2)(2) = -16$

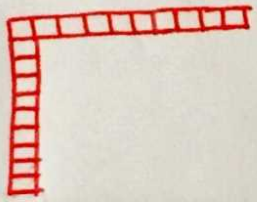
$(-2)^4 = (-2)(-2)(-2)(-2) = 16$

9. Stamps are sold in a 10 by 10 sheet. The total value of a sheet of stamps is $60.00.

a) Express the number of stamps as a power and in standard form.

$10 \times 10 = 10^2 = 100$

b) Draw a picture to represent this power.



c) What is the value of one stamp?

$\$60 \div 100 = \$0.06$

Name _____ Date _____

Master 2.18

Extra Practice 2

Lesson 2.2: Powers of Ten and the Zero Exponent

1. Evaluate each power.

a) 4^0 = 1

b) 23^0 = 1

c) $(-6)^0$ = 1

d) 1^0 = 1

e) -1^0 = -1

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

2. Write each number as a power of 10.

a) 10 000 = 10^4

b) 1 000 000 = 10^6

c) one billion = 10^9

d) ten = 10^1

e) 1 = 10^0

3. Use powers of 10 to write each number.

a) 700 000 000 000 = 7×10^{11}

b) 7000 = 7×10^3

c) 77 077 $(7 \times 10^4) + (7 \times 10^3) + (7 \times 10^1) + (7 \times 10^0)$

d) 7 000 007 = $(7 \times 10^6) + (7 \times 10^0)$

4. Write each number in standard form.

a) (8×10^5) = 800 000

b) $(9 \times 10^7) + (9 \times 10^6) + (5 \times 10^5)$ = 99 500 000

c) $(2 \times 10^3) + (2 \times 10^2) + (6 \times 10^0)$ = 2206

d) $(5 \times 10^5) + (4 \times 10^8) + (8 \times 10^0) + (3 \times 10^4)$ = 400 530 008

Name _____ Date _____

5. Write these numbers in standard form, then order them from least to greatest.

fifty-five hundred 50 500 $(5 \times 10^6) + (5 \times 10^0)$

5500 5 000 005

five hundred thousand 5×10^4 500 500

500 000 50 000

Fifty-five hundred ; 5×10^4 ; 50 500 , five hundred thousand , 500 500 , $(5 \times 10^6) + (5 \times 10^0)$

6. **a)** Complete this table for a base of 10.

Exponent	Power	Standard Form
6	10^6	1 000 000
5	10^5	100 000
4	10^4	10 000
3	10^3	1 000
2	10^2	100
1	10^1	10
0	10^0	1

Name _____ Date _____

Master 2.19

Extra Practice 3

Lesson 2.3: Order of Operations with Powers

1. Evaluate.

a) $5^2 + 3$
$= 25 + 3$
$= 28$

b) $5^2 - 3$
$= 25 - 3$
$= 22$

c) $5 + 3^2$
$= 5 + 9$
$= 14$

d) $5 - 3^2$
$= 5 - 9$
$= -4$

e) $(5 + 3)^2$
$= (8)^2$
$= 64$

f) $(5 - 3)^2$
$= (2)^2$
$= 4$

g) $5^2 + 3^2$
$= 25 + 9$
$= 34$

h) $5^2 - 3^2$
$= 25 - 9$
$= 16$

2. Evaluate.

a) $4^3 \times 2$
$= 64 \times 2$
$= 128$

b) $4^3 \div 2$
$= 64 \div 2$
$= 32$

c) 4×2^3
$= 4 \times 8$
$= 32$

d) $4 \div 2^3$
$= 4 \div 8$
$= 0.5$

e) $(4 \times 2)^3$
$= (8)^3$
$= 512$

f) $(4 \div 2)^3$
$= (2)^3$
$= 8$

g) $4^3 \times 2^3$
$= 64 \times 8$
$= 512$

h) $4^3 \div 2^3$
$= 64 \div 8$
$= 8$

Name _____ Date _____

3. Evaluate.

a) $(18 \div 3^2 + 1)^4 - 4^2$

$(18 \div 9 + 1)^4 - 4^2$

$(2 + 1)^4 - 4^2$

$(3)^4 - 4^2$

$81 - 9$

$= 72$

b) $3^3 \div 9(3^0 - 2^2)$

$3^3 \div 9(1 - 4)$

$3^3 \div 9(-3)$

$27 \div 9(-3)$

$3(-3)$

$= -9$

c) $(12^2 + 5^3)^0 - 2[(-3)^3]$

$1 - 2[-27]$

$1 - (-54)$

$= 55$

d) $(7 - 5)^3 \times (8 + 2)^4$

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

$8 \times 10\,000$

$= 80\,000$

e) $(4^2 \times 1^5)^2$

$(16 \times 1)^2$

$(16)^2$

$= 256$

f) $[(-3)^4 - (-2)^3]^0 \div [(-4)^3 - (-3)^2]^0$

$[1] \div [1]$

$= 1$

5. The formula for the volume, V, of a cylinder with height, h, and radius, r, is $V = \pi r^2 h$. Janet made 3 L of salsa and stores it in jars with a radius of 4 cm and a height of 10 cm.

She uses this expression to determine the number of jars she will need: $\dfrac{3000}{\pi(4)^2 \times 10}$

About how many jars will Janet need for the salsa?

$\dfrac{3000}{3.14(16) \times 10} = \dfrac{3000}{502.4} = 5.9$ ≈ 6 jars

6. Aftab, Shane, and Kyra got different answers when they evaluated this expression: $(-4)^2 - 3[(-9) \div 3]^2$ Aftab's answer was 97, Shane's answer was 43, and Kyra's answer was 19.

a) Show the correct solution.

$(-4)^2 - 3[-9 \div 3]^2$

$16 - 3(-3)^2$

$16 - 3(9)$

$16 - 27$

$= -11$

Extra Practice 4

Name: _____

Lesson 2.4: Exponent Laws 1

1. Write each product as a single power.

a) $4^3 \times 4^2$

$= 4^5$

b) $5^0 \times 5^0$

$= 5^0$

c) $(-2)^2 \times (-2)^4$

$= (-2)^6$

d) $-6^3 \times 6^1$

$= -6^4$

e) $(-7)^0 \times (-7)^2$

$= (-7)^2$

f) $(-9)^6 \times (-9)^3$

$= (-9)^9$

2. Write each quotient as a single power.

a) $8^7 \div 8^5$

$= 8^2$

b) $10^4 \div 10^0$

$= 10^4$

c) $(-1)^6 \div (-1)^3$

$= (-1)^3$

d) $\frac{-3^4}{3^4}$

$= -3^0$

e) $\frac{(-9)^{10}}{(-9)^5}$

$= (-9)^5$

f) $\frac{11^9}{11^6}$

$= 11^3$

3. Express as a single power.

a) $2^3 \times 2^6 \div 2^9$

$= 2^9 \div 2^9$

$= 2^0$

b) $(-5)^8 \div (-5)^4 \times (-5)^3$

$= (-5)^4 \times (-5)^3$

$= (-5)^7$

c) $\frac{6^3 \times 6^5}{6^2 \times 6^4}$

$= \frac{6^8}{6^6}$

$= 6^2$

4. Simplify, then evaluate.

a) $2^2 - 2^0 \times 2 + 2^3$

$2^2 - 2^1 + 2^3$

$4 - 2 + 8$

$2 + 8$

10

b) $(-2)^6 \div (-2)^5 - (-2)^5 \div (-2)^3$

$(-2)^1 - (-2)^2$

$-2 - (4)$

$= -6$

c) $-2^2(2^3 \div 2^1) - 2^3$

$-2^2(2^2) - 2^3$

$-2^4 - 2^3$

$-16 - 8$

-24

5. Simplify, then evaluate.

a) $4^3 \div 4^2 + 2^4 \times 3^2$

$= 4^1 + 2^4 \times 3^2$

$= 4 + 16 \times 9$

$= 4 + 144$

$= 148$

b) $3^2 + 4^2 \times 4^1 \div 2^3$

$= 3^2 + 4^3 \div 2^3$

$= 9 + 64 \div 8$

$= 9 + 8$

$= 17$

c) $\frac{3^4}{3^3} + \frac{4^2 \times 4^0}{2^4}$

$= 3^1 + \frac{4^2}{2^4}$

$= 3 + \frac{16}{16}$

$= 3 + 1$

$= 4$

6. Write each relationship as a product of powers or a quotient of powers.

a) One million is 1000 times as great as one thousand. $10^3 \times 10^3 = 10^6$

b) One billion is 1000 times as great as one million. $10^6 \times 10^3 = 10^9$

c) One hundred is one-tenth of one thousand. $10^3 \div 10^1 = 10^2$

d) One is one-millionth of one million. $10^6 \div 10^6 = 10^0$

e) One trillion is 1000 times as great as one thousand million. $10^9 \times 10^3 = 10^{12}$

7. Identify, then correct any errors in these answers.
Explain how you think the errors occurred.

a) $5^3 \times 5^2 = 5^6$

$= 5^7$

Wrong

→ Multiplied exponents instead of adding

b) $2^3 \times 4^2 = 8^5$

Wrong

→

c) $(-3)^8 \div (-3)^4 = (-3)^4$

$= (-3)^4$

Correct

d) $1^2 \times 1^4 - 1^3 = 1^3$

$1^6 - 1^3$

$1 - 1$

$= 1$

Wrong

→ They added exponents $2+4=6$ then subtract the exponents $6-3=3$

e) $\frac{4^2 \times 4^4}{4^2 \times 4^1} = 4^2$

$\frac{4^6}{4^3} = 4^3$

Wrong

→ They divided the exponents when they should have subtracted

Extra Practice 5 Name : _____

Lesson 2.5: Exponent Laws II

1. Write each expression as a product of powers or a quotient of powers.

a) $(3 \times 2)^4$ $= 3^4 \times 2^4$

b) $[(-4) \times 3]^2$ $= (-4)^2 \times (3)^2$

c) $[(-2) \times (-4)]^3$ $= (-2)^3 \times (-4)^3$

d) $(7 \times 11)^0$ $(7)^0 \times (11)^0$

e) $(10 \div 5)^3$ $10^3 \div 5^3$

f) $[(-12) \div (-6)]^2$ $(-12)^2 \div (-6)^2$

g) $\left(\frac{8}{4}\right)^4$ $\frac{(8)^4}{(4)^4}$

h) $\left(\frac{1}{10}\right)^6$ $\frac{(1)^6}{(10)^6}$

2. Write as a power.

a) $(3^4)^2$ 3^8

b) $(5^0)^3$ 5^0

c) $-(7^2)^2$ $-(7)^4$

d) $[(-3)^3]^2$ $(-3)^6$

3. Why is the value of $[(-3)^3]^2$ positive and the value of $[(-3)^3]^3$ negative?

$(-3)^6$ → negative base to an even exponent will be positive

$(-3)^9$ → Negative base to an odd exponent will be negative

4. Simplify, then evaluate.

a) $(2^3 \times 2^1)^2$ $= (2^4)^2$ $= 2^8$ $= 256$

b) $(5^4 \div 5^2)^2$ $(5^2)^2$ $= 5^4$ $= 625$

c) $[(-3)^0 \times (-3)^3]^2$ $[(-3)^3]^2$ $= (-3)^6$ $= 729$

d) $(10^2)^4 \div (10^3)^2$ $10^8 \div 10^6$ $= 10^2$ $= 100$

5. Simplify, then evaluate each expression.

a) $(3^2 \times 4^3)^2 - (4^4 \div 4^2)^2$

$3^4 \times 4^6 - (4^2)^2$

$81 \times 4096 - 4^4$

$331\,776 - 256$

$= 331\,520$

b) $(2^3 \div 2^2)^3 + (7^4 \times 7^3)^0$

$(2^1)^3 + (7^7)^0$

$2^3 + 7^0$

$8 + 1$

$= 9$

c) $[(-1)^3]^4 - [(-1)^4 \div (-1)^3]^2$

$(-1)^{12} - [(-1)^1]^2$

$(-1)^{12} - (-1)^2$

$1 - 1$

$= 0$

d) $(4^2 \times 4^3)^0 - (3^2)^2$

$(4^5)^0 - 3^4$

$4^0 - 3^4$

$1 - 81$

$= -80$

e) $(5^2 \times 5^0)^3 + (2^5 \div 2^3)^3$

$(5^2)^3 + (2^2)^3$

$5^6 + 2^6$

$= 15\,625 + 64$

$= 15\,689$

f) $(10^6 \div 10^3)^2 + (2^3 \div 2^1)^4$

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

$= 10^6 + 2^8$

$= 1\,000\,000 + 256$

$= 1\,000\,256$

6. Find and correct any errors in each solution.

a) $(4^3 \times 2^2)^2 = (8^5)^2$
$= 8^{10}$
$= 1\,073\,741\,824$

You try $(4^3 \times 2^2)^2 = (8^5)^2$

$4^6 \times 2^4$

4096×16

$= 256$

b) $[(-10)^3]^4 = (-10)^7$
$= -10\,000\,000$

You try $[(-10)^3]^4 = (-10)^7$

$(-10)^{12}$

$= 1\,000\,000\,000\,000$

c) $(2^2 + 2^3)^2 = (2^5)^2$
$= 2^{10}$
$= 1024$

No Law for adding

You try $(2^2 + 2^3)^2 = (2^5)^2$

$(4+8)^2$

$(12)^2$

144