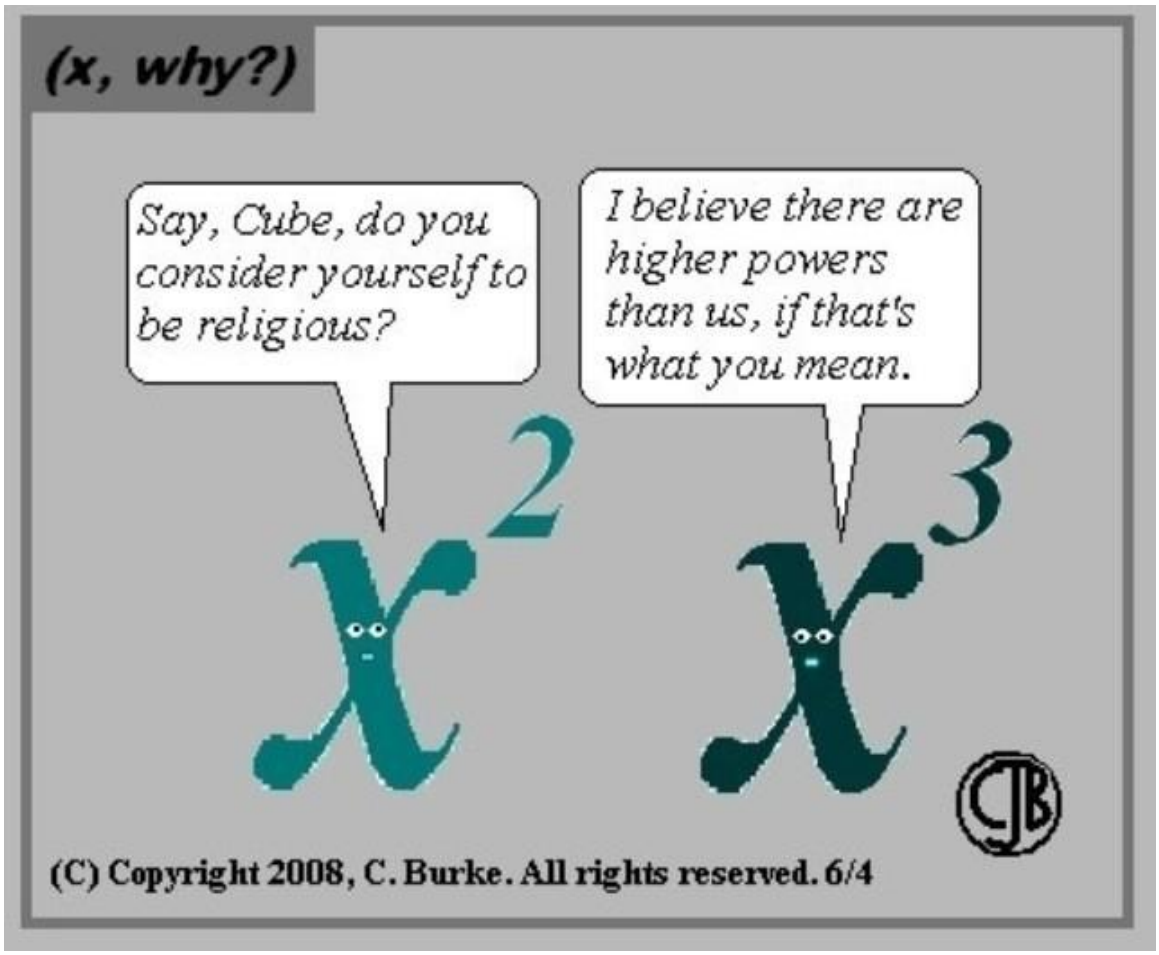
Chapter 3 Booklet
Powers and Exponents



Name:_____

Due Date: _____

MATH 9 – POWERS & EXPONENTS
REGULAR ASSESSMENT RECORD

Category	Topic	Due Date	Mark
3.1	***Using Exponents to Describe Numbers***		
	Pg. 97 Q. 5, 6, 9, 10, 11, 12, 13, 15		
	Pg. 98 Q. 16, 18, 19, 21, 22 or 23		
3.2	***Exponent Laws***		
	Pg. 105/106 Q. 3, 5, 8, 10, 12, 13, 15		
	Pg. 107 Q. 17, 18, 19, 21, 22, 23, 24, 25		
3.3	***Order of Operations***		
	Pg. 111/112 Q. 5, 6, 8, 9, 10, 11, 12, 14, 16		
	Pg. 113 Q. 17, 20		
3.4	***Using Exponents to Solve Problems***		
	Pg. 118 Q. 4, 5, 6, 9		
	Pg. 119 Q. 10, 11, 12, 13		
	Chapter 3 Review		
	Pg. 120 – 121 Q. 1 – 22		

At the end of this unit you will be assessed on the following:

- ☐ 1. I can show a power as a repeated multiplication
- ☐ 2. I can show a repeated multiplication as a power
- ☐ 3. I can explain using patterns why a power with an exponent of zero is equal to one
- ☐ 4. I can evaluate (find the value) of a power
- ☐ 5. I can explain how parentheses affect the value of a power [-2^4 or $(-2)^4$ or (-2^4)]
- ☐ 6. I can use order of operations to evaluate expressions involving powers (BEDMAS)
- ☐ 7. I can use powers as a strategy for problem solving
- ☐ 8. I can simplify powers using exponent laws
  - When multiplying powers with the same base _____ the exponents
  - When dividing powers with the same base _____ the exponents
  - When raising a power to an exponent _____ the exponents
  - When a product or quotient is raised to an exponent, the exponent applies to _____
  - **EXCEPTIONS**
    - I can add or subtract powers and demonstrate the process as the exponent laws do not apply
    - I can evaluate operations involving powers with different bases as the exponent laws do not apply
- ☐ 9. I can identify an error in a simplification of an expression involving powers

3.1 Using Exponents to Describe Numbers

Power - an expression made up of a base and an exponent

Base - the number you multiply by itself in a power

Exponent - the number of times you multiply the base in a power

Exponential Form - a shorter way of writing a repeated multiplication

2^5 means 2 x 2 x 2 x 2 x 2

Try Questions:

Write in *exponential form* **and** *evaluate* the power.

a) 4 X 4 X 4 X 4 X 4
b) (-2) (-2)(-2)(-2)
c) 3 squared
d) 5 cubed

$(-3)^4 =$ 81

Why are these different?

$-3^4 =$ -81

Compare these results:

$(-3)^3 =$ -27

$-3^3 =$ -27

Why are these the same?

Try Questions:

Evaluate each power.

a) $(-2)^5$
b) -3^6

Zero Exponents

$10^4 =$ 10 000

$10^3 =$ 1 000

$10^2 =$ 100

$10^1 =$ 10

$10^0 =$ 1

$3^4 =$ 81

$3^3 =$ 27

$3^2 =$ 9

$3^1 =$ 3

$3^0 =$ 1

What happens when your result is too large for the calculator?

Scientific Notation on a Calculator e.g. 3.56×10^{25}

Order these powers in from smallest to largest.

7^{15}

8^{13}

9^{11}

Key Ideas:

1) A power is a short way to represent repeated _____ $8 \times 8 \times 8 = 8^3$.

2) A power consists of a _____ and an _____. The base represents the number you multiply repeatedly. The exponent represents the number of times you repeat the base.

3) It matters whether the _____ is inside or outside the brackets.

4) Any base to the exponent _____ is equal to _____.

5) Very _____ numbers can be expressed in scientific notation.

Practice Problems:

3.1 Using Exponents to Describe Numbers, Pages 97 & 98 DUE DATE: _____

Page 97, #5	Page 97, #6
Page 97, #9	Page 97, #10
Page 97, #11	Page 97, #12

Page 97, #13	Page 97, #15
Page 98, #16	Page 98, #18
Page 98, #19	Page 98, #21

Page 98, 22 or 23

3.2 Exponent Laws

Exponent Laws are the _____ that apply to exponents, which allow us to _____ calculations.

Product Law

$7^5 \times 7^9 = 7^{14}$

$\left(\frac{3}{7}\right)^4 \times \left(\frac{3}{7}\right)^8 = \left(\frac{3}{7}\right)^{12}$

$(-3)^7 \times (-3) \times (-3)^{12} = (-3)^{20}$

$a^6 \bullet a^{11} \bullet a = a^{18}$

Quotient Law

$9^7 \div 9^3 = 9^4$

$\left(\frac{5}{8}\right)^{17} \div \left(\frac{5}{8}\right)^5 = \left(\frac{5}{8}\right)^{12}$

$(-5)^{13} \div (-5)^7 \div (-5) = (-5)^5$

$m^{27} \div m^{15} = m^{12}$

$\frac{v^8}{v^3} = v^5$

Try Questions:

a.	b)	c)

Power of a Product

$(5 \times 7)^4 = 5^4 \times 7^4$

$7^5 \times 3^5 = (7 \times 3)^5$
$= 21^5$

$(mn)^5 = m^5 n^5$

$(4x)^3 = 4^3 x^3$
$= 64x^3$

$(2xy)^5 = 2^5 x^5 y^5$
$= 32x^5 y^5$

Power of a Quotient

$\left(\frac{3}{7}\right)^4 = \frac{3^4}{7^4}$

$\frac{6^2}{11^2} = \left(\frac{6}{11}\right)^2$

$\left(\frac{x}{y}\right)^6 = \frac{x^6}{y^6}$

$3^9 \div 8^9 = (3 \div 8)^9$
$= \left(\frac{3}{8}\right)^9$

$\left(\frac{x}{3}\right)^4 = \frac{x^4}{3^4}$
$= \frac{x^4}{81}$

Try Questions:

a.	b)	c)

Power of a Power

$(3^5)^4 = 3^{20}$

$((-5)^7)^3 = (-5)^{21}$

$(x^6 y^4)^3 = x^{18} y^{12}$

$(7x^9 y)^3 = 7^3 x^{27} y^3$
$= 343x^{27} y^3$

Combination of Operations with Powers

$\frac{2^5 \cdot 2^3}{2^6} = \frac{2^8}{2^6} = 2^2$

$\frac{(-7)^4 \cdot (-7)^3 \cdot (-7)^0}{(-7)^2} = \frac{(-7)^7}{(-7)^2} = (-7)^5$

$\frac{y^2 \cdot y^0 \cdot y^5}{y} = \frac{y^7}{y} = y^6$

$8 \cdot 8^4 \cdot 8^6 \cdot 8^3 = 8^{14}$

Try Questions:

a)

b)

Key Ideas:

1) To multiply two powers with the same base, keep the base and

_____

2) To divide two powers with the same base, keep the base and

_____

3) To simplify a power that is raised to an exponent, keep the base and

_____

4) When a fraction is raised to an exponent, the exponent applies to

_____

5) When a product is raised to an exponent, you can rewrite each number in the product

_____

Practice Problems:

3.2 Exponents Laws, Pages 105 - 107 DUE:_____

Page 105, #3	Page 106, #5
Page 106, #8	Page 106, #10

Page 106, #12	Page 106, #13
Page 106, #15	Page 107, #17
Page 107, #18	Page 107, #19

Page 107, #21	Page 107, #22
Page 107, #23	Page 107, #24
Page 107, #25	

3.3 Order of Operations

B
E
D
M
A
S

Why is -7^4 different than $(-7)^4$?

Determining the Product of a Power

Example 1:
Write each expression using a coefficient and a power. Then find the value of each expression.

a) 4 X 2 X 2 X 2 X 2 X 2

b) -1 X 9 X 9 X 9 X 9 X 9

When we use order of operations, we need to evaluate the _____ first, then _____by the _____ (the number out front).

Try Questions:

a) $3(2)^4$

b) $-3(-5)^2$

c) -4^4

When there is more than one operation, we must follow the rules of BEDMAS.

Example 2:
Tara was asked to evaluate the following expression. Identify the incorrect step in the following solution. Then show how to correct it. What is the correct answer?

$-2(-15-4^2) + 4(2 + 3)^3$

$= -2(-15-16) + 4(5)^3$ Step 1

$= -2(-31) + 4(5)^3$ Step 2

$= -2(-31) + (20)^3$ Step 3

$= 62 + 8000$ Step 4

$= 8062$ Step 5

Try Questions

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

b) $8(5+2)^2 – 12 \div 2^2$

What would you type into your calculator to get the answer for :

a)

b)

Word Problems

An absent minded business man left his briefcase on a local bus. He notified the lost property department of the bus comapny. When he was asked the number of the bus, he couldn't remember exactly. He did recall that the bus number was a perfect square and that if the numbers of the bus were reversed, it would have also been a perfect square. What are the possible bus numbers he could have been on?

Exponents with Coefficients

A bacteria colony starts with 70 bacteria.
The bacteria reproduce every hour by splitting in half.
The colony size doubles every hour.
How many bacteria will there be in 24 hours?

Hour	Number of Bacteria
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
.	
.	
.	

Exponential Growth

Coefficient (Base) $^{\text{Exponent}}$

Coefficient → How many is the starting amount

Base → What is happening (Doubling, Tripling, etc .)

Exponent → How many times does this happen

e.g.

50 bacteria doubling every 20 min.

How many after 7 hours?

$$50\left(2^{21}\right)$$

Try Question:

The local rabbit population in Canmore started with 150 released rabbits. Every two years, it triples in size if it is not controlled. How many rabbits will be in the population in ten years if left uncontrolled?

Key Ideas

1) Expressions with powers can have a numerical coefficient (a number out front). Evaluate the _____, THEN _____ by the coefficient.

2) Evaluate expressions with _____ using the proper _____:
Brackets, Exponents, Multiplication and Division (left to right), Addition and Subtraction (left to right). BEDMAS.

Really Big Powers

$5^{3^2} = 5^9$

You must calculate the exponent first, then if it fits into your calculator, you can determine the result.

2^{222} $\quad$ 22^{22}

$2^{2^{22}}$ $\quad$ 22^{2^2}

2^{22^2} $\quad$ 222^2

Simplifying Powers with Similar Bases

32^4 $\quad$ 64^3

$\downarrow$ $\quad$ $\downarrow$

$(2^5)^4$ $\quad$ $(2^6)^3$

2^{20} $\quad$ 2^{18}

3.3 Using Exponents to Solve Problems, Pages 111 - 113 DUE: _____

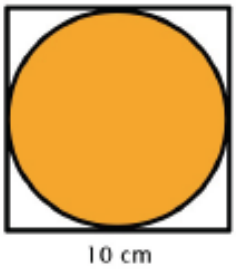
Page 111, #5	Page 111, #6
Page 111, #8	Page 112, #9
Page 112, #10	Page 112, #11

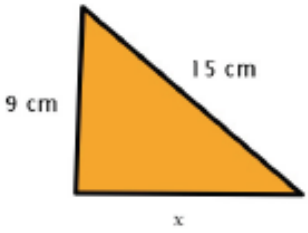
Page 112, #12	Page 112, #14
Page 113, #16	Page 113, #17 and #20

3.4 Using Exponents to Solve Problems

Problem Solving with Exponents

Shapes





Using Exponents in Formulas

Examples:

Surface Area

Cube → $SA = 6s^2$

Sphere → $SA = 4\pi r^2$

Volume

Cube → $V = s^3$

Sphere → $V = \frac{4}{3}\pi r^3$

Example 1:

$SA = 6(7^2)$

$= 6(49)$

$= 294 cm^2$

$SA = 6(3^2)$

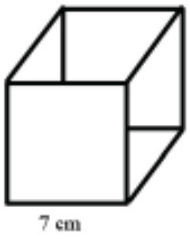
$= 6(9)$

$= 54 cm^2$

What is the ratio of the surface area of the small cube to the large cube?

How much more surface area does the larger cube have?

Example 2:



$V = 7^3$

$= 343 cm^3$

$V = 3^3$

$= 27 cm^3$

How many times greater is the volume of the large cube than the small cube?

Example 3:

Formulas

e.g. $x = \frac{1}{2} a b^2$

If $a = 7$
$b = 3$
$x \rightarrow ?$

If $x = 192$
$b = 8$
$a \rightarrow ?$

Key Ideas:

1) _____ are found in many formulas. When _____ multiplication is present in a formula, it is represented as a power. The use of _____ keeps the formula as _____ as possible.

2) Many _____ that involve _____ multiplication can be modeled with expressions that contain _____.

3.4 Using Exponents to Solve Problems, Page 118 - 119 DUE: _____

Page 118, #4	Page 118, #5

Page 118, #6	Page 118, #9
Page 119, #10	Page 119, #11
Page 119, #12	Page 119, #13

Chapter Review, Pages 120 - 121 DUE: _____

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Page 120, #7	Page 120, #8
Page 120, #9	Page 120, #10

Page 120, #11	Page 120, #12
Page 120, #13	Page 121, #14
Page 121, #15	Page 121, #16

Page 121, #17	Page 121, #18
Page 121, #19	Page 121, #20
Page 121, #21	Page 121, #22