1.7 Exponents, Order of Operations and Averages

1. Exponents: An exponent is a number that indicates how many times the base is to be used as a factor. Exponents indicate repeated multiplication. The base is the number that is multiplied.

Example: Identify the base and the exponent: 2^3
Two is the base and three is the exponent.

Example: Simplify.

a. 3^2

b. 2^3

c. 4^3

d. 5^2

2. Zero exponent: Any number other than 0 raised to the zero power is 1.

Example: Simplify.

a. 2^0

b. 15^0

c. x^0 (assume that x is not zero)

Example: Write an expression that contains an exponent and that has a value of 1.

3. Order of operations: When evaluating mathematical expressions, we will perform operations in the following order:

> **First**: If the expression contains grouping symbols, such as parenthesis (), brackets [ ], braces { }, or a fraction bar, then we perform the operations inside the grouping symbols, or above and below the fraction bar, first.
> **Second**: Evaluate, or simplify, any numbers with exponents.
> **Third**: Do all multiplications and divisions in order from left to right.
> **Fourth**: Do all additions and subtractions in order from left to right.

Example: Simplify.

a. $2 + 3 \cdot 5$ (operations of addition and multiplication are present)

    $= 2 + 15$ (perform multiplication first)

    $= 17$ (perform addition second)

b. $3 + 2 \cdot 4^2$ (operations of addition, mult, and exponentiation)

    $= 3 + 2 \cdot 16$ (do exponents first)

    $= 3 + 32$ (do multplication second)

    $= 35$ (do addition third)

c. $2 \cdot 3 + 4(8 - 3)$

d $\dfrac{4 + 6 \cdot 3}{15 - (9 - 5)}$

e. $3^2 + 2(17 - 3^2)$

4. Averages: There are three types of averages: the mean, the median and the mode.

Mean: To find the mean for a set of numbers, we add all the numbers and then divide the sum by the number of numbers in the set. The mean is sometimes called the arithmetic mean.

Median: To find the median for a set of numbers, we write the numbers in order from smallest to largest. If there is an odd number of numbers, the median is the middle number. If there is an even number of numbers, then the median is the mean of the two numbers in the middle.

Mode: The mode for a set of numbers is the number that occurs most frequently. If all the numbers in the set occur the same number of times, there is no mode.

Example: Find the mean, median and mode of the set of numbers: $35,344; $38,290; $39,199; $40,346; $42,866.

Example: Find the mean, median, and mode of the set of numbers: 77, 87, 100, 65, 79, 87, 79, 85, 87, 95, 56, 87, 56, 75, 79, 93, 97, 92

5. Vocabulary: We will now translate into mathematical symbols English phrases that contain complicated expressions involving the terms sum, product, difference, and quotient.

English phrase	Math symbols
sum of a and b	
two times the sum of a and b	
product of p and q	
product of p and the sum of a and b	
sum of p and the product of a and b	
difference of p and the sum of a and b	
sum of the product of a and b and the product of c and d	

Example: Translate each phrase into math symbols.
a.   product of 4 and the sum of 3 and x

b. difference of 4 and the sum of 3 and x

c. sum of the product of 4 and 3 and the product of 2 and 5

d. twice the product of 4 and x

e. twice the sum of 8 and 5