MA40 F 2017

Section 1.1: Variables and Expressions; Rule of 4

NC.M1.A-SSE.1a: Interpret the structure of expressions. Identify and interpret parts of a linear, exponential, or quadratic expression including terms, factors, coefficients, and exponents.

An **algebraic expression** consists of SUMS AND/OR PRODUCTS OF #'s & VARIABLES

For example in the algebraic expression $0.01d$, the letter d is called a VARIABLE and the number 0.01 is called the COEFFICIENT.

In Algebra, **variables** are SYMBOLS USED TO REPRESENT VALUES.

Any letter may be used as a variable.

Example 1: $0.10d$ $2x+4$ $3+\frac{z}{6}$ $p \cdot q$ $\frac{4cd}{3mn}$

A **term** of an expression may be a *number*, a *variable*, or a *product* or *quotient* of numbers and variables.

Example 2: $2x+4$ TERMS: $2x$, 4.

In a *multiplication* expression, the quantities being multiplied are FACTORS, and the result is a PRODUCT.

An expression like x^2 is called a POWER. In this case, the number 2 is referred to as the EXPONENT while the variable x is referred to as the BASE of the expression.

Application 1. For each of the following, identify the terms, variables, coefficients, factors, bases, and exponents as they apply.

1. $3x^4$ TERM: $3x^4$ COEF: 3 BASE: x
VAR: x FACTORS: $3, x^4$ EXPONENT: 4

2. $5z^2+16$ TERMS: $5z^2, 16$ COEF: 5 BASE: z
VAR: z FACTORS: $5, z^2$ EXP: 2

3. $16u^2-3$ TERMS: $16u^2, -3$ COEF: 16 BASE: u
VAR: u FACTORS: $16, u^2$ EXP: 2

4. $5+6.3s$ TERMS: $5, 6.3s$ COEF: 6.3 BASE: N/A
VAR: s FACTORS: $6.3, s$ EXP: N/A

Terms and coefficients in algebraic expressions can be interpreted to represent **quantities in context**.

Example 3:

a. The height (in feet) of a balloon filled with helium can be modeled with the expression $6 + 5s$ where s is the number of seconds after the balloon is released. Identify and interpret the terms and coefficients in the expression.

TERMS: 6 → INITIAL HT OF BALLOON 6 ft

5s → BALLOON RISES AT A RATE OF 5 ft/sec (SLOPE = RATE OF Δ)

b. Suppose a repair company charges a flat fee of $90 to come to your house to repair a washing machine. Additionally, they charge $40 for every hour the repair takes. Write an expression for the total cost, T, to repair the washing machine if it takes H hours.

TYPO

$T = 90 + 40H$

Application 2.

5. Coach Martinez orders 250 key chains printed with his athletic team's logo and 500 pencils printed with their Web address.

a. ~~Write an algebraic expression that represents the total cost of the order if *k* key chains and *p* pencils are ordered.~~ K = COST OF KEY CHAIN P = COST OF PENCIL

$250K + 500P$.

b. Identify the terms and coefficients in the expression. Explain what the coefficients represent.

TERMS: 250K COEF: 250

500P 500

6. The volume of a cylinder is π times the radius *r* squared multiplied by the height *h*. Write an expression for the volume.

$V = \pi r^2 h$

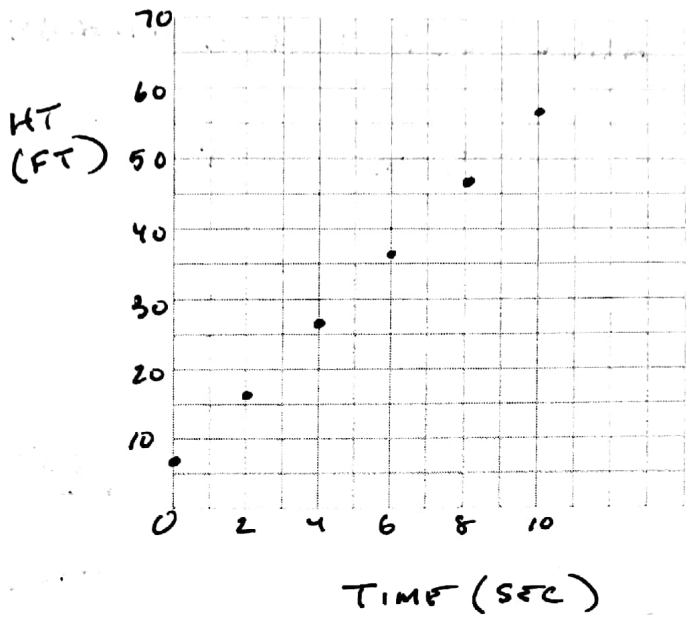
7. Jocelyn makes *x* dollars per hour working at a grocery store and *n* dollars per hour babysitting. Write an expression that describes her earnings if she babysat for 25 hours and worked at the grocery store for 15 hours.

$15x + 25n$

Activity. Let's return to the helium balloon example. Recall that the height (in feet), h, of a balloon filled with helium can be modeled with the equation $h = 6 + 5s$ where s is the number of seconds after the balloon is released.

a. Use the equation to make a table and a graph of values of (h, s) for s = 0 to 10 seconds in steps of 2 seconds. Label the axes on the graph.

Time (seconds)	Height (feet)
0	6
2	16
4	26
6	36
8	46
10	56



b. Use your equation to determine h(12) and explain the meaning your answer. Include units in your explanation.

$h(12) = 6 + 5(12) = 66$ ft

AFTER 12 SEC, BALLOON WILL BE 66 ft HIGH.

The "Rule of 4"

This activity is a very good illustration of something in mathematics called the "Rule of 4." This is a very important rule and can be applied at all levels of mathematics.

Essentially the rule says that mathematical expressions, equations, and functions can be expressed *four different ways*:

VERBAL (WORDS) STARTS AT 6 ft, RISES 5 ft/sec.	SYMBOLIC #'S ALG $h = 6 + 5s$
NUMERICAL (DATA, TBL'S) T | H 0 | 6 2 | 16 4 | 26	GRAPHICAL 

Practice

1. A certain smartphone family plane costs $55 per month plus additional usage costs. If x is the number of cell phone minutes used and y is the number of megabytes of data used, interpret the following expressions:

a. 0.25x ADD'L COST = $.25/MINUTES FOR TALKING

b. 2y ADD'L COST = $2/MEGABYTE FOR DATA.

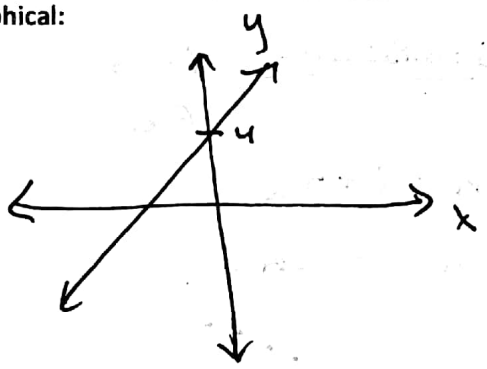
c. 0.25x + 2y + 55 TOTAL COST.

2. An object is dropped from a height of 250 feet. The height of the object, h, above the ground at s seconds is described by the equation $h = -16s^2 + 250$.

a. What is the height of the object at s = 0 seconds? 250 ft

b. What is the height of the object at s = 2 seconds? $-16(2)^2 + 250 =$
$-64 + 250 = 186$ ft.

3. Complete the following using the "Rule of 4."

Verbal:	**Symbolic:**
The sum of 4 and 5 times a number x	$y = 4 + 5x$
Graphical: 	**Numerical:** x | y 0 | 4 1 | 9 2 | 14 3 | 19