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Mathematics

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Algebraic Expressions

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

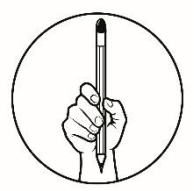
This module was designed and written with you in mind. It is here to help you master the Algebraic Expressions. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

The module is comprised only of one lesson:

- Algebraic Expressions

After going through this module, you are expected to:

1. illustrate and differentiates related terms in algebra; and
2. evaluate algebraic expressions for given values of the variable.



What I Know

Choose the letter of the correct answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following considered a constant?
   a. f
   b. □
   c. 300
   d. 24x

2. Which of the following is a term?
   a. 2m + 5
   b. (2)(6x)
   c. x – y + 2
   d. $\frac{1}{2}$ x – y

3. Which of the following is correct?
   a. $4^2 = 4 \bullet 4 = 16$
   b. $2^4 = 2 \bullet 2 \bullet 2 \bullet 2 = 8$
   c. $2^5 = 2 \bullet 5 = 10$
   d. $3^3 = 3 \bullet 3 \bullet 3 = 27$

4. What is the numerical coefficient of -5xy?
   a. -5
   b. 5
   c. xy
   d. –xy

5. What is the literal coefficient of $-12x^2y$?
   a. -12
   b. 12
   c. x^2y
   d. $-x^2y$

6. What is the degree of $(3x - 2y)^5$?
   A. 1
   B. 2
   C. 3
   D. 5

7. Which of the following expressions is NOT a polynomial?
   A. $-7y^2$
   B. $\sqrt{7}y^2$
   C. $-\frac{y^2}{7}$
   D. $\frac{7}{y^2}$

8. When x = -2, which expression has the value -64?
   A. $3x^2$
   B. $(3x)^2$
   C. $2x^3$
   D. $(2x)^3$

9. What do you call a polynomial with three terms??
   A. monomial
   B. binomial
   C. trinomial
   D. multinomial

10. What is the value of $4x^2 + 3$ when x = 0
   A. 7
   B. 4
   C. 3
   D. 0

11. The number of terms in the expression $15x^4 - 3x^2 + 7$.
   A. 1
   B. 2
   C. 3
   D. 4

12. Find the value of 10x if x = 7
   A. 7
   B. 10
   C. 17
   D. 70

13. What is the degree of the polynomial $6x^6 + 5x^5 + 4x^4 + 3x^3 + 2x^2 + 1$?
    A. 3
    B. 4
    C. 5
    D. 6

14. Which of the following polynomial does not have a degree?
    A. 0
    B. πr^2
    C. $m^4 - 4$
    D. $x^2 - 2x + 3$

15. What is the degree of $3a^3b + a^2 + 2$?
    A. 4
    B. 3
    C. 2
    D. 1

Lesson 1 Algebraic Expressions

Mathematical concepts, rules and properties of numbers will not be easy to understand without knowledge of algebraic symbols and expressions. A single variable or a combination of mathematical symbols, variables and constant constitute an algebraic expression. In this lesson, we will learn related terms in algebra and evaluates the algebraic expressions. Mastery of these concepts is fundamental to learn algebra.

What's In

Recall that a numerical or an arithmetic expression is any symbol for a number.

We are familiar with the arithmetic statement 2 +3 = 5.

There are times, however, when expressions have missing terms which are represented by a blank (___), a circle ( ), a box ( ) , or simply by x or y like

□ + ○ = 5
x + y = 5

In the last expression, x and y may take values from the set of integers that make the statement true. For example:

5 + 0 = 5	2 + 3 = 5	-1 + 6 = 5	-4 + 9 = 5
4 + 1 = 5	1 + 4 = 5	-2 + 7 = 5	-5 + 10 = 5
3 + 2 = 5	0 + 5 = 5	-3 + 8 = 5	-6 + 11 = 5

There is an infinite number of values that can take the places for x and y. These letters are called *variables* and the number 5, which remains unchanged, is called *constant.*

What's New

To understand the concepts, let us do the following activity:

Suppose numbers are assigned to letters of the alphabet as follows:

A = 1,B = 2, C= 3, D= 4, E = 5 and so on, up to Z = 26

Using the above values, find the value of a name by adding the values of its digits.

For example: MARY = 13 + 1 + 18 + 25 = 57

ACE = 1 + 3 + 5 = 9

Try This!

A. Find the numerical value of each name:

1. BEN

2. LAURA

3. Find the value of your name. Compare it with the values of the names of others. Are there two names with the same value?

B. Determine the values of the whole expression.

Substitute the given value of the variable

Follow these examples:

a. What is the value of $x + 8$ if $x = 3$?

$$x + 8 = 3 + 8$$
$$= 11$$

b. What is the value of $x^2 - 3$ if $x = 2$?

$$x^2 - 3 = (2)^2 - 3$$
$$= 4 - 3$$
$$= 1$$

c. Evaluate $\frac{x+2}{y-1}$ if x = 1, y = 2

$$\frac{x+2}{y-1} = \frac{1+2}{2-1} = \frac{3}{1}$$
$$= 3$$

d. What is the value $x^3 + 2x + 1$ if $x = -1$

$$x^3 + 2x + 1 = (-1)^3 + 2(-1) + 1$$
$$= -1 - 2 + 1$$
$$= -2$$

Try This!

1. What is the value of $x + 5$ if $x = 10$? _____ = _____
   = _____

2. What is the value of $5 - x$ if $x = 1$ _____ = _____
   = _____

3. Find the value of $4x^2 + 3$ if $x = 3$ _____ = _____
   = _____
   = _____

4. Find the value of $x^3 - 3x - 4$ if $x = -2$ _____ = _____
   = _____
   = _____

5. Evaluate $\frac{3x+2}{5y-3}$ if x = 1, y = -1 _____ = _____
   = _____
   = _____

Great! You were be able to answer the activity. Let us now define related terms and how to evaluate algebraic expressions.

What is It

Terms in Algebra

A. *Positive Integer Exponent (a^n,where $a \neq 0$ and n is a positive integer)*

The expression 2●2●2●2 can be written as 2^4

base→$2^{\mathbf{4}}$→exponent

Similarly, x●x●x can be written as x^3. The variable x is the base and the number 3 is the exponent. The exponent tells how many times the base is used as a factor.

Here are other illustrations.

$(-5)^3 = (-5)\ (-5)\ (-5) = -125$

$\left(\frac{1}{2}\right)^2 = \left(\frac{1}{2}\right)\ \left(\frac{1}{2}\right) = \left(\frac{1}{4}\right)$

An exponent of 1 can be omitted in a term such as in 2y, xy, and -8x which means $2y^1$, x^1 y^1, and $-8x^1$, respectively.

The following are read as follows:

4^2	four to the second power or four squared
2^3	two to the third power or two cube
x^4	x to the fourth power or x to the fourth

In general, an expression of the form $\boldsymbol{a^n}$, where a ≠ 0 and *n* is the degree of the expression or the exponent which is a nonnegative or a positive integer.

In $\boldsymbol{a^n} = a \bullet a \bullet a \bullet a \ldots \bullet a$ in which there are **n** factors of $\boldsymbol{a}$, $\boldsymbol{a}$ is called the base and n is the exponent.

$$\text{base} \rightarrow \boldsymbol{a^n} \rightarrow \text{exponent}$$

B. Constants and Variables

A symbol that represents an unknown number is referred to as a *variable*. Symbols like x, y, a, α, β, θ can be used as variables.

A *constant* is a symbol which has exactly one number or a fixed value in its replacement set. Any numeral is a constant such as 7, 4, and 11. Pi or π is also a constant.

Consider the expression, $4x^2 + 3y + 2$.

The number *2* is a constant. The letters *x* and *y* are the variables.

C. Literal Coefficients and Numerical Coefficients

The numerical factor of a term is called *its numerical coefficient* or simply coefficient and the variable factor of a term is called *literal coefficient.*

In the term $3x^2$, 3 is called the *numerical coefficient* and x^2 is called the *literal coefficient*.

The term –x has a numerical coefficient which is -1 and a literal coefficient which is x.

The term 5 is called the *constant*, which is usually referred to as the term without a variable or simply a constant term.

Numerical coefficient is the number part of a term. Literal coefficient is the variable including its exponent. The word coefficient alone is referred to as the numerical coefficient.

D. Algebraic Expressions, Terms and Polynomials

Algebra is a branch of mathematics which generalizes the facts of arithmetic. The result of combining symbols such as letters, numbers, punctuations and operations of arithmetic is called an *algebraic expression* or simply an *expression.*

Some examples of algebraic expressions are:

$7,\ 2x,\ -3y + 4,\ \sqrt{4b^2},\ \frac{x^2\sqrt{3}}{4} + (xy - 1),\ \pi r^2,\ 4x^{-3}yz,\ \frac{1}{2}(\alpha + \beta)$

A *term* is a constant or a variable or constants and variables multiplied together.

Examples: $4,\ xy,\ 8yz,\ 2\pi r,\ 8a^4b^3c^{\frac{1}{2}},\ -3\beta,\ \frac{1}{2}xyz$

A *polynomial* is an algebraic expression that represents a sum of one or more terms containing whole-number exponents on the variables.

Here are some examples of polynomials:

5	$2x$	$-\frac{5}{4}x + y$
$\frac{x-y}{4}$	$x^2 + 3x - 1$	$\sqrt{4}x^2 + 3x^3y - x^2y^2 - xy^3 + y^4$

An expression is NOT a polynomial if:

1. Its exponent is not a whole number or a variable.

   Examples: $3x^{-2} + 1,\quad x^2y^2 + 3xy^3 + y^{4/3},\quad 5^x$

2. The variable is in the denominator.

   Examples: $\frac{4}{x},\quad \frac{x}{2y},\quad \frac{x+y}{3z}$

3. The variable is under the radical sign.

   Examples: $\sqrt{4x^2},\quad \sqrt{x},\quad \sqrt{a+3b}$

E. Number of terms, degree of the term and degree of the polynomial

Any algebraic expression separated from another algebraic expressions by a plus (+) or a minus (-) sign is called a *term.*

There are four terms in the expressions $5x^4 + 2x^3y^3 - xy - 7$, namely, $5x^4$, $2x^3y^3$,$-xy$, -7.

Examples:

Count the number of terms in each expression.

A. $3x^2 - 4x + 1$ - There are three terms.

B. $\frac{2x+1}{4}$ - There is only one term.

C. $2(x+1) - \sqrt{4x^2 + x^3}$ - There are two terms.

D. $\frac{1}{x+1} - x^2 + x^{-3} + 1$ - There are four terms.

The *degree of a term* is the exponent of its variable while the degree of the polynomial is the highest degree appearing in any of the terms in that polynomial. For example, in the polynomial $3x^4 + x^2 – 9x + 7$, the degree of the terms are as follow:

$3x^4$ has degree 4, x^2 has degree 2, $-9x$ has degree 1, and 7 has degree 0.

Since 4 is the highest degree, the degree of the polynomial $3x^4 + x^2 – 9x + 7$ is degree 4.

If a term consists of two or more variables, the degree of that term is the sum of the exponents of the variables. For example, in the polynomial $xy^2 + 7x^2y^4 – 5y^4$, we have the degree of each term as follow:

xy^2	has degree 3	(1+2 = 3)
$7x^2y^4$	has degree 6	(2+4 = 6)
$– 5y^4$	has degree 4	

Since 6 is the highest sum of the exponent from the term $7x^2y^4$, the polynomial $xy^2 + 7x^2y^4 – 5y^4$ has a degree 6.

Kind of polynomial according to the number of terms

Kinds of Polynomial	No. of Terms	Examples
Monomial	One term	$-7x^3$, 53, 8x, x
Binomial	Two terms	$5x – 7y$, $\frac{x+y}{2}$, $3(y + z)$ *Note:* $\frac{x+y}{2}$ is the same as $\frac{x}{2} + \frac{y}{2}$. $3(y + z)$ is the same as $3y + 3z$ because of Distributive Property.
Trinomial	Three terms	$x^2 – 8x + 12$, $3(x - y + z)$ *Note:* $3(x - y + z)$ is equal to $3x – 3y + 3z$ because of Distributive Property.
Multinomial or Polynomial	Four or more terms	$x^3 + 5x^2 – 4x + 5$

Note that $\sqrt{4x}$ is not a monomial since it is not a polynomial in the first place.

Kind of polynomial according to its degree

Kinds of Polynomial in terms of degree	Degree	Examples
Constant	Zero	1, 5, and any number
Linear	One	$5x$, $x + 1$, $3x - 2y + 3$
Quadratic	Two	$5x^2$, $x^2 + 1$, $3x^2 - 2y + 3$
Cubic	Three	$5x^3$, $x^3 + 1$, $3x^3 - 2y^2 + 3$
Quartic	Four	$5x^4$, $x^4 + 1$, $3x^4 - 2y^3 + 3$
Quintic	Five	$5x^5$, $x^5 + 1$, $3x^5 - 2y^4 + 3$

Evaluating an Algebraic Expression

To evaluate an algebraic expression means to substitute the given specific values for the variables and then simplify the resulting numerical expressions.

Steps to follow in evaluating algebraic expressions:

1. Substitute the given values for each variable.
2. Simplify first the expression within the parenthesis.
3. Perform all indicated operations and simplify the result.

Example 1. Evaluate

a. $x + 3y$ if $x = 2$, and $y = -1$.

b. $2x^2 - 3xy + 4y$ if $x = -1$, and $y = 2$.

Solution:

a. Replacing the values for x and y and simplifying, we get

$$\begin{aligned} x + 3y &= 2 + 3(-1) \\ &= 2 - 3 \\ &= -1 \end{aligned}$$

b. Upon substituting the values of x and y and simplifying, we obtain

$$\begin{aligned} 2x^2 - 3xy + 4y &= 2(-1)^2 - 3(-1)(2) + 4(2) \\ &= 2(1) + 6 + 8 \\ &= 16 \end{aligned}$$

Example 2. Evaluate the polynomial $x^3 - 3x - 4$ when

a. $x = -1$

b. $x = 0$

c. $x = 1$

d. $x = 2$

Solution:

a. $x^3 - 3x - 4$; $x = -1$

$= (-1)^3 - 3(-1) - 4$

$= -1 + 3 - 4$

$= -2$

b. $x^3 - 3x - 4$; $x = 0$

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

$= 0 - 0 - 4$

c. $x^3 - 3x - 4$; $x = 1$

$= (1)^3 - 3(1) - 4$

$= 1 - 3 - 4$

$= -6$

d. $x^3 - 3x - 4$; $x = 2$

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

$= 8 - 6 - 4$

= -4 = -2

What's More

A. Tell whether each polynomial is a monomial(M), binomial(B), trinomial(T) or multinomial (MT).

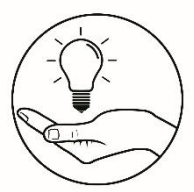
1. 3x _____
2. 12x + 3y – 1 _____
3. 5y – 1 _____
4. 7x – 11y _____
5. x(6xy) _____
6. $\frac{x-y}{4}$ _____
7. $\frac{1}{2}$ ab + 4 _____
8. 2 (x + y + z) _____
9. 5 (y- 3) _____
10. $5m^6 - 6m^5 + 5m^4 - 4m^3 + 3m^2 - 3$ _____

10

B. Find in column B the values of the algebraic expressions listed in column A if $z = 2$. Write the letter of your answer on the space provided.

A	**B**
_____1. 1 + z	a. -7
_____2. z – 2	b. -5
_____3. 2z	c. -2
_____4. $\frac{z}{2}$	d. -1
_____5. 3z	e. 0
_____6. 2z + 1	f. 1
_____7. -2z – 1	g. 2
_____8. 4 – 3z	h. 3
_____9. 3z – 1	i. 4
_____10. $\frac{-7z}{2}$	j. 5

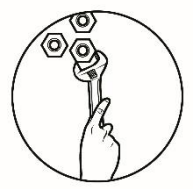
k. 6



What I Have Learned

Match each term in column A with the correct meaning in column B by writing the letter in the space provided that corresponds to each item.

A	**B**
_____1. Term	a. The numerical factor in a term
_____2. Constant	b. Any combinations of numbers, variables, grouping, symbols and operation
_____3.Numerical coefficient	c. the variable factor of a term
_____4.Literal coefficient	d. A symbol which represents any number from a given replacement set
_____5.Algebraic expressions	e. a constant or variable multiplied together
_____6. Algebra	f. n in mb^n
_____7. Polynomial	g. A term with no variable or a term with fixed value
_____8. Monomial	h. A branch of mathematics which generalizes the fact of arithmetic
_____9. Variables	i. represents the sum of one or more terms
_____10. Exponent	j. a polynomial with one term



What I Can Do

Here is another activity that will let you apply what you have learned about terms and concepts on polynomials.

Activity

Tell whether the given expression is a polynomial or not. If it is a polynomial, determine its degree and tell its kind according to the number of terms. If it is NOT, explain why.

1) $3x^2$
2) $x^2 - 5xy$
3) 11
4) $3x^2 - 5xy + x^3 + 5$
5) $x^3 - 5x^{-2} + 3$
6) $x^{1/2} - 3x + 4$
7) $\sqrt{4}\, x^4 - x^7 + 3$
8) $3x^2\sqrt{2x} - 1$
9) $\frac{1}{3}x - \frac{3x^3}{4} + 6$
10) $\frac{3}{x^2} - x - 1$

Great work! You did a good job in applying what you have learned.

Assessment

Multiple Choice. Choose the letter of the correct answer. Write the chosen letter on a separate sheet of paper.

1. What do you call a polynomial with one term?
   A. binomial
   B. monomial
   C. multinomial
   D. trinomial

2. Which of the following is a term?
   A. 3m + 4
   B. (3)(5x)
   C. x – y + 3
   D. $\frac{2}{3}$ x – y

3. Which of the following is correct?
   A. $5^2 = 5 \bullet 5 = 25$
   B. $3^3 = 3 \bullet 3 \bullet 3 = 9$
   C. $4^5 = 4 \bullet 5 = 20$
   D. $2^3 = 2 \bullet 2 \bullet 2 = 27$

4. What is the numerical coefficient of -10xy?
   A. x
   B. xy
   C. -10
   D. 10

5. What is the literal coefficient of $-17a^2b$?
   A. $-a^2b$
   B. a^2b
   C. 17
   D. -17

6. What is the degree of $(7x - 8y)^2$?
   A. 1
   B. 2
   C. 3
   D. 4

7. Which of the following expressions is NOT a polynomial?
   A. $-4x^2$
   B. $\sqrt{4}x^2$
   C. $-\frac{x^2}{4}$
   D. $\frac{4}{x^2}$

8. What is the value of $4x^2 + 3$ when $x = \frac{1}{2}$?
   A. 72
   B. -7
   C. 4
   D. -4

9. What do you call a polynomial with two terms??
   A. monomial
   B. binomial
   C. trinomial
   D. multinomial

10. Evaluate the polynomial $3x - 2y + 4$ if $x = -2$, $y = -4$.
   A. 22
   B. 14
   C. -8
   D. 6

11. What is the degree of the polynomial $3x^4y^3 - 3x^2y - 5x - 7$?
   A. 2
   B. 4
   C. 6
   D. 7

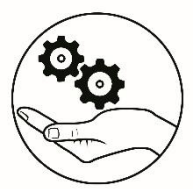
12. Evaluate the polynomial $x^3 - 3x - 4$ if $x = -2$.
   A. -2
   B. -4
   C. -6

D. 4

13. What is the numerical coefficient of $(3x)(-2x^3)$?
    A. 2
    B. 3
    C. 6
    D. -6

14. The number of terms in the expression $23x^4 + 2x^3 – 3x^2 + 11$.
    A. 1
    B. 2
    C. 3
    D. 4

15. Find the value of $4 - 3x + x^2$ if $x = 7$
    A. -3
    B. 3
    C. -32
    D. 32



Additional Activities

A. Tell whether each statement is ***True*** or ***False.***

_____1. The degree of a binomial is always 2.

_____2. The degree of the polynomial $x^2 - x$ is 2.

_____3. In the polynomial $x^2 - x + 1$, the coefficient of x is 5.

_____4. The degree of the polynomial $3x^2 - 5xy + x^3 + 5$ is 2.

_____5. Every trinomial is of degree 3.

B. Let us make use of your newly acquired skill! Accomplish each task box below. The first box was done for you.

Box 1. Given the algebraic expression k^3, what is its:

1. degree **3**
2. classification **Monomial**
3. Its value if $k = 1$.

$$k^3 = (1)^3 = 1$$

Box 2.Given the algebraic expression $k - 13$, what is its:

1. degree _____
2. classification _____
3. Its value if $k = 1$.

Box 3. Given the algebraic expression $4k + k^2 + 2$, what is its:

1. degree _____
2. classification _____
3. Its value if $k = 1$.

Box 4. Given the algebraic expression $3k$, what is its:

1. degree _____
2. classification _____
3. Its value if $k = 5$.

Answer Key

What I Know

1. C
2. B
3. A
4. A
5. C
6. D
7. D
8. D
9. C
10. C
11. C
12. D
13. D
14. A
15. A

What I Have Learned

1. e
2. g
3. a
4. c
5. b
6. h
7. i
8. j
9. d
10. f

What's New

A.
BEN = 21
2. LAURA= 53
3. answers may vary

B.

1. $x + 5 = 10 + 5$
$= 15$
2. $5 - x = 5 - 1$
$= 4$
3. $4x^2 + 3 = 4(3)^2 + 3$
$= 4(9) + 3$
$= 36 + 3$
$= 39$
4. $x^3 - 3x - 4 = (-2)^3 - 3(-2) - 4$
$= (-8) + 6 - 4$
$= -6$
5. $\frac{3x+2}{5y-3} = \frac{3(1)+2}{5(-1)-3}$
$= \frac{3+2}{-5-3} = \frac{5}{-8}$

What's More

A.	B.
1. M	1. h
2. T	2. e
3. B	3. i
4. B	4. f
5. M	5. k
6. B	6. j
7. B	7. b
8. T	8. c
9. B	9. j
10. MT	10. a

Assessment

1. B
2. B
3. A
4. C
5. B
6. B
7. D
8. C
9. B
10. D
11. D
12. C
13. D
14. D
15. D

What I Can Do

1.
A1. Polynomial, degree two, monomial
2. polynomial, degree two, binomial
3. polynomial, degree zero, monomial
4. polynomial, degree three, multinomial
5. not, negative exponent
6. not, rational exponent
7. polynomial, degree 7, trinomial
8. not, radical exponent
9. polynomial, degree three, trinomial
10. not, variable is in denominator

Additional Activities

A.

1. false	3. false	5. false
2. true	4.false	

B.

Box 1	***Box 2***
1. 3	1. 1
2. Monomial	2. Binomial
3. 1	3. -12

Box 3	***Box 4***
1. 2	1. 1
2. Trinomial	2. Monomial
3. 7	3. 15

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