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LEARNER NAME: _____

SUBJECT	:	MATHEMATICS
CLASS	:	GRADE 8
TASK	:	INFORMAL ACTIVITIES ALGEBRAIC EXPRESSIONS
DURATION	:	TERM 1
NUMBER	:	14 ACTIVITIES

This document consists of 51 pages including cover page

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MD, Phillips., J, Basson., J, Odendaal. (2015) Mind Action Series Mathematics Grade 8 and 9 3rd edn., Sanlamhof: Allcopy Publishers.

Kevin Smith. (2017) Maths Handbook and Study Guide. Berlut Books CC.

1. NUMBERS, OPERATIONS AND RELATIONSHIPS

WHOLE NUMBERS:

Describe the real number system by recognising, defining and distinguishing properties of real numbers.

Real number system consists of many different classifications. Types of numbers learnt so far and introduction of rational and irrational numbers.

NATURAL NUMBERS

$\{1; 2; 3; 4; \dots\}$

Start at 1 and increase in ones up to infinity (∞).

The symbol used for a set of natural numbers is: $\mathbb{N}$

WHOLE NUMBERS

$\{0; 1; 2; 3; 4; \dots\}$

Start at 0 and increase in ones up to infinity (∞).

The symbol used for a set of natural numbers is: $\mathbb{N}_0$

INTEGERS

$\{\dots; -4; -3; -2; -1; 0; 1; 2; 3; 4; \dots\}$

They extend whole numbers to include negative numbers.

Integers start at $-\infty$ and increase in ones up to $+\infty$.

The symbol used for a set of integers is: $\mathbb{Z}$

RATIONAL NUMBERS

Numbers which can be written as fraction (where numerator and denominator are integers and denominator cannot be zero), thus $\frac{\text{any integer}}{\text{any non-zero integer}}$.

The set includes: natural numbers, whole numbers and integers. It also includes terminating $\{0,25; 3,14; 1,75\}$ and recurring $\{0,\dot{6}; 1,\dot{2}\dot{5}; 0,\dot{3}\}$ decimals.

Example: $0,25 = \frac{25}{100} = \frac{1}{4}$ and $0,\dot{6} = \frac{3}{5}$

The symbol used for a set of rational numbers is: $\mathbb{Q}$

IRRATIONAL NUMBERS

Numbers that cannot be written as a fraction or with terminating or recurring decimals. They are non – terminating and non – recurring.

The set includes: square and cube roots of numbers that are not perfect squares and cubes, pi (π).

The symbol for a set of irrational numbers is: $\mathbb{Q}'$

NOTE THE FOLLOWING POINTS:

- If a number is rational, it cannot be irrational and vice versa.
- A natural number is also a whole number, integer and rational number.
- A whole number is also an integer and natural rational number.
- An integer is also a rational number.

REAL NUMBERS

The set of rational ($\mathbb{Q}$) and irrational ($\mathbb{Q}'$) numbers.

The symbol for a set of real numbers is: $\mathbb{R}$

NB: This are system of numbers done up to now and as a results we are now going to study this numbers when they are used with letters of alphabets.

2. PATTERNS, FUNCTIONS AND ALGEBRA

ALGEBRAIC EXPRESSIONS

Algebra is a study of numbers in which letters of alphabets are used. Those letters are used to stand for numbers.

Think of a natural numbers less than 4. Double this number and add 1.

There are three possible answers:

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

$$2 \times 2 + 1 = 5$$

$$2 \times 3 + 1 = 7$$

If natural number chosen is not known, the rule used was going to be:

$$2 \times \text{number} + 1$$

Instead of “number” we can write “ n ” which will represent the number chosen and therefore the rule used is $2 \times n + 1$. We can also use “ x ” for the number chosen and the rule changes to $2 \times x + 1$.

The letter x in this rule can take on three different values depending on the numbers chosen:

If 1, then $x = 1$ and the answer is $2 \times 1 + 1 = 3$

If 2, then $x = 2$ and the answer is $2 \times 2 + 1 = 5$

If 3, then $x = 3$ and the answer is $2 \times 3 + 1 = 7$

Using algebraic notation, we can state that $x \in \{1; 2; 3\}$. Therefore the meaning is x is an element ($\in$) of set ($\{ \}$) of natural numbers less than 4.

Writing the rule $2 \times x + 1$ in a simplified form will be $2x + 1$ where $2 \times x$ have the same meaning as $2x$. $2 \times x$ can also be written as $2 \cdot x$ or $2(x)$.

The expression $2x + 1$ is called **algebraic expression**.

If asked to state the value of x if the answer got was 7, then the rule will be seen as $2x + 1 = 7$ and it is now called the **algebraic equation**.

And now we will know that the value of x is 3 ($x = 3$) in order to get 7 because we know that $2(3) + 1 = 7$.

You are also allowed to use **any alphabet in algebra** and you are also allowed to use **more than one alphabet** in algebra.

Multiplying two numbers you don't know can be expressed as the rule $x \times y$ or xy . If you chose $x = 2$ and $y = 3$, then your answer will be $(2)(3) = 6$.

Note that **in algebra** we prefer to write **letters in alphabetical order**. Therefore the expression $x \times y$ is written as xy rather than yx .

$5 + 3$ is called a **number expression** involving **addition** and it can be **simplified** to 8.

An **expression** containing **one or more letters** is called an **algebraic expression**. For an example $x + 2$ is an algebraic expression which can **only be simplified** if the **value of x is given** and as it stands, it is **not possible to simplify $x + 2$** .

In algebra word statements are also translated into mathematical terms with numbers and variables (letters).

TERMINOLOGY AND NOTATION

Four basic operations required to know:

- Addition (+)
- Subtraction (−)
- Multiplication (×)
- Division (÷)

Various ways that the basic operations can be expressed in words.

Expressions in words	Operations
Sum of / More than / Plus / Add / Exceeds	Addition (+)
Less than / Decrease / Differences	Subtraction (−)
Products / Multiply / Times	Multiplication (×)
Divide / Quotient	Division (÷)

There are other symbols which can be expressed in words which you are required to know.

Expressions in words	Symbol
Squared	$()^2$
Square root	$\sqrt{\square}$
Cubed	$()^3$
Cube root	$\sqrt[3]{\square}$

CLASSWORK 1**DATE:****BASELINE ACTIVITY****1. Complete the table below:**

	Statement	Algebraic Expression
1.1	Sum of 2 and a number.	
1.2		$3x + 4$
1.3	The sum of a number and 1 then multiplied by 6.	
1.4		$x - 10$
1.5	The difference between 10 and a number.	
1.6		$9x - 8$
1.7	The quotient of twice a number and 7	

2. Write the following in a more simplified form:

2.1 $1x^1$

2.2 $8 \times y^1$

2.3 $3 \times y^1 \times x^1 \times 8$

2.4 $b \times c \times a$

3. If $x \in \{0; 1; 2\}$ what are the values of the following:

3.1 $3x$

3.2 $4x - 2$

3.3 $\frac{x^2}{2}$

4. If $x \in \{0; 7; 8\}$, determine the value of x which will make the following algebraic equations true.

4.1 $4x + 1 = 29$

4.2 $\frac{x}{5} = 0$

Correct corrections or expanded opportunities

HOMEWORK 2**DATE:****1. Complete the table below:**

	Statement	Algebraic Expression
1.1		$x - 5$
1.2	The difference between 5 and a number.	
1.3	The square root of a number.	
1.4		x^3
1.5	6 more than a quotient of three time a number and 4.	
1.6		$(x - 5)7$
1.7	The quotient of 5 more than a number and 2.	

2. Write the following in a more simplified form:

2.1 $1a^1$

2.2 $z^1 \times 8$

2.3 $3 \times n^1 \times 8 \times m^1$

3. If $x \in \{0; 1; 2\}$ what are the values of the following:

3.1 $2x^3$

3.2 $3(x + 2)$

3.3 $\frac{x^2}{2}$

4. If $x \in \{5; 7; 8\}$, determine the value of x which will make the following algebraic equations true.

4.1 $x - 4 = 1$

4.2 $\frac{x}{2} = 4$

Correct corrections or expanded opportunities

UNKNOWN NUMBERS AS VARIABLES

Unknown numbers are written as **variables in algebra**. These are usually letters of the alphabet such as a and b .

Example: The **sum** of a **number and 5** can be written as: $y + 5$.

Any letter of the **alphabets** can be used as the **unknown**.

Take note of the following when multiplying numbers and variables in Algebraic expressions:

1. It is not necessary to **separate numbers and variables** with **brackets or a multiplication sign**.

Example: $2 \times a$ can be written as $2a$.

2. When dealing with **numbers** and **variables** the order in which they are written does not matter. But we usually write the **number first** followed by the **variables** written in **alphabetical order**.

Example: $n \times 4 \times m$ can be written as $n4m$. But we will normally write it as $4mn$. It will also be correct to write it as $4nm$. However **by convention** the letters should be written in **alphabetic order**.

3. It is not necessary to write **1** in front of the product of **1** and **variable(s)**.

Example: $1 \times x$ can be written as $1x$. But we normally write it as x .

4. It is not necessary to write **1** when **variable is raised to the exponent of 1**.

Example: x^1 can be written as x .

TERMS IN AN ALGEBRAIC EXPRESSIONS

A **term** in algebraic expressions can be a **single number or a combination of numbers and variables multiplied together**.

Example: $5, 5x, 5x^2y, \frac{2}{3}p$.

Terms are separated by a **plus or minus sign**.

Example: $x + 4, 3a + 2b - 8, (2d + 5) - (1 + e), \frac{a+7}{2b-3} + 4$.

POLYNOMIALS

An **algebraic expression** which consists of **one or more terms** is refer to as **polynomial**.

Different types of polynomials:

A **monomial** is a polynomial consisting of **one term**.

Example: $3, 4z, (3r + s), \frac{4x-3}{2}, \frac{4x-3}{x-2}, (f + 3)(h - 2)$

A **binomial** is a polynomial consisting of **two terms**.

Example: $3 + t, 7k - 1, (a - 5) + (b + 8)^2$

A **trinomial** is a polynomial consisting of **three terms**.

Example: $2x + x^2 - 9, \frac{1}{2}x^3 - x^2 + x, (x - 2)(x + 1) - xy + 1$

8 components of a polynomial.

1. **Degree** of a polynomial is determine by the **highest exponent of any variable in an expression**.
2. **Arrange the polynomial in a particular order**.
3. **Type** of a polynomial.
4. **Variables** (letters used to represent numbers).
5. **Coefficients** (the number next to a variable(s) in a term. Basically a coefficient of a particular term is an expression which when you multiply by it with will give you that term).
6. **Constant terms** (the term with no variable).
7. **Exponent** is a number a variable is raised to.
8. Determine **the value of the polynomial** if the value(s) is/are given.

Example: Examine the polynomial $6x - 1 + 5x^2$

1. **Polynomial is of second degree.** The highest exponent is **2**.
2. Arrange the polynomial in **descending order of x** .
 $5x^2 + 6x - 1$
3. **Type of a polynomial** is trinomial.
4. **Variable** is x .
5. **Coefficient of x^2** is 5 and of x is 6.
6. A **constant term** is -1
7. Determine **the value** of $5x^2 + 6x - 1$ if $x = -2$.

$$\begin{aligned}
 &5x^2 + 6x - 1 \\
 &= 5(-2)^2 + 6(-2) - 1 \\
 &= 20 - 6 - 1 \\
 &= 20 - 7 \\
 &= 13
 \end{aligned}$$

CLASSWORK 3**DATE:**

Examine the polynomial $6x + 5x^3 - 3 - 2x^2$ and answer the questions that follow:

1. Arrange the polynomial in descending power of x .
2. What is the degree of a polynomial?
3. How many terms are there in the polynomial?
4. Write down the constant term in the polynomial.
5. What is the coefficient of x^2 ?
6. Determine the value of the polynomial if $x = -1$.

$$6x + 5x^3 - 3 - 2x^2$$

Correct corrections or expanded opportunities

HOMEWORK 4**DATE:**

Examine the polynomial $4x^5 + 6x$ and answer the questions that follow:

1. What type of polynomial is shown above?
2. What is the coefficient of x ?
3. Write down the constant term?
4. What is the degree of the polynomial?
5. Determine the value of the polynomial if $x = 1$.

$$4x^5 + 6x$$

Correct corrections or expanded opportunities

LIKE AND UNLIKE TERMS

If you have **3 oranges** and **2 apples** in a basket and you place an additional **2 oranges** and **5 apples** in the basket you would have a total of **5 oranges** and **7 apples**.

Oranges and apples are considered unlike terms. You can only add or subtract like terms. If you have one orange and you add 1 apple you will have 1 orange and 1 apple.

Example: **3 oranges** + **2 apples** + **2 oranges** + **5 apples**

$$= \mathbf{5\text{ oranges} + 7\text{ apples}}$$

The same principle can be applied to variables

Example: **3a** + **2b** + **2a** + **5b**

$$= \mathbf{5a + 7b}$$

Terms having the same bases and the same exponents are referred to as like terms. Therefore anything except that is an unlike term.

Like terms can be added/subtracted together but unlike terms cannot.

Example: Simplify $5x^2 + 8x - 7x^2 + 8x - 4 - 4x^2 + 1$ by firstly collecting the like terms.

Solution: $5x^2 + 8x - 7x^2 + 8x - 4 - 4x^2 + 1$

$$= 5x^2 - 7x^2 - 4x^2 + 8x + 8x - 4 + 1$$

$$= -2x^2 - 4x^2 + 16x - 3$$

$$= -6x^2 + 16x - 3$$

CLASSWORK 5**DATE:**

Simplify the following algebraic expressions by first collecting the like terms:

1. $5x - 2y - 3x - y$

2. $2y^3 - 3y - 6y^3 - 3y$

3. $5x^2y + 8xy^2 + 3yx^2 - 2y^2x$

4. $5x - 4y + 3y - 2x + 2z - 4z + 3x$

5. $2x^2 + 2x - 5x^2 - y^2 + 5x - 5y$

6. $3xyz + 3xy - 5yxz + yx + 2yz$

7. $-3a^3bc + 4bca^3 - ab^3c + b^3ca$

Correct corrections or expanded opportunities

HOMEWORK 6**DATE:**

Simplify the following algebraic expressions by first collecting the like terms:

1. $2a + 3b - a + 2b$

2. $4xyz - 3wz + 2xzy - zy$

3. $4x + 6y + 2x - 4y + 3$

4. $4x^2 + 3x + 4 + x^2 - 2x + 2$

5. $3ab + 3by - 3xa - 9ab - 3yb + 12ax$

6 $9x^3y^2 - 15y^2x^3 - 7x^3y - 9yx^3 - x^2y^2 + 4y^2x^2$

Correct corrections or expanded opportunities

CLASSWORK 7**DATE:****1. Simplify the following:**

1.1 $2 \times 3x$

1.2 $(-3xy) \times (-2xy^2)$

1.3 $2(4 + 1)$

1.4 $-5a(2b - c)$

1.5 $-3(2 - a - a^2)$

1.6 $7x(x^4 - 2x^3 + 3)$

$$1.7 \quad -\frac{16a^{12}b^7}{12a^8b^2}$$

$$1.8 \quad \frac{3x+6}{3}$$

$$1.9 \quad \frac{x^3+9x^2-10x}{x}$$

$$1.10 \quad \frac{8a^3-2a^2+4a}{-2a}$$

2. Add $x^2 + 2x + 4$ and $3x^2 - 4x - 5$

3. Subtract $3x^2 - 2x - 1$ from $-2x^2 + 7x - 5$

Correct corrections or expanded opportunities

HOMEWORK 8**DATE:****1. Simplify the following:**

1.1 $3x \times -4y$

1.2 $4xy^2 \times 5x^2y$

1.3 $2(4x + 1)$

1.4 $-3x(-y - z)$

1.5 $x(x^2 - 2x - 2)$

1.6 $\frac{4xy}{2}$

1.7 $\frac{-12a^7}{-3a^2}$

1.8 $\frac{8p-16q}{4}$

1.9 $\frac{3p^5 + 15p^4 - 9p^3}{3p^2}$

1.10 $\frac{6m^3n^4 + 12m^2n^5 - 18mn^6}{3mn^4}$

- 2.** From $6y^2 + 3y - 2$ subtract the sum of $-3y^2 + 2y + 3$ and $2y^2 + y + 1$.

Correct corrections or expanded opportunities

CLASSWORK 9**DATE:****Simplify the following:**

1. $6 - 5(2a + 2)$

2. $5(3x - 1) + 4(x + 2)$

3. $-3(2y + 3) - (4y - 2)$

4. $x - 13 - (x - x^2 + 12)$

5. $x(x^2 + 5x - 8) + x^2 - 12$

6. $a(a^2 + 5a - 2) - 2(a^2 + 5a - 2)$

Correct corrections or expanded opportunities

HOMEWORK 10**DATE:****Simplify the following:**

1. $4(2p - 5) - 3(p - 1)$

2. $x(x + 5) + x(x - 2)$

3. $2x^2 + 5x + 2 - x(x + 6)$

4. $x^2 - 9x - 8 - 2(x^2 - 5x - 9)$

5. $3x^2 - 2x + 5 - (x - 9 + x^2)$

6. $x^2 + 5x - 2 - (x^2 + 3x - 2)$

Correct corrections or expanded opportunities

SQUARES, SQUARE ROOTS, CUBES AND CUBE ROOTS OF ALGEBRAIC EXPRESSIONS

There are two main rules that will be used in this section:

$$1. \quad (a^x b^y c^z)^p = a^{x \times p} b^{y \times p} c^{z \times p}$$

$$2. \quad \sqrt{a^x b^y c^z} = a^{\frac{x}{2}} b^{\frac{y}{2}} c^{\frac{z}{2}} \quad \text{and} \quad \sqrt[3]{a^x b^y c^z} = a^{\frac{x}{3}} b^{\frac{y}{3}} c^{\frac{z}{3}}$$

When finding the square root of an expression, square root numbers normally and then divide the exponents of the variables by 2.

When finding the cube root of an expression, cube root numbers normally and then divide the exponents of the variables by 3.

Example 1: Simplify $\sqrt{16x^8y^4z^2}$

Solution: $\sqrt{16x^8y^4z^2}$

$$= 4^{\frac{2}{2}} x^{\frac{8}{2}} y^{\frac{4}{2}} z^{\frac{2}{2}}$$

$$= 4x^4y^2z$$

Example 2: Simplify $\sqrt[3]{27a^{12}b^6c^3}$

Solution: $\sqrt[3]{27a^{12}b^6c^3}$

$$= 3^{\frac{3}{3}} a^{\frac{12}{3}} b^{\frac{6}{3}} c^{\frac{3}{3}}$$

$$= 3a^4b^2c$$

CLASSWORK 11**DATE:****Simplify the following:**

1. $\frac{(8a^3b)^2}{32a^3b}$

2. $\sqrt{16p^4}$

3. $\sqrt[3]{125m^3n^6o^9p^{12}}$

4. $\sqrt{\frac{4x^6y^4}{z^2}}$

Correct corrections or expanded opportunities

HOMEWORK 12**DATE:****Simplify the following:**

1. $\frac{(4b^3)^2}{4b^2 + 4b^2}$

2. $\sqrt{9a^4 + 16a^4}$

3. $\sqrt[3]{\frac{125p^3q^{27}}{r^9}}$

4. $\sqrt[3]{64x^{18}y^{21}}$

5. $\sqrt{\frac{25x^4 - 7x^4}{2x^2}}$

Correct corrections or expanded opportunities