MATHEMATICS
GRADE 8

DATE: ....

TOPIC: Algebraic Expressions

CONCEPTS & SKILLS TO BE ACHIEVED: **By the end of the topic learners should know and be able to:** • **Recognise and interpret rules/relationships represented in symbolic form.** • **Identify variables and constants from formulae or equations.** • **Recognise and Identify conventions for writing algebraic expressions:** **a) like & unlike terms** **b) coefficients & Exponents.** • **Perform calculations:** **a) Add and subtract like terms** **b) Multiply and** **c) Divide integers and monomials by : monomials, binomials and trinomials.** • **Simplify algebraic expressions** • **Find the following for single algebraic terms:** **a) square** **b) cube** **c) square root** **d) cube root** • **Determine the numerical value of an expressions using substitution.**	
RESOURCES:	DBE Workbook, Sasol-Inzalo book, Textbooks,
ONLINE RESOURCES	Please look for the videos in the lessons indicated by the icon:

DAY 1: ACTIVITY 1:

DAY 1: Revision:

NOTE TO LEARNER:

1. In grade 7 you learnt about variables and constants as well as formulae and equations and how to identify them
We will revise these concepts and build on them.

- **<u>1. Let's look at algebraic expressions:</u>**
- **What is an expression?**
- An algebraic expression is a symbolic description of a set of calculations that can be performed on different values of a variable.
- Remember this does not have an equal sign (=)

- **What is a term?**
- A term is a part of an algebraic expression.
- Terms are separated ONLY by + or –
- If an expression has **one term** it is called a **monomial**.
- If an expression has **two terms** it is called a **binomial.**
- If an expression has **three terms** it is called a **trinomial**.
- If it has **more than two terms** it can also be called a **polynomial**.

Examples:

To help you understand these examples the terms have been circled after every solution. Remember to do this too in a test / exam.

Algebraic expression:	**Number of terms:**
$3x^2 + 2x - 3$	3 terms (trinomial) $3x^2 + 2x - 3$
$x + y$	2 terms (binomial) $x + y$
$(x + y)$	1 term (Monomial) *The bracket makes it one term*
$\frac{2x + y}{xy}$	1 term (monomial) When it is in a fraction form it becomes one term only.
$(2x - 3y) + (-2x + 5)$	2 terms (binomial) $(2x - 3y) + (-2x + 5)$

What other important words do I need to know regarding algebraic expressions?

Term:	**Explanation:**	**Example:**
Variable	Letters of the alphabet which could represent different values.	$3ab + 3a - 3b$ Variables: ab, a, b
Constant	A number making up a term on its own in an expression. A constant value can therefore not change	$7a + 4$ Constant: 4
Coefficient	The number that can be found in front of a variable (the sign to its left goes with it)	$6a - 4b$ Coefficient of a: 6

	The coefficient is therefore multiplied with that variable when performing calculations.	*Coefficient of* b: -4
Exponent	This will be the number or variable (letter) written at the top (to the power of)	$4b^3$ *Exponent of* b: 3 *Exponent of* 4: 1
Like terms	Terms that have the same variables. The variables therefore also need to have the same exponents. These terms can be added together or subtracted from one another.	$4a^2 + 2a - 2a^2 + 3$ *Like terms:* $4a^2$ *and* $2a^2$ *(because they are like terms, we can add them together* $4a^2$ *and* $2a^2 = 6a^2$*)*
Unlike terms	Terms that do not have the same variables. They can therefore not be added or subtracted.	$4a^2 + 2a - 2b + 3$ *Unlike terms: all the terms in this example.*

Example:

Identify all the terms in the table above from the algebraic expression below.

$$-3a^2 + 4ab + 5$$

Variables: a^2 and ab

Constant: 5

Coefficient of: $a^2 = -3$

$ab = 4$

Exponent of a in the first term= 2

CLASSWORK:

Work through the exercise. Only consult the answers at the end of the lesson, once you have completed the exercise:

1. Use the algebraic expression below to answer the questions that follow:

$$5b^6 + 20m^3 - 4a^8 - 7$$

a) How many terms are there in this expression? ***4***
b) Identify the constant. ***-7***
c) What is the exponent of m? ***3***
d) what is the coefficient of a^8? ***-4***
e) are there any like terms? If so, write them down. ***no***

2. Use the algebraic expression below to answer the questions that follow:

$$(5x^4 + 3x^4) + (10m^3 - 4m)$$

a) How many terms are in this expression? ***2***

b) Identify die variables. x^4, m^3 *and* m

c) What is the coefficient of m? ***-4***

d) What is the exponent of x? ***4***

CONSOLIDATION

IT IS IMPORTANT TO REMEMBER:

- **Only a + or – separates terms in an algebraic expression.**
- **It is helpful to circle all terms in an expression and then count them.**
- **You need to know the definitions of all the parts of an algebraic expression to be able to answer question on them.**

HOMEWORK:

Do the following exercises,applying what you have learnt today. FIRST ATTEMPT TO DO ALL YOUR HOMEWORK BEFORE YOU CHECK YOUR ANSWERS IN THE MEMORANDUM.

1. Use the algebraic expression below to answer the questions that follow:

$$10ab^5 \times 7c - 3m^3$$

a) How many terms are in this expression?

b) Identify die variables.

c) what is the coefficient of ab^5?

d) What is the exponent of m?

2. . Use the algebraic expression below to answer the questions that follow:

$$3y^2 - 6 + 7y^3 - y$$

a) How many terms are in this expression?

b) What is the coefficient of y?

c) What is the constant term?

d) Are there any like terms? If so, write them down.

DAY 2:

LESSON DEVELOPMENT

CLASSWORK:

WORKING WITH ALGEBRAIC EXPRESSIONS:

1. **ALGEBRAIC EXPRESSIONS CAN BE REPRESENTED IN THREE DIFFERENT FORMS AND WE NEED TO BE ABLE TO USE ALL THREE.**
2. **WE NEED TO BE ABLE TO WRITE IN ALGEBRAIC LANGUAGE.**
3. **WE NEED TO BE ABLE TO ADD & SUBTRACT LIKE TERMS.**

The three forms are:

1. Words
2. Flow diagrams
3. Expressions.

Remember that an expression is basically a set of calculation instructions.

1. REPRESENTATIONS OF ALGEBRAIC EXPRESSIONS:

The table below has been completed for you to indicate three types of representations. (Cover two of the three and try to get the same answer as in the table)

Words:	Flow diagram:	Expression:
Multiply a number by three and add eight to the answer	→ x 3 → +8 →	$3 \times x + 8$
Add six to a number and then multiply the answer by three	→ +6 → x 3 →	$3 \times (x + 6)$
Multiply a number by two and subtract four from the answer	→ x 2 → - 4 →	$2 \times x - 4$
Subtract four from a number and multiply the answer by two	→ - 4 → x 2 →	$2 \times (x - 4)$

Remember:

- The flow diagram indicates to you the order in which the steps will need to be done.
- In the expression the part "a number" is replaced by a variable (letter) in this case it was x.

2. WRITING IN ALGEBRAIC LANGUAGE:

If we have:

$3 \times x$ we write it as $3x$
$1 \times a$ we write it as a
$-2 \times c$ we write it as $-2c$
$a \times p$ we write it as ap
$2 \times b + a$ we write as $2b + a$

(when you need to evaluate or perform calculations with an expression It is still important that you remember $3x$ means $3 \times x$ and the value of x will be provided.

BODMAS, in the case of simplifying an expression, the bracket will need to be done first, and then the rest.

When we write the expression we need to make sure that we write the **constant** last (at the back)

Examples:

Write the following algebraic expressions using standard algebraic language:

(Try to complete these using the information above and then check your answers after you have completed the example.)

1. $3 + 5 \times a$	2. $4 \times b + 1 \times c + 2$	3. $6\,a \times b - 1$	4. $a \times -b + 3$

Answers:

1) $5a + 3$ 2) $4b + c + 2$ 3) $6ab - 1$ 4) $-ab + 3$

3. WORKING WITH LIKE TERMS:

We will need to start performing calculations with like terms.

Remember that in a like term the **variable** must be the same as well as the **exponent** (power).

Let's look at some examples:

$\mathbf{4b + 3b}$ are like terms

$\mathbf{4b^2 + 3b}$ are unlike terms

$\mathbf{4b + 3}$ are unlike terms

Try and figure out why example 2 and 3 are unlike terms.

Remember:

In Lesson 1 we said that **like terms** can be **added together or subtracted** from each other, in other words we can simplify that expression.

You need to make sure that your variable and exponent does not change in this case.

Let's look at some examples:

1) $4c + 6\,c = 10c$

2) $4c^2 + 6c^2 = 10c^2$

3) $5\,m + 3\,m - 2\,m = 6\,m$

4) $4m^2 - 2m^2 + 4m = 2m^2 + 4m$

Let's practice: (try completing all of these before you look at the answers)

Simplify the following expressions:

1. $4a + 3b - 2a - b$	2. $7a^2 + 3a + 9c + c$	3. $8m^3 + 6n - 3m^3 + 8\,n$
4. $4p^2 + 8p^4 + 2p$	5. $25\,a - 30b + 3\,a - 3b$	6. $4\,y^2 + 8\,y^4 + 4\,y^2 - 4y^4$

Answers:

1. $2a + 2b$	2. $7a^2 + 3a + 10c$	3. $5m^3 + 14n$
4. $4p^2 + 8p^4 + 2p$	5. $28\,a - 33b$	6. $8\,y^2 + 4y^4$

CONSOLIDATION

IT IS IMPORTANT TO REMEMBER:

- That we need to be able to use any of the three representations of expressions, and that we need to be able to perform calculations with all three.
- We need to be able to write and understand algebraic language, but also understand what it means.
- We need to be able to identify and perform calculations with like terms.

HOMEWORK:

Do the following exercises, applying what you have learnt today. FIRST ATTEMPT TO DO ALL YOUR HOMEWORK BEFORE YOU CHECK YOUR ANSWERS IN THE MEMORANDUM.

1. Complete the missing columns in the table below:

Words:	***Flow diagram:***	***Expression: (use x as variable)***
Add six to number and then multiply the answer by two		$2 \times (x + 6)$
Multiply a number by three and then subtract two from the answer	→ x 3 → -2 →	
	→ -7 → x 9 →	
		$3x + 4$

2. Simplify the following expressions as far as possible, and write the answer in correct algebraic language.

a) $3 \times b + 2$	b) $7k + 4m^2 - 2k + 10m^2$	c) $15\,p^4 + 9\,p^2 - 3p^3 + 4p^2$
d) $40m - 22n + 3m - 10\,n$	e) $40f^6 + 22\,f^5 - 13f^6$	f) $4\,d + 3a^2 + d - a^2$

DAY 3:

LESSON DEVELOPMENT

CLASSWORK:

WORKING WITH ALGEBRAIC EXPRESSIONS.

You need to be able to:

1. **Evaluate Expressions.**
2. **Identify equivalent expressions.**
3. **Use properties of expressions:**
   a) the commutative property of expressions
   b) associative property of expressions

Remember:
To use BODMAS
That $6x$ means $6 \times x$

Let's look at what these mean (definitions and examples)

1. Evaluating expressions:

When we evaluate expressions, we chose or we are given a value of the variable in the expression.
When you have this value, you can now perform the calculations in the expression.
When we use a value for a variable, we call it substitution.

Example:

Calculate the numerical values of the expressions for the values provided for x:		
Expression:	$x = 2$	$x = 10$
$6x$	*6× 2 = 12*	*6(10) = 60* *Or 6 x 10 = 60*
$3x + 4$	*3 x 2 +4* *6 +4 = 10*	*3 x 10 + 4* *30 +4 = 34*
$2x + 3x + 2$	*2 x 2 + 3 x 2 + 2* *4 + 6 +2= 12*	*2 x 10 + 3 x10 + 2* *20 + 30 +2 = 52*

Now try:

Complete the table first before looking at the solutions:

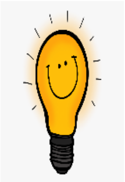
Calculate the numerical values of the expressions for the values provided for b:		
Expression:	$b = 4$	$b = 7$
$7b$		
$9b - 2$		
$5b + 4b - 2$		

Solutions:

Expression:	$b = 4$	$b = 7$
$7b$	*7 x 4 = 28*	*7x 7 = 49*
$9b - 2$	*9 x4 -2 = 34*	*9x 7 – 2 = 61*
$5b + 4b - 2$	*5x 4 + 4 x 4 -2 = 34*	*5 x7 + 4 x 7 -2 = 61*

2. Equivalent Expressions:

Equivalent expressions are algebraic expressions that have the same numerical value(answer) for the same value of x , but they look different.
We normally find them by rearranging and combining like terms.



Did you notice?

In the example above you got the same answer for the expressions:
$9b-2$ and $5b+4b-2$ for both values of b?
If you look at the expressions carefully you will see that $5b+4b$ are like terms and can therefore be added together to give you $9b$. The constant in the expressions was -2 and that stays the same. So that means those two expressions were examples of equivalent expressions.

Example:

Are the following expressions equivalent?
Cover the solution and write your answer down. Then check your answer to see if you got it right.

Expression 1:	Expression 2:	Solution:
$8a+2$	$5a+3a+2$	Yes, because if you simplify $5a+3a\ you\ get=8a$. The constant (+2) was also the same in both expressions.
$4b-2b$	$4b-2$	No, because the terms 2b and 2 are not like terms.
$5c$	$c+c+c+c+c$	Yes, if you add all the terms in **Expression 2** together, you also get 5c
$3x^2+2x^2$	$5x^4$	No, because the terms are not like terms. If **Expression 1** was to be simplified the answer would have been $3x^2+2x^2=5x^2$

3. Properties of expressions:

a) Commutative property:

*This means that no matter the order in which we **add or multiply** numbers, our answer will remain the same.*

Example:	***Using values:***	***Using algebra:***
e.g 1:	$5+2=2+5$	$a+b=b+a$
e.g 2	$2\times 3=3\times 2$	$ab=ba$

Remember to use a pencil or colour to help you group like terms

b) Associative property:

This is applicable to three or more numbers.
This mean that the order in which we group three or more numbers when we add or multiply them, will not change the answer.

Example:	***Using values:***	***Using algebra:***
e.g 1:	$(2+3)+4=2+(3+4)$	$(a+b)+c=a+(b+c$
e.g 2	$(2\times 3)4=2(3\times 4)$	$(ab)c=a(bc)$

These properties are therefore useful when we need to simplify expressions. When we use them we can rearrange and combine like terms.

Examples:

Simplify the following expressions using the properties above:

Expression:	Solution:
$6t+5+4t-2$	$6t+4t+5-2$ $=10t+3$
$5ab+3ba-2ab+4$	$5ab+3ab-2ab+4$

	$= 6ab + 4$
$9p^3 + 4p^2 - p + 2p^2 + 2p - 5p^3$	$9p^3 - 5p^3 + 4p^2 + 2p^2 + 2p - p$ $= 4p^3 + 6p^2 + p$
$20\,k + 14\,f + k - 17\,f + 4$	$20\,k + k + 14f - 17\,f + 4$ +4 $=21\,k - 3f + 4$
$3c + 2c - 5c + 2$	$3c + 2c - 5c + 2$ $= 0 + 2$ $= 2$
Add the following expressions together: $-h + 2p - 4$ and $- 5h + p - 6$	$-h - 5h + 2p + p - 4 - 6$ $= -6h + 3p - 10$

Why is this important?

- When we simplify algebraic expressions, it makes it easier for us to work with.
- It often reduces the number of calculations that must be done and reduces the odds of you making mistakes.

CONSOLIDATION

IT IS IMPORTANT TO REMEMBER:

- **That only like terms can be added together or subtracted from each other.**
- **That we can use the concept of evaluating expressions to check our answers.**
- **That we can minimise the chances of making mistakes by simplifying expressions.**
- **That the properties of expressions are useful when we simplify expressions.**

HOMEWORK:

Do the following exercises, applying what you have learnt today. FIRST ATTEMPT TO DO ALL YOUR HOMEWORK BEFORE YOU CHECK YOUR ANSWERS IN THE MEMORANDUM.

1. Consider the expressions: $3x + 2z + y$ and $6xyz$
a) What is the value of $3x + 2z + y$ for : $x = 4, y = 7$ and $z = 10$
b) What is the value of $6xyz$ for $= x = 4 \;\; y = 7$ and $z = 10$
c) Are these two expressions equivalent? Explain your answer.

2. Write down an equivalent expression for each of the following expressions:

a) $4m + 7\,m - 5\,m - m$ b) $3x^2 + 5x^2$
c) $9ab - 3c + 8ba + c$ d) $7f + f + f - 3$

3. Choose the correct answer:
The sum of $6x^2 - x + 4$ and $x^2 - 5$ is:

A) $7x^2 - x + 9$ B) $7x^2 - x - 1$ C) $6x^4 - x - 9$ D) $7x^4 - x - 1$

4. John thinks that the expressions: $135\,x$ and $35x + 100$ are equivalent because for $x = 1$ both expressions have a numerical value of 135. Explain to John why these two expressions are NOT equivalent.

5. Explain why the terms: $8ems$, $-25sem$, $2mes$ and $13mse$ are **like terms**.

DAY 4:

LESSON DEVELOPMENT

CLASSWORK:

EXPANDING ALGEBRAIC EXPRESSIONS

1. Using the distributive property of expressions.
2. Product expressions.
3. Sum expressions
4. Expanding expressions

IT IS IMPORTANT TO NOTE THAT:

1. When we expand algebraic expressions, we use the distributive property of expressions. We therefore limit the number of calculations we perform.

- The distributive property means that:

	Using values:	Using algebra:
e.g 1	$5(3+2)$ $= 5 \times 3 + 5 \times 2$ $= 25$	$a(b+c)$ $= ab + ac$
e.g 2	$5(3-2)$ $=5 \times 3 - 5 \times 2$ 5	$a(b-c)$ $= ab - ac$

How does the distributive property work in algebra ?

Let's first look at the example above:

a(b + c) this gives us: $a \times b + a \times c$
$= ab + ac$

Let's look at a few more examples:

2 (f + 3) this gives us : $2 \times f + 2 \times 3$
$= 2f + 6$

7 (p - 2) this gives us : $7 \times p$ and 7×-2
$= 7p - 14$

-3(n -3) this gives us: $-3 \times n$ and -3×-3
$= -3n + 9$

Now remember you can be provided with any number for the variables.

- When we see ab it actual means a x b.
- BODMAS, always perform calculations in brackets first, or simplify them as far as possible.

- That a bracket means **multiplication** e.g: 2(3) = 2 x 3 = 6

Examples:
Work through the examples that demonstrate the above-mentioned distributive property:
Find the value for the following expressions if ***m* = 3**

	Expression:	*Solution*
1.	$2(m+3)$	$2(3+3)$ $=2(6)$ $=12$
2.	$2m+6$	$2(3)+6$ $6+6$ $=12$
3.	$4(m-2)$	$4(3-2)$ $4(1)$ $=4$
4.	$4m-8$	$4(3)-8$ $12-8$ $=4$

You will note that the answer of 1 & 2 and 3& 4 is the same.
This is because…
$\mathbf{2(m+3)}$ *can be expressed as* $\mathbf{2m+6}$
and $\mathbf{4(m-2)}$ *can be expressed as* $\mathbf{4m-8}$ *using the* ***distributive properties.***

This means those expressions are equivalent.

2. What is a product expression?

- *An expression can be called a product expression or product in short whenever the last step in evaluating the expression is to* ***MULTIPLY.***
- *We can also simplify a repetitive expression as a product expression, which will* ***abbreviate*** *it.*

Example:

e.g 1) $2+3+2+3+2+3+2+3+2+3$
$=5(2+3)$

e.g 2). $2a+3+2a+3+2a+3+2a+3+2a+3$
$=5(2a+3)$

3. What is a sum expression?

- *This can be found when we use the commutative property of expressions.*
- *We rearrange the terms into like terms and then we apply the short way of writing repeated addition.*

Example:

e.g 1). $2+3+2+3+2+3+2+3+2+3$
$=2+2+2+2+2+3+3+3+3+3$
$=(5\times 2)+(5\times 3)$

e.g 2). $2a+3+2a+3+2a+3+2a+3+2a+3$
$=2a+2a+2a+2a+2a+3+3+3+3+3$
$=(5\times 2a)+(5\times 3)$

4. What does it mean to expand an expression?

- *We expand an expression when we write a product expression as a sum expression.*
- *It can also be referred to as: multiplication of algebraic expressions.*

CONSOLIDATION

IT IS IMPORTANT TO REMEMBER:

- **How to use the distributive property of expressions.**
- **The how to substitute into an expression to find the value of the expression, and to follow BODMAS when substituting.**
- **You can expand expressions using product and sum expressions.**

HOMEWORK:

Do the following exercises, applying what you have learnt today. FIRST ATTEMPT TO DO ALL YOUR HOMEWORK BEFORE YOU CHECK YOUR ANSWERS IN THE MEMORANDUM.

1. Write an expression without brackets that will give the same results as the given expression:

a) $4(m+6)$ b) $b(b+2)$
c) $2(4n+3e)$ d) $2c(2c+3a+2)$
e) $b(c+e)$ f) $h^2(h-3)$

2. Write the following expressions as:
i) Product expressions and
ii) sum expressions:

a) $3n\ +5\ +\ 3n\ +5\ +\ 3n\ +5\ +\ 3n\ +5\ +\ 3n\ +5\ +\ 3n\ +5\ +\ 3n\ +5\ +\ 3n\ +5$
b) $4a\ -2b\ +\ 4a\ -2b\ +\ 4a\ -2b\ +\ 4a\ -2b$
c) $g\ +3\ +\ g\ +3\ +\ g\ +3\ +\ g\ +3\ +\ g\ +3\ +\ g\ +3\ +\ g\ +3\ +\ g\ +3$

3. Which of the expressions below are equivalent? Motivate your answer.

A) $4(m+3)$ B) $4m+3$
C) $4m+12$ D) $4+3m$

DAY 5:

LESSON DEVELOPMENT

CLASSWORK:

SIMPLIFYING ALEGEBRAIC EXPRESSIONS:

Remember:
$+ \times + = +$
$+ \times - = -$
$- \times + = -$
$- \times - = +$

You will need to

- **expand, rearrange, and combine (like)terms.**
- **Use the distributive principle to remove brackets.**
- **Remember to multiple the coefficient with all the terms.**
- **Remember to multiply with the coefficient and its sign (+ or -)**
- **Remember to check your answer by evaluating your expressions.**
- **Remember that $2\ (a)$ or $2a$ means $2 \times a$**

Let us look at some examples:

Write the shortest possible equivalent expression without brackets:

e.g 1: $2+3\ (m+4)$

$= 2 + 3m + 12$
$= 3m + 14$

Remember that we can still use the commutative and associative properties of expressions we learnt in lesson 3

e.g 2: $3\ (\ 4e - 2) + 5e$

$= 12\,e - 6 + 5e$
$= 17e - 6$

e.g 3: $-4\ (\ 2b - 2) + 10\ b - 10$

$= 8b + 8 + 10\ b - 10$
$= (8\ b + 10\ b\ )$

e.g 4 : $4\ -2\ (\ 3 - m)$

$=4 - 6 + 2m$

Checking your answers:

- *Remember it is useful to check if you simplified expressions correctly by **evaluating** your expressions.*
- *This means you are going to choose a value (preferably not 1) that you will substitute your variables with.*

Examples:

e.g 1 : Use the algebraic expression below to answer the questions that follow:

$3\ (\ p+2) + 5\ (\ 2p + 2)$

a) Simplify the expression.

$3\,(p+2)+5\,(2p+2)$

$= 3p + 6 + 10p + 10$

$= 13p + 16$

b) Evaluate the **original and simplified** expression for **p = 3.**

Original: $3\,(p+2)+5\,(2p+2)$

$= 3\,(3+2)+5\,(2(3)+2)$

$= 3\,(3+2)+5\,(6+2)$

$= 3(5)+5\,(8)$

$= 15 + 40$

$= 55$

Simplified: $13p + 16$

$= 13\,(3) + 16$

$= 39 + 16$

$= 55$

Note that:

- **the number of calculations for the simplified expression is much less.**
- **We obtained the SAME answer for both of these expressions, that means we simplified the original expression correctly.**

e.g 2 : Use the algebraic expression below to answer the questions that follow:

$$3m\,(m+4)-(4m+3)$$

a) Simplify the expression.

$$3m\,(m+4)-(4m+3)$$

$$= 3m^2+12m-4m-3$$

$$= 3m^2+8m-3$$

Remember that – in front of a bracket means $-\mathbf{1}$

b) Evaluate the original and simplified expression for **m= 2.**

Original: $3m\,(m+4)-(4m+3)$

$= 3(2)(2+4)-1[(4(2)+3]$

$= 6(6) - 1(11)$

$= 36 - 11$

$= 25$

Simplified: $3m^2+8m-3$

$= 3(2)^2 + 8\,(2)-3$

$= 3\,(4) + 8(2)-3$

$= 12 + 16 - 3$

$= 25$

CONSOLIDATION

IT IS IMPORTANT TO REMEMBER:

- **To use the distributive, commutative and associative properties of expressions when you simplify them**
- **That you need to be able to evaluate your expressions by substituting the variables with numbers.**
- **That you remember to make use of BODMAS when performing calculations.**

- **That you revise how to add and multiply with negative values.**

HOMEWORK:

Do the following exercises, applying what you have learnt today. FIRST ATTEMPT TO DO ALL YOUR HOMEWORK BEFORE YOU CHECK YOUR ANSWERS

1 .Write the expressions without brackets. **Do not simplify**:

a) $3x - (2y + z)$ b) $12m(4 - m)$ c) $-2(ab - 3)$

2. Write **simplified equivalent expressions** for the expressions below:

a) $5(c + 5) + 3(2c + 3)$ b) $22m + (14m - 8)$ c) $14f - (10f + 4g - 3)$

3. **Evaluate** the expressions below for $\boldsymbol{p = -2}$

a) $p + 2(p - 3)$ b) $(6 + p)^2$ c) $4(p + 3) + 2(p + 8)$

4. **Simplify:**

a) $3(y^2 + 2) - 2y - 6$ b) $-4(m^2 + 2m - 3) + 5m^2$

DAY 6:

LESSON DEVELOPMENT

CLASSWORK:

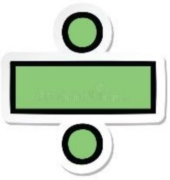
How to simplify quotient expressions.


What is a quotient expression?

It is when you have an algebraic expression, and the last step in evaluating is **DIVISION**.

This is often written as an **algebraic fraction.**

> **Remember the rules of exponents:**
> $$\frac{a^5}{a^2} = a^{5-2}$$
> $$= a^3$$



What property do we use?

When we divide an expression by a single term we use the distributive property.

How does it work?

> **Remember you still need to divide coefficients (and subtract exponents, if the base is the same)**

e.g 1: $\frac{8a^2+3a}{a} = \frac{8a^2}{a} + \frac{3a}{a}$

$= 8a + 3$

e.g 2: $\frac{12b^2+6b}{2b} = \frac{12b^2}{2b} + \frac{6b}{2b}$

$= 6b + 3$

> Remember the rules for negative values:
> $- \div - = +$
> $- \div + = -$

e.g 3: $\frac{-9c^2-3c}{3c} = \frac{-9c^2}{3c} + \frac{-3c}{3c}$

$= -3c - 1$

e.g 4: $\frac{-8d^4+2d}{4d} = \frac{-8d^4}{4d} + \frac{2d}{4d}$

$= -2d^3 + \frac{1}{2}$

> Remember that $\frac{2}{4} = \frac{1}{2}$ when we simplify

e.g 5: $\frac{5b^2+3b}{b^2} = \frac{5b^2}{b^2} + \frac{3b}{b^2}$

$= 5 + \frac{3}{b}$

> Remember that sometimes you are left with a quotient in your answer.

e.g 6: $\frac{3a^2+6a^2-3a^3}{-3a}$

$= \frac{9a^2-3a^3}{-3a} = \frac{9a^2}{-3a} + \frac{-3a^3}{-3a}$

$= -3a + a^2$

> Remember to simplify like terms FIRST if there are any.

e.g 7: $\frac{4k+3k+k}{0}$ = undefined

Remember!

The rules when we work with **negative values.**

That we cannot **divide by zero.** This answer is always: **undefined.**

That you can be asked to **evaluate** expressions by using numbers for variables (we practiced this in the previous lesson).

HOMEWORK:

Do the following exercises, applying what you have learnt today. FIRST ATTEMPT TO DO ALL YOUR HOMEWORK BEFORE YOU CHECK YOUR ANSWERS.

1. Evaluate the following expressions for i) **a = 0** and ii) **a = 4**

a) $2 + a$

b) $\frac{20a+10a^2}{10a}$

2. For the expressions found in **question 1**:

a) Which expression had less calculations?

b) Can we say these expressions are equivalent $a = 0$ excluded?

3. Simplify each fraction below:

a) $\frac{10\,b+6c+4}{2}$ b) $\frac{21ab-14a^2}{7a}$ c) $\frac{-20\,b^2+10}{-5b}$

4. Evaluate :

a) $\frac{3h+6}{h}$ for $h = 3$ b) $\frac{4x^2+8x+4}{2x}$ for $x = 2$

5. Cindy was asked to evaluate $\frac{4x^2+2x+2}{2x}$ for $x = 5$

She did the following calculation: $\frac{4x^2+2x+2}{2x} = 4x + x + 2$

= 4(5) + 5 + 2

= 27 .

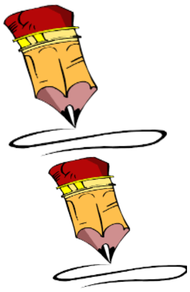
Show through your own calculations if her calculations are accurate.

DAY 7:

LESSON DEVELOPMENT

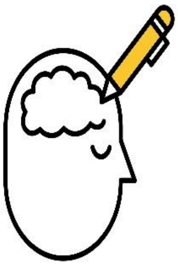
CLASSWORK:

SIMPLIFYING SQUARES AND CUBES



Let's revise the concept of a **square** and a **cube.**
A **square** is any number or factor multiplied by itself **twice.**
e.g : $2^2 = 2 \times 2$
$a^2 = a \times a$
A **cube** is any number or factor multiplied by itself **three** times
e.g : $2^3 = 2 \times 2 \times 2$
$a^3 = a \times a \times a$

Remember that when we **multiply,** we use the **commutative** property of expressions.
This means that ***a* x *b* = *b* x *a***



Remember that when we simplify squares and cubes we can use the **laws of exponents.**

$$(a^m)^n = a^{m\times n}$$
$$(2^2)^3 = 2^{2\times 3}$$
$$= 2^6$$
$$= 64$$

Or the product rule:

$$a^m \times a^n = a^{m+n}$$
$$2^2 \times 2^3 = 2^{2+3}$$
$$= 2^5$$
$$= 32$$

Remember the rules of multiplication, especially when we work with **negative** values:

$$- \times - = +$$
$$- \times + = -$$

Remember to square or cube **all factors.**
Remember to always **evaluate** your answer, by checking the answer for at least two or three numbers for the variable.
Remember that **coefficients** are multiplied using **integer** rules and **variables** using **exponent** rules.

Let's try some examples:

Cover the solution and try the question first. Then check your answer.

	Simplify:	Solution	Alternative Solution
e.g 1	$(3b)^2$	$= 3b \times 3b$ $= 3 \times 3 \times b \times b$ $= 9b^2$	3^2b^2 $=9b^2$

e.g 2	$(2b^2)^2$	$= 2b^2 \times 2b^2$ $= 2 \times 2 \times b^2 \times b^2$ $= 4b^4$	$2^2b^{2\times2}$ $=4b^4$
e.g 3	$(3a + a + 5a)^2$	$= (9a)^2$ $= 9a \times 9a$ $= 81a^2$ Remember BODMAS – if you can add like terms in a bracket, do that first	9^2a^2 $=81a^2$
e.g 4	$(3b^2)^3$	$= 3b^2 \times 3b^2 \times 3b^2$ $= 3 \times 3 \times 3 \times b^2 \times b^2 \times b^2$ $= 27b^6$ Here you add the powers of the exponents: $b^2 \times b^2 \times b^2 = b^{2+2+2}$	$3^3b^{2\times3}$ $=27b^6$
e.g 5	$(2a^3)^3$	$= 2a^3 \times 2a^3 \times 2a^3$ $= 2 \times 2 \times 2 \times a^3 \times a^3 \times a^3$ $= 8a^9$	$2^3a^{3\times3}$ $=8a^9$
e.g 6	$(8a - 5a)^3$	$= (3a)^3$ $= 3a \times 3a \times 3a$ $= 3 \times 3 \times 3 \times a \times a \times a$ $= 27a^3$	$(3a)^3$ $= 3^3a^{1\times3}$ $=27a^3$
e.g 7	$(-k)^2$	$= -k \times -k$ $=k^2$	k^2
e.g 8	$(-3c)^2$	$=-3c \times -3c$ $= -3 \times -3 \times c \times c$ $=9c^2$	$-3^2c^{1\times2}$ $=9c^2$
e.g 9	$(-3c)^3$	$=-3c \times -3c \times -3c$ $= -3 \times -3 \times -3 \times c \times c \times c$ $=-27c^2$	$-3^3c^{1\times3}$ $=-27c^3$

HOMEWORK:

Do the following exercises, applying what you have learnt today. FIRST ATTEMPT TO DO ALL YOUR HOMEWORK BEFORE YOU CHECK YOUR ANSWERS IN THE MEMORANDUM.

1. **Simplify:**

a)	$(4b)^2$	**b)**	$(-5a^3)^2$	**c)**	$(6a + a + a)^2$
d)	$(c^2)^2$	**e)**	$(-3m)^3$	**f)**	$(2a^4)^3$

g)	$(10a + 4a - 9a)^3$	**h)**	$(2a)^2 + (-3a)^3$	**i)**	$(3m^2 + 2m^2)^2$

DAY 8:

LESSON DEVELOPMENT

CLASSWORK:

SIMPLIFYING ROOTS OF EXPRESSIONS:

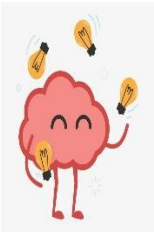
Remember that when we try to simplify a root (**square root** or **cube root**)

We need to find a number multiplied by itself that is equal to the value in the root sign. The number we multiplied by itself is therefore the root.

e.g1 : $\sqrt{\mathbf{16}} = \sqrt{\mathbf{4} \times \mathbf{4}} = \mathbf{4}$ (because 4 x 4 = 16)

e.g 2: $\sqrt[3]{\mathbf{8}} = \sqrt[3]{\mathbf{2} \times \mathbf{2} \times \mathbf{2}} = \mathbf{2}$ (because 2 x 2 x 2 = 8)

$\sqrt{} = square\ root$
$\sqrt[3]{} = cube\ root$



Now we need to remember that we are busy with **algebraic expressions** so we will need to remember the rules of exponents and how to work with them:

Let's look at the product rule again: $\boldsymbol{a^m} \times \boldsymbol{a^n} = \boldsymbol{a^{m+n}}$

e.g 1: $2^2 \times 2^3$
$= 2^{2+3}$
$= 2^5$

e.g 2: $a^5 \times a^5$
$= a^{5+5}$
$= a^{10}$

Let's look at some **basic** examples using **exponents.**

e.g 1: $\sqrt{4a \times 4a} = 4a$

e.g 2: $\sqrt{6c^2 \times 6c^2} = 6c^2$

Let's look at some more examples:

Always check if there are LIKE terms in the root:

e.g 1: $\sqrt{25\,a^2 - 16a^2}$

$= \sqrt{9a^2}$

$= \sqrt{3a \times 3a}$

$= 3a$

e.g 2: $\sqrt[3]{30a^3 - 3a^3}$

$= \sqrt[3]{27a^3}$

$= \sqrt[3]{3a \times 3a \times 3a}$

$= 3a$

If the terms are like terms you can simplify them by **ADDING or SUBTRACTING them.**

What happens when there are no LIKE terms?

e.g $\sqrt{25a^3 - 16b^2}$

Unless we know the values of $\boldsymbol{a}$ and $\boldsymbol{b}$ we cannot simplify the root.

HOMEWORK:

Do the following exercises, applying what you have learnt today. FIRST ATTEMPT TO DO ALL YOUR HOMEWORK BEFORE YOU CHECK YOUR ANSWERS IN THE MEMORANDUM.

1. **DETERMINE THE FOLLOWING:**

a)	$\sqrt{144x^2}$	b)	$\sqrt[3]{216t^3}$
c)	$\sqrt{85e^2 + 28e^2 + 8e^2}$	d)	$\sqrt[3]{68h^3 - 4h^3}$
e)	$\sqrt{k^{14}}$	f)	$\sqrt[3]{p^{15}}$
g)	$\sqrt{225m^8}$	h)	$\sqrt[3]{512c^9}$

DAY 9&10:

LESSON DEVELOPMENT

CLASSWORK:

Multiplying and dividing integers &monomials with monomials, binomials and trinomials:

In this lesson we are going to combine all the work you learnt in the previous lessons to simplify algebraic expressions.

Let's recap some of the important information you will need in this lesson:

When we multiply or divide **integers** we use normal integer rules (numbers)

e.g: $6 \div 2 = 3$

e.g $4 \times 3 = 12$

When we multiply or divide **exponents** we use the laws of exponents:

$$(a^m)^n = a^{m \times n}$$

$$(ab)^n = a^n b^n$$

$$a^n \times a^m = a^{n+m}$$

$$\frac{a^5}{a^2} = a^{5-2}$$

$- \times - = +$
$- \times + = -$
$+ \times - = -$
$+ \times + = +$

$- \div - = +$
$- \div + = -$
$+ \div - = -$
$+ \div + = +$

Remember:

A negative value raised to an **EVEN** power will be **POSITIVE.**

A negative value raised to an **ODD** power will be **NEGATIVE**.

- To use the rules of BODMAS.
- To check if there are any like terms you can subtract or add.
- To use the correct value when you multiply into a bracket (see lesson 5)

Now remember to follow these steps:

<u>How shall we approach these?</u>

1. Decide on the sign (+ or -)

2. Raise the coefficient to the power (using integer rules).

3. Raise the variable to the power using exponent rules.

4. Find final answer.

Let's look at some examples:

Multiplying monomials by monomials:

e.g 1: $-4a \times 2a = -8a^2$

Dividing monomials by monomials:

e.g 1: $\frac{-9a^3b^2}{-3ab} = 3a^2b$

Multiplying polynomials by monomials:

e.g 1: $4c(c+d) - 3(f^2 - 2d)$

$=4c^2 + 4cd - 3f^2 + 6d$

e.g 2: $a + 2(a - 4b) + 2d(d + 4d)$

$= a + 2(a - 4b) + 2d(5d)$

$=a + 2a - 8b + 10d^2$

$=3a - 8b + 10d^2$

Dividing polynomials by monomials:

e.g 1: $\frac{6a^2-4a-8}{2a} = \frac{6a^2}{2a} - \frac{4a}{2a} - \frac{8}{2a}$

$= 3a - 2 - \frac{4}{a}$

e.g 2: $\frac{10b+6}{2} + \frac{14b-21}{7} = \frac{10b}{2} + \frac{6}{2} + \frac{14b}{7} - \frac{21}{7}$

$= 5b + 3 + 2b - 3$

$= 7b$

HOMEWORK:

Do the following exercises, applying what you have learnt in this unit. FIRST ATTEMPT TO DO ALL YOUR HOMEWORK BEFORE YOU CHECK YOUR ANSWERS IN THE MEMORANDUM.

1. Simplify the following:

a) $-3b \times -4b$

b) $\frac{18c^4d}{3c}$

c) $-2(5k - 2k) + 2 + 3b(b^2 - 4) + 10$

d) $\frac{10n - 4}{-2}$

e) $(-3a^2b^3)(-2ab^2)(2a^4b)$

f) $\frac{4x + 8}{2} + \frac{5x - 3}{5}$

g) $-x^3(-x + xy)$

h) $(\frac{12k^2 - 4k^2 + 6k}{2k}) + (\frac{4f - 2}{-2})$

i) $(-4a^2)^3$

j) $-(-2x^3)^2 + 3(2x^2)^3$

2. Use substitution to find the value of the following expressions:

a) $5a + 2b$
$if\ a = 3$ and $b = 2$

b) $3x - y + 2v$
$if\ x = -1\ y = -2\ and\ v = -3$

c) $4x^2 - y^3$
$if\ x = -1\ and\ y = 2$

d) $2p^2q + (qr)^2$
$if\ p = 2\ q = -2\ and\ r = 3$

HOMEWORK LESSON 1 – 10
ALGEBRAIC EXPRESSIONS MEMORANDUM

MEMORANDUM: DAY 1:

1 a) 2 b) ab^5, c, m^3 c) 10 d) 3

2 a) 4 b) -1 c) -6 d) no

MEMORANDUM: DAY 2:

1.

Words:	Flow diagram:	Expression: (use x as variable)
Add six to number and then multiply the answer by two	→ +6 → x 2 →	$2 \times (x + 6)$
Multiply a number by three and then subtract two from the answer	→ x 3 → -2 →	$3 \times x - 2$
Subtract seven from a number and multiply the answer by nine	→ -7 → x 9 →	$9 \times (x - 7)$
Multiply a number by three and add four to the answer	→ x 3 → + 4 →	$3x + 4$

2

a) $3b + 2$
b) $5k + 14m^2$
c) $15p^4 - 3p^3 + 13p^2$
d) $43m - 32n$
e) $27f^6 + 22f^5$
f) $5d + 2a^2$

MEMORANDUM: DAY 3:

1.

a) $3(4) + 2(10) + 7$
$3 \times 4 + 2 \times 10 + 7 = 39$

b) $6(4)(7)(10)$
$6 \times 4 \times 7 \times 10 = 1\ 680$

c) They are not, because they have different numerical values for the same values of x, y and z .

2.

a) $5m$ b) $8x^2$
c) $17ab - 2c$ d) $9f - 3$

3. B) $7x^2 - x - 1$

4.For them to be equivalent, they will need to have the same numerical values when the same value for x is substituted into both expressions. These expressions will not be equal for any value other than $x = 1$. Therefore, the expressions are not equivalent. *For example, if x = 2 is used you will get two different answers.*

5. All four terms have the same variables, raised to the same exponent.

MEMORANDUM: DAY 4

1.

a)	$4m + 24$	b)	$b^2 + 2b$
c)	$8n + 6e$	d)	$4c^2 + 6ac + 4c$
e)	$bc + be$	f)	$h^3 - 3h^2$

2.

	i)	ii)
a)	8(3n + 5)	(8 x 3n) + (8 x 5)
b)	4(4a -2b)	(4 x 4a) + (4 x -2b)
c)	8(g+3)	(8 x g) + (8 x 3)

3.

a and c.

If you use the distributive property of expressions you will see that these are equivalent, and that when substituting any number in m, you will have the same value for the expression.

MEMORANDUM: DAY 5:

1.

a) $3x - 2y - z$ b) $48m - 12m^2$ c) $-2ab + 6$

2.

a) $11c + 34$ b) $36m - 8$ c) $4f - 4g + 3$

3.

a) =-12 b)16 c) 16

4. Simplify:

a) $3y^2 - 2y$ b) $m^2 - 8m + 12$

MEMORANDUM: DAY 6:

1(a)

	i)	ii)
a)	2+ 0= 2	2 + 4 = 6
b)	$\frac{20(0) + 10(0)^2}{10(0)}$ = undefined	$\frac{20(4) + 10(4)^2}{10(4)}$ $= \frac{80+160}{40}$ $= \frac{240}{40}$ = 6

2a) Expression a

b) Yes, they had the same solution for a = 4

3.

a) $5b+3c+2$ b) $3b-2a$ c) $4b-\frac{2}{b}$

4.

a) $\frac{3(3)+6}{3}=\frac{9+6}{3}=5$

b) $\frac{4(2)^2+8(2)+4}{2(2)}=\frac{4(4)+16+4}{4}=\frac{36}{4}=9$

5.

$\frac{4x^2+2x+2}{2x}$ for $x=5$

Let's simplify: $2x+1+\frac{1}{x}$

$= 2(5) + 1 + \frac{1}{5}$

$= 11\frac{1}{5}$

MEMORANDUM: DAY 7:

a) $(4b)^2$
$= 4b \times 4b$
$= 4 \times 4 \times b \times b$
$= 16b^2$
Or: $4^2 b^{1\times2}$
$=16b^2$

b) $(-5a^3)^2$
$= -5a^3 \times -5a^3$
$= -5 \times -5 \times a^3 \times a^3$
$= 25a^6$
Or : $-5^2 a^{3\times2}$
$= 25a^6$

c) $(6a + a + a)^2$
$= (8a)^2$
$=8a \times 8a$
$= 64a^2$
Or : $8^2 a^{1\times2}$
$= 64a^2$

d) $(c^2)^2$
$=c^2 \times c^2$
$= c^4$
Or : $c^{2\times2}$
$= c^4$

e) $(-3m)^3$
$= -3m \times -3m \times -3m$
$= -27m^3$
Or: $-3^3 m^{1\times3}$
$= -27m^3$

f) $(2a^4)^3$
$= 2a^4 \times 2a^4 \times 2a^4$
$= 2 \times 2 \times 2 \times a^4 \times a^4 \times a^4$
$= 8a^{12}$
Or: $2^3 a^{4\times3}$
$= 8a^{12}$

g) $(10a + 4a - 9a)^3$
$= (5a)^3$
$= 5a \times 5a \times 5a$
$= 5 \times 5 \times 5 \times a \times a \times a$
$= 125a^3$

h) $(2a)^2 + (-3a)^3$
$= 2^2 a^{1\times2} + -3^3 a^{1\times3}$
$= 4a^2 - 27a^3$
$= -27a^3 + 4a^2$

i) $(3m^2 + 2m^2)^2$
$= (5m^2)^2$
$=5^2 m^{2\times2}$
$=25m^4$

MEMORANDUM: DAY 8:

a) $12x$

b) $6t$

c) $\sqrt{121e^2}$
$= 11e$

d) $\sqrt[3]{64h^3}$
$=4h$

e) k^7

f) p^5

g) $15m^4$

h) $8c^9$

MEMORANDUM: DAY 9&10:

1.

a) $12b^2$

b) $6c^3 + \frac{d}{3c}$

c) $-2(3k) + 2 + 3b(b^2 - 4) + 10$
$= -6k + 2 + 3b^3 - 12b + 10$
$= 3b^3 - 12b - 6k + 12$

d) $-5n + 2$

e) $= 12a^7b^6$

f) $\frac{4x+8}{2} + \frac{5x-3}{5}$
$2x + 4 + x - \frac{3}{5}$
$3x + 3\frac{2}{5}$ or $3x + \frac{17}{5}$

g) $x^4 - x^4y$

h) $\frac{8k^2+6k}{2k} + \frac{4f-2}{-2}$
$4k + 3 - 2f + 2$
$-2f + 4k + 5$

i) $-64a^6$

j) $-(-2x^3)^2 + 3(2x^2)^3$
$-(4x^6) + 3\,(8x^6)$
$= -4x^6 + 24x^6$
$= 20x^6$

2.

a) $5(3) + 2(2)$
$= 15 + 4$
$= 19$

b) $3(-1) - (-2) + 2(-3)$
$= -3 + 2 - 6$
$= -7$

c) $4(-1)^2 - (2)^3$
$= 4(1) - 8$
$= 4 - 8$
$= -4$

d) $2(2)^2(-2) + (-2 \times 3)^2$
$= 2(4)(-2) + (-6)^2$
$= -16 + 36$
$= 20$