Topic: SIMPLIFYING ALGEBRAIC EXPRESSIONS

Introduction

An *algebraic expression* is a mathematical phrase that can contain ordinary numbers, variables (like x or y) and operators (like add, subtract, multiply, and divide). In algebra, we use letters to stand for numbers. We need to be able to work with these letters by following a few simple rules

Outline:

- Collecting like terms
- Multiplying out brackets
- Simplifying algebraic expressions
- Factorising algebraic expressions

Video clip on: Simplifying Algebraic Expressions

https://www.youtube.com/watch?v=mw0QpaSriZw
https://www.youtube.com/watch?v=w8htNTIH32g

Collecting like terms

We can often simplify algebraic expressions by '**collecting like terms**'.

Look at the expression: $2x + 5y + x - 3y$.

There are four **terms** and $2x$, $5y$, x and $3y$.

Two of the terms involve x, and two involve y.

We can **re-order** the terms in the expression so that the x terms are together and the y terms are together:

Now we can combine the ***x*** terms and combine the ***y*** terms to get: $2x + x + 5y - 3y$

So, when simplified, becomes: $3x + 2y$

Example

Collect like terms and simplify this algebraic expression:

$a + 4b + 3a - 3b$

- Change the order to: $a + 3a + 4b - 3b$
- Simplify to: $4a + b$

Exercises1:

Now, have a go at simplifying the following:

Question 1: 5a + 4b - a + b

Question 2: 4x - y - x + 2x

Question 3: 3m + n - m + 4n - 2m

Question 4: 6a + 5b – 2a – b + 3a

Answers:

Q1: 4a + 5b

Q2: 5x – y

Q3: 5n

Q4: 7a + 4b

Multiplying out brackets (To remove brackets, we multiply them out).

Example:

Look at the expression: $4(y-5)$
This expression means everything inside the brackets is **multiplied by 4.**

$4(y - 5)$

$= 4y - 4 \times 5$

$= 4y - 20$

Therefore $4(y-5)$ becomes $4y-20$, when the brackets is removed.

Exercises 2:

Not try these questions:

Question1: Multiply out the brackets in: 5(3 + y)

Question 2: Multiply out the expression 2(6 – 4y)

Question 3: Remove the brackets from: 4(3w – 2y)

Question 4: Remove the brackets from: 9(3a + 6b)

Answers:

Q1: 15 + 5y

Q2: 12 – 8y

Q3: 12w – 8y

Q4: 27a + 54b

Simplifying algebraic expressions

Now we'll combine multiplying out brackets and collecting like terms, to simplify algebraic expressions.

Example 1: We want to simplify the expression: $5(a + b) - 2b$

$5(a + b) - 2b$

$= 5a + 5b - 2b$ (when the brackets are multiplied out)

$= 5a + 3b$ (when like terms are collected and combined)

Therefore,

$5(a + b) - 2b = 5a + 3b$

Example 2: Simplify: $3(x - 2y) + 4x$

We want to simplify it:

$= 3 \times x - 3 \times 2y + 4x$

$= 3x - 6y + 4x$

$= 3x + 4x - 6y$ *(collecting like terms)*

$= 7x - 6y$

Exercises 3:

Now try these questions:

Question 1: Simplify $2(x + 7) + 3x + 2$

Question 2: Simplify $4(2a + b) - 6a - b$

Questions 3: Simplify $2(m + 5) - 4 + m$

Question 4: Simplify $3(x + y) + 2(3x - y)$

Answers:

Q1: $5x + 16$

Q2: $2a - 3b$

Q3: $3m + 6$

Q4: $9x + y$

Factorising algebraic expressions

The largest factor of the expression: $10 + 4x$, is 2 because 2 is the largest number that divides exactly into both 10 and $4x$.

$\frac{10}{2} = 5 \quad and \quad \frac{4x}{2} = 2x$

Therefore: $10 + 4x = 2(5 + 2x)$

We say that the expression $10 + 4x$ has been **factorised** (the factors being 2 and $5 + 2x$)

Example

Factorise 6a – 9

$\frac{6a}{3} = 2a \quad and \quad \frac{9}{3} = 3$

The largest number dividing 6a and 9 exactly is 3.

Therefore, $6a - 9$, becomes $3(2a - 3)$ when factorised.

Exercises 4:

Now try these questions:

Question1: Factorise: 15 + 10x

Question 2: Factorise: 3 – 12a

Question 3: Factorise 20y – 6

Question 4: Factorise 16 + 4m

Answers:

Q1: 5(3 + 2x)

Q2: 3(1 – 4a)

Q3: 2(10y – 3)

Q4: 4(4 + m)

Exercises 5:

Q1: Simplify the following expressions by collecting like terms:
(a) 2x + 3y + 4x (b) 9u – 2u + 6v
Q2: Multiply out the brackets:
(a) 6(3 + 2a) (b) 6(2m – 3)
Q3: Simplify the following:

Answers:

1. (a) 6x + 3y (b) 7u + 6v
2. (a) 18 + 12a (b)12m -18
3. (a) 4x – 8 (b) 6m + 6n
4. (a) 5(2x + 1) (b) 5(1 – 3y)

(a) 2(3x + 4) – 2x (b) 3m + 3(m +2n)

Q4: Factorise the following:

(a) 10x +5 (b) 5 – 15y