

# Mathematics, Grade 9, Factorisation

In algebra, expressions also have factors.

For example:

The factors of the expression

$$2x + 2y$$
 are 2 and  $(x + y)$ . We say,  $2x + 2y = 2(x + y)$ 

Also we say 
$$(2x + 2y) \div 2 = x + y (2x + 2y) \div (x + y) = 2$$

 Factorisation is like splitting a number or an expression into a product of simpler expressions.

## For example

Factor 4x + 20

Both 4x and 20 have a common factor of 4

4x is (4)(x)

20 is (4)(5)

So you can factor the whole expression into:

4x + 20 = 4(x+5)

So, 4x+20 has been "factored into" 4 and x+5.

Using the Distributive property let us change the expression from a product to a sum by finding the GCF and Polynomial Factor.

### For example,

- An expression such as 4m(x b) tells you to multiply 4m by x b.
- When you do that, you get the sum 4mx 4mb. When you do that in reverse, by writing 4mx – 4mb as the product of the two factors 4m by x – b, you are factoring.
- Factoring is simply the process of finding the factors of a given product.

- A Common Factor is a term that occurs as a factor in each of the expressions being added or subtracted.
- A common monomial factor is the product of the literal and numerical factor common to all terms of the polynomial.
- The Highest Common Factor is the highest among the common factors in each expressions being added or subtracted.

Now study the following examples of factorisation of algebraic expression.

#### Example 1

Factorize 8x<sup>2</sup> + 28x

Both 8 and 28 have a common factor of 4 and they also share a Solution:

variable x.

Together that makes 4x which is the HCF of 8x<sup>2</sup> and 28x.

So you can factor  $8x^2 + 28x$  by dividing by 4x

Therefore,  $8x^2 + 28x = 4x(2x + 7)$ 

#### Example 2

 $2x^2 - 6x^3 + 8x^4$ Factorize

 $2x^2 - 6x^3 + 8x^4$  has  $2x^2$  as a common factor. Solution:

 $2x^2 - 6x^3 + 8x^4 = 2x^2(1 - 3x + 4x^2)$  divide each term by HCF

Therefore, the factors of  $2x^2 - 6x^3 + 8x^4$  are  $2x^2$  and  $(1 - 3x + 4x^2)$ .

Check using the distributive law of multiplication.

$$2x^{2}(1-3 x + 4x^{2}) = 2x^{2}(1) - 2x^{2}(3x) + 2x^{2}(4x^{2})$$
$$= 2x^{2} - 6x^{3} + 8x^{4}$$

#### Rules

Take note of the following notes and shortcuts if they should arise in tests or exams

# **Special Products**

- $(x + y)(x y) = x^2 y^2$   $(x + y)^2 = x^2 + 2xy + y^2$   $(x y)^2 = x^2 2xy + y^2$   $(x + y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$   $(x y)^3 = x^3 3x^2y + 3xy^2 y^3$

# Factoring

• 
$$x^2 - y^2 = (x + y)(x - y)$$

• 
$$x^2 + 2xy + y^2 = (x + y)^2$$

• 
$$x^2 - 2xy + y^2 = (x - y)^2$$

• 
$$x^2 - y^2 = (x + y)(x - y)$$
  
•  $x^2 + 2xy + y^2 = (x + y)^2$   
•  $x^2 - 2xy + y^2 = (x - y)^2$   
•  $x^3 + y^3 = (x + y)(x^2 - xy + y^2)$   
•  $x^3 - y^3 = (x - y)(x^2 + xy + y^2)$ 

• 
$$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$$