Simplify expressions by collecting like terms

Simplify means answer in its simplest form.

If there are like terms in a mathematical expression, we must add (or subtract) them.

Like terms

like terms are algebraic terms with the same combination of variables.
This includes the exponents.

For example:

$(2x)$ and $(3x)$ are like terms because they have the variable (x) with the same power.

$(4x^2)$ and $(6x^2)$ are also like terms because they share the same variable and exponent.

However, $(2x)$and $(3y)$are not like terms (different letters), and $(4x^2)$and $(6x^4)$ are not like terms (different powers).

Example

Simplify the following expressions:

$a)\ 2a + 3b - a + 4b$

$b)\ (2a - a) + (3b + 4b)$

$c)\ 4x^2 + 3x - 2x^2 + 5x$

$d)\ 7m - 3n + 4m + 2n$

$a)$

$2a + 3b - a + 4b = a + 7b$

$b)$

$(2a - a) + (3b + 4b) = a + 7b$

$c)$

$4x^2 + 3x - 2x^2 + 5x = 2x^2 + 8x$

$d)$

$7m - 3n + 4m + 2n = 11m - n$

Distributive law

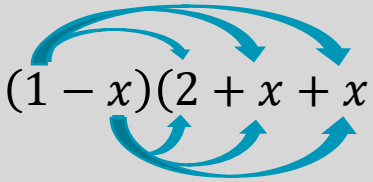
Distributive law: A term outside a bracket multiplies each of the terms inside the bracket.

Consider the following expressions,
we can **expand** the brackets using the distributive law :

$$2(3x + 5y) = 6x + 10y$$

$$3x(5 - 2x + x^2) = 15x - 6x^2 + 3x^3$$

Products two brackets:



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

We rewrite in descending order
(we add and subtract like terms)

Distributive law

Products of more than two brackets:

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

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

$$= 3x+2x^2-3x^2-2x^3+6+4x$$

We rewrite in descending order (we add and subtract like terms)

$$= -2x^3-x^2+7x+6$$

Example

Simplify the following expressions:

a) $2(5x - 1)$

b) $3x(2x - 4)$

a)

$2(5x - 1) = 10x - 2$

b)

$3x(2x - 4) = 6x^2 - 12x$

Example

Simplify the following expressions:

a) $5x(1-3x+4x^2)$ b) $-x(3x^2-2x+1)$

a)

$$5x(1-3x+4x^2) = 5x-15x^2+20x^3$$

b)

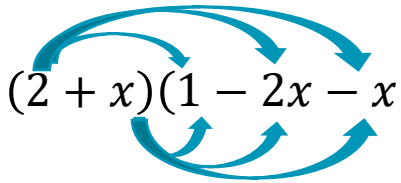
$$-x(3x^2-2x+1) = -3x^3+2x^2-x$$

Example

Simplify the following expressions:

a) $(2+x)(1-2x-x^2)$ b) $(2x-1)(x^2+3x-4)$

a)

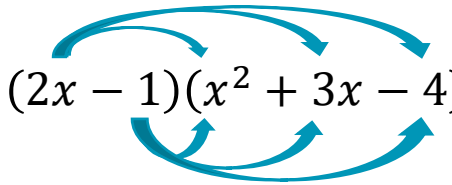


$(2+x)(1-2x-x^2) = 2\boxed{-4x}\boxed{-2x^2}\boxed{+x}\boxed{-2x^2}-x^3$

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

We rewrite in descending order (we add and subtract like terms)

b)



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

$= 2x^3 +5x^2 -11x + 4$

We rewrite in descending order (we add and subtract like terms)

Example

Simplify the following expression:

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

$$(2+x)(x-3)(1+3x) = (2x-6+x^2-3x)(1+3x) = (-x-6+x^2)(1+3x)$$

We rewrite in descending order
(we add and subtract like terms)

$$= -x-3x^2-6-18x+x^2+3x^3$$

$$= 3x^3-2x^2-19x-6$$

Perfect square expansion

Perfect squares expansion is a topic in Mathematics that involves expanding binomials raised to the power of 2. The perfect square formula for expanding binomials raised to power 2 is:

$$(x+y)^2 = (x+y)(x+y)$$

$$= x^2 + (x)(y) + (x)(y) + y^2$$

$$\boldsymbol{(x+y)^2 = (x)^2 + 2(x)(y) + (y)^2}$$

Square the first term

Add twice the product of the first and last terms.

Add on the square of the last term.

For example: $(3-2x)^2 = (3)^2 + 2(3)(-2x) + (-2x)^2$

$$= 9 - 12x + 4x^2$$

Example

Simplify the following expressions:

a) $(2+5x)^2$ b) $(2x^2-7x)^2$

a) $(2+5x)^2 = (2)^2 + 2(2)(5x) + (5x)^2$

$= 4 + 20x + 25x^2$

b) $(2x^2-7x)^2 = (2x^2)^2 + 2(2x^2)(-7x) + (-7x)^2$

$= 4x^4 - 28x^3 + 49x^2$

Difference between two squares

The difference between two squares is another topic in Mathematics that involves factorising an algebraic expression. The difference between two squares formula is:

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

$$= x^2 - y^2$$

$$\boldsymbol{(x-y)(x+y) = (x)^2 - (y)^2}$$

Square the first term

Minus

Square of the last term

For example: $(3x-5)(3x+5) = (3x)^2 - (5)^2$

$$= 9x^2 - 25$$

Example

Simplify the following expressions:

a) $(1-x)(1+x)$

b) $(\frac{2x}{3}+x^3)(\frac{2x}{3}-x^3)$

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

$= 1-x^2$

b) $\left(\frac{2x}{3}+x^3\right)\left(\frac{2x}{3}-x^3\right) = (\frac{2x}{3})^2-(x^3)^2$

$= \frac{4x^2}{9}-x^6$

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Simplify expressions by collecting like terms

and

Expansion

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