Algebraic expressions

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Objective : Multiplying algebraic expressions

Revision:

Multiply Exponents – Example Two

Simplify: $8a^5 \times 5a$

$= 8 \times a^5 \times 5 \times a^1$ (Group Numbers)

$= 8 \times 5 \times a^5 \times a^1$

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

$= 40 \times a^{5+1}$

$= 40a^6$ ✓

$$x^a \times x^b = x^{a+b}$$

Example 5 $(5x^3)(3x^5) = 15x^8$

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

Example 7 $(3x^2y^3z)(4x^4y^6)(x^3z) = 12x^9y^9z^2$

تذكّر : الأسس في حالة الضرب تجمع اذا كان لها نفس الأساس.

Multiplying Algebraic Expressions

Distributive Law

The **distributive law** for real numbers states that

$$a(b \pm c) = ab \pm ac$$

$$(a \pm b)c = ac \pm bc$$

for any real numbers a, b, and c.

Quick Example

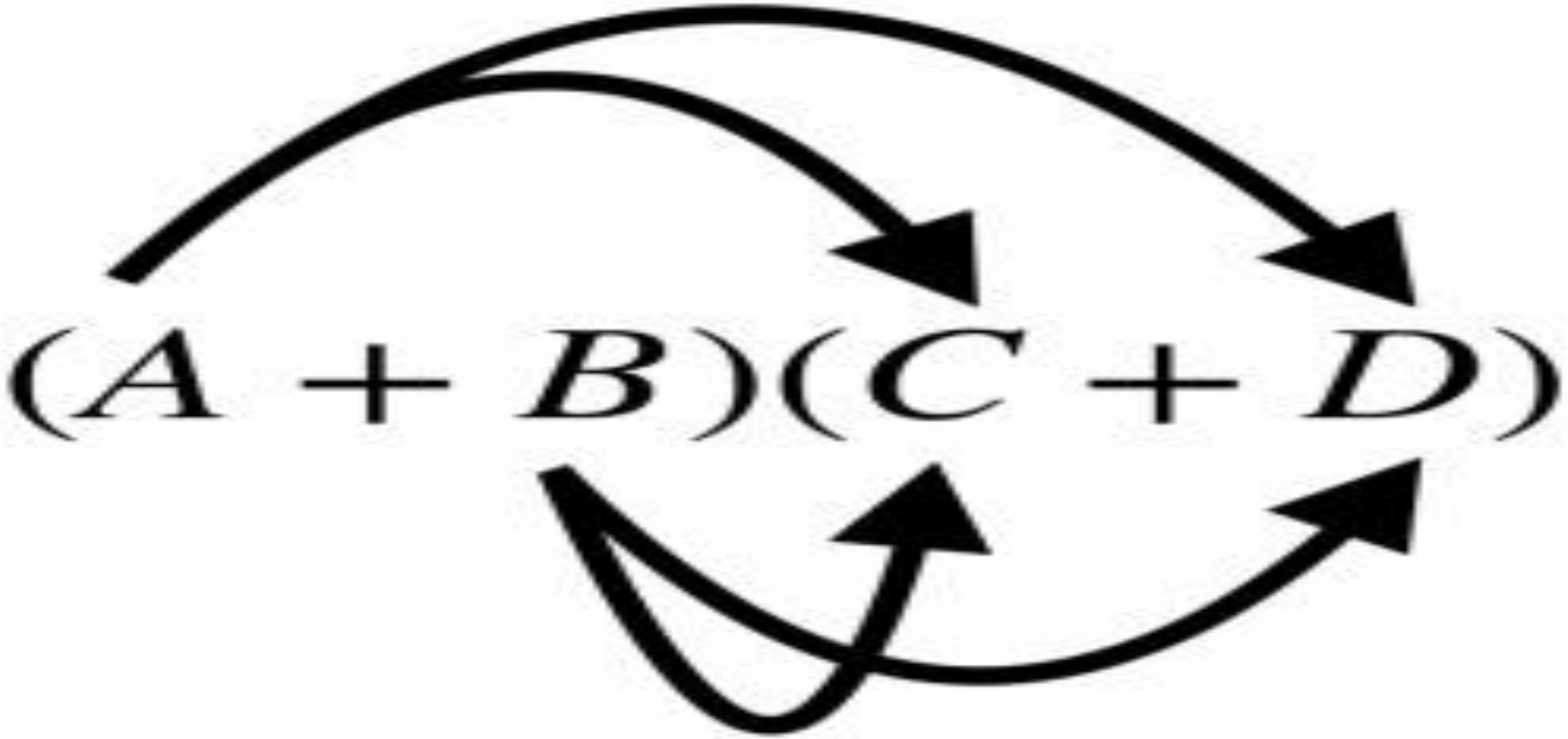
$2(x - 3)$ is *not* equal to $2x - 3$ but is equal to $2x - 2(3) = 2x - 6$.

Open brackets

Distributive law

$$a(b + c) = a\,b + a\,c$$

$$a(b - c) = a\,b - a\,c$$


(A + B)(C + D)

Expanding Single Brackets Examples

www.cazoommaths.com

Expand the brackets

multiply

$2 (x + 8)$

$2x + 16$

$6y (9 - y)$

$54y - 6y^2$

Expanding Brackets - Example 5

Expand the Binomial: **(m + 4) (m + 1)**

$(m + 4)(m + 1) =$

$m \times m + m \times 1 + 4 \times m + 4 \times 1$

$= m^2 + m + 4m + 4$

$= \mathbf{m^2 + 5m + 4}$ ✓

Simplify by Combining the Like Term items.

brackets with everything in the second set.
We can either use the linking method, which for double brackets uses FOIL, or the Grid Method.

Linking Method - FOIL

FOIL stands for:

F - First
O - Outside
I - Inside
L - Last

$(x+2)(x-10)$

$x^2 - 10x + 2x - 20$

$x \quad -8x$

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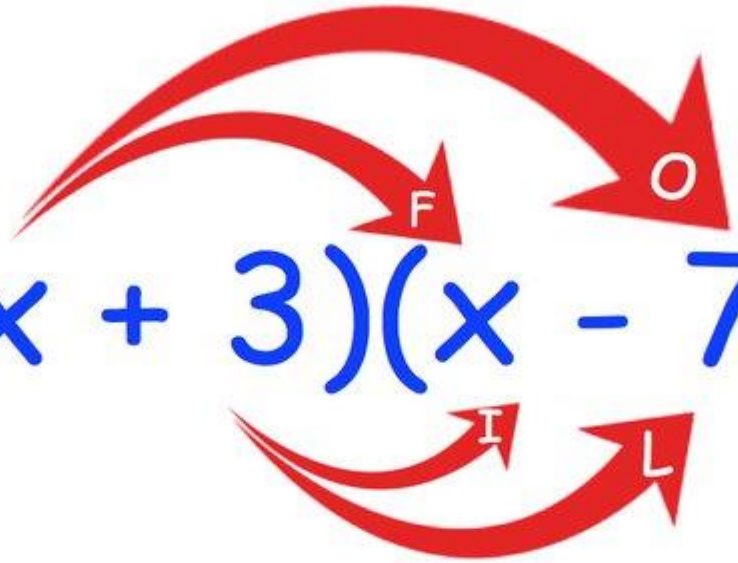
Expanding Two Brackets

To expand two brackets... use FOIL



Expand: $(x + 3)(x - 7)$

First
Outer
Inner
Last

$= x^2 - 7x + 3x - 21$

$= x^2 - 4x - 21$

x times x = x^2
x times -7 = -7x
3 times x = 3x
3 times -7 = -21

Using the distributive property to find the product of two binomials.

Simplify: $(x - 6)(4x + 3)$

$(x - 6)(4x + 3)$

$x(4x + 3) - 6(4x + 3)$

$4x^2 + 3x - 24x - 18$

$4x^2 - 21x - 18$

Exercise (1): *Simplify*:

1. $2 \times y$
2. $2n \times 6m$
3. $4t \times 3t^3$
4. $2x^2 y^2 x^4$

Example 1:

Simplify: $8a^5 \times 5a$

$= 8 \times a^5 \times 5 \times a^1$ (Group Numbers)

$= 8 \times 5 \times a^5 \times a^1$ $\quad a^m \times a^n = a^{m+n}$

$= 40 \times a^{5+1}$

$= 40a^6$ ✓

Example 2: *Simplify*: $4m^2 \times 3y^2 \times m^3$

$= (4 \times 3) \times (m^2 \times m^3) \times y^2$

$= 12m^5 y^2$

Exercise (1): Simplify:

Answer

1. $2 \times y = 2y$ (عزب)

2. $2n \times 6m = 12nm$ (عزب)

توضيح $= 2 \times n \times 6 \times m$

$= 12\,nm$

3. $4t \times 3t^3 = 12\,t^4$ (عزب)

$= 4 \times t^1 \times 3 \times t^3$

$= 12\,t^4$

4. $2x^2 y^2 x^4 = 2x^6 y^2$

توضيح $= 2 * x^2 * y^2 * x^4$

$= 2\,x^6 y^2$

Example 1:

Simplify: $8a^5 \times 5a$

$= 8 \times a^5 \times 5 \times a^1$ (Group Numbers)

$= 8 \times 5 \times a^5 \times a^1$ $\quad a^m \times a^n = a^{m+n}$

$= 40 \times a^{5+1}$

$= 40a^6$ ✓

Example 2:

Simplify: $4m^2 \times 3y^2 \times m^3$

$4m^2 \times 3y^2 \times m^3 = 4 \times 3 \times m^2 \times m^3 \times y^2$

$= (4 \times 3) \times (m^2 \times m^3) \times y^2$

$= 12m^5 y^2$

Exercise (2): Expand and Simplify:

1. $2y(3y+6)$
2. $(x-7)(x+6)$
3. $(x+3)^2$

Expanding Brackets - Example 5

Expand the Binomial: **(m + 4) (m + 1)**

(m + 4) (m + 1) =

m x m + m x 1 + 4 x m + 4 x 1

= m^2 + m + 4m + 4

= **m^2 + 5m + 4** ✓

Simplify by Combining the Like Term items.

Remember: Distributive Law قانون التوزيع

$a(b+c) = ab + ac$

$a(b-c) = ab - ac$

Exercise (2): Expand and Simplify:

1 $2y(3y+6)$

$6y^2 + 12y$

2 $(x-7)(x+6)$

$= x^2 + 6x - 7x - 42$

Like Terms

$= x^2 - x - 42$

Note: $6x - 7x =$

$(6-7)x = -1x$

$= -x$

3 $(x+3)^2$

$= (x+3)(x+3)$

$= x^2 + 3x + 3x + 9$

Like Terms

$= x^2 + 6x + 9$

Multiplying algebraic expressions
(Important Terms)

1 $(a+b)^2 = a^2 + 2ab + b^2$

2 $(a-b)^2 = a^2 - 2ab + b^2$

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

1

➢ Square of a Sum

The square of (a + b) is equal to the square of the first term (a), plus twice the product of the first and second terms (a, b), plus the square of the second term (b).

$$(a+b)^2 = a^2 + 2ab + b^2$$

$$(a+b)(a+b)$$

$$(a)(a) + (a)(b) + (b)(a) + (b)(b)$$

$$a^2 + 2ab + b^2$$

$$(a-b)^2 = [a+(-b)]^2 = (a)^2 + 2(a)(-b) + (b)^2$$

مربعُ مجموعِ حدَّينِ

$$= a^2 - 2ab + b^2$$

أبسطُ

$$(a - b)^2 = a^2 - 2ab + b^2$$

Expanding Brackets

Video Tut: 'Expanding Double Brackets (Advanced)'

Expand and simplify...

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(a)

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

by foil Method

$$(5x+2)(5x+2)$$

$$25x^2 + 10x + 10x + 4$$

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

(b)

by $(a+b)^2 = a^2 + 2ab + b^2$

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

$a \rightarrow 5x$, $b \rightarrow 2$

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

Special Binomial Products to Memorize

- When a **binomial** is **squared**, the result **is** always a "**perfect square trinomial**"

1. $(a + b)^2 = a^2 + 2ab + b^2$
2. $(a - b)^2 = a^2 - 2ab + b^2$

- Both of these can be summarized as a formula:
  - **Square** the **first** term
  - **Multiply 2 times first** term **times second** term
  - **Square** the **last** term

$$(3x+2)^2 = 9x^2 + 12x + 4$$

$$(4x-5)^2 = 16x^2 - 40x + 25$$

Examples

$$(a+b)^2 = a^2 + 2ab + b^2$$

1 $(3k+5)^2$

$$(a+b)^2 = a^2 + 2ab + b^2$$ قانونُ مربعِ مجموعِ حدَّين

$$(3k+5)^2 = (3k)^2 + (2 \times 3k \times 5) + (5)^2$$ $a = 3k,\ b = 5$

$$= 9k^2 + 30k + 25$$ أبسطُ

2 $(y^2+3)^2$

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$$(a+b)^2 = a^2 + 2ab + b^2$$

$a = y^2, b = 3$

$$(y^2+3)^2 = (y^2)^2 + (2 \times y^2 \times 3) + 3^2$$

أبسطُ

$$= y^4 + 6y^2 + 9$$

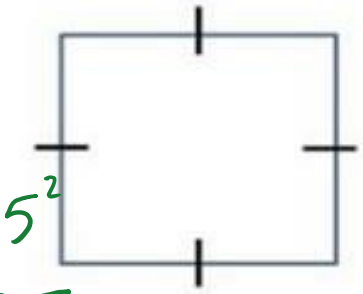
What is the area of the following shape?

3

$(x+5)^2 =$

$x^2 + 2 * x * 5 + 5^2$

$x^2 + 10x + 25$



x + 5

a) $x^2 + 25$

b) $x^2 + 10x + 25$

c) $4x + 20$

d) not enough info

A B C D

4

(a) $(2h - z)^2$

قانونُ مربعِ الفرقِ بَيْنَ حدَّينِ $(a-b)^2 = a^2 - 2ab + b^2$

$a = 2h, b = z$

$(2h-z)^2 = (2h)^2 - (2 \times 2h \times z) + (z)^2$

أبسطُ $= 4h^2 - 4hz + z^2$

5

(a) $(6-5y^3)^2$

قانونُ مربعِ الفرقِ بَيْنَ حدَّينِ $(a-b)^2 = a^2 - 2ab + b^2$

$a = 6, b = 5y^3$

$(6-5y^3)^2 = (6)^2 - (2 \times 6 \times 5y^3) + (5y^3)^2$

أبسطُ $= 36 - 60y^3 + 25y^6$

Show your work

Exercise 8

Prove that :

$$(x-9)^2 = x^2 - 18x + 81$$

1) By opening brackets . (foil method)

2) By using the formula.

① $(x-9)^2 = (x-9)(x-9) = x^2 - 9x - 9x + 81$

$= x^2 - 18x + 81$ ✓

② $(x-9)^2 = (x)^2 - (2 \times x \times 9) + (9)^2$

$= x^2 - 18x + 81$ ✓

a = x, b = 9

Show your work

Expand and simplify:

$$(5m^3 - 3n^5)^2$$

1) By opening brackets. (Foil Method)

2) By using the formula.

① $(5m^3-3n^5)^2 = (5m^3-3n^5)(5m^3-3n^5)$

$= 25m^6 - 15m^3n^5 - 15m^3n^5 + 9n^{10}$

$= 25m^6 - 30m^3n^5 + 9n^{10}$

Show Your Work

Expand and simplify:

$$(5m^3 - 3n^5)^2$$

1) By opening brackets . (Foil Method)

2) By using the formula.

② $(5m^3 - 3n^5)^2 = (5m^3)^2 - 2 * 5m^3 * 3n^5 + (3n^5)^2$

$= 25m^6 - 30m^3n^5 + 9n^{10}$

a b

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

$(a+b)(a-b) = a^2 - ab + ab - b^2$

$= a^2 - b^2$

Examples:

① $(5x - 3)(5x + 3) = (5x)^2 - (3)^2$

a b a b

$= 25x^2 - 9$ ✓

② $(4m^2 + 3n^5)(4m^2 - 3n^5) = (4m^2)^2 - (3n^5)^2$

Sum × difference

$= 16m^4 - 9n^{10}$

③ $(-7f^2m^3 + 3n^6)(-7f^2m^3 - 3n^6) =$

Sum × difference

a b

$= (-7f^2m^3)^2 - (3n^6)^2$

$= 49f^4m^6 - 9n^{12}$

Note:

$(-7f^2m^3)^2$

$= (-7)^2 (f^{2\times 2})(m^3)^2$

$= +49f^4m^6$

The End