

Example: The Distributive Property

Find $(x + 3)(x + 2)$.

Method 1 Vertical

Multiply by 2.

$$\begin{array}{r} x + 3 \\ (\times) x + 2 \\ \hline 2x + 6 \end{array}$$

$$2(x + 3) = 2x + 6$$

Multiply by x .

$$\begin{array}{r} x + 3 \\ (\times) x + 2 \\ \hline 2x + 6 \\ x^2 + 3x \end{array}$$

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

Combine like terms.

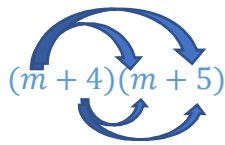
$$\begin{array}{r} x + 3 \\ (\times) x + 2 \\ \hline 2x + 6 \\ x^2 + 3x \\ \hline x^2 + 5x + 6 \end{array}$$

Method 2 Horizontal

$$\begin{aligned} (x + 3)(x + 2) &= x(x + 2) + 3(x + 2) && \text{Distributive Property} \\ &= x(x) + x(2) + 3(x) + 3(2) && \text{Distributive Property} \\ &= x^2 + 2x + 3x + 6 && \text{Multiply.} \\ &= x^2 + 5x + 6 && \text{Combine like terms.} \end{aligned}$$

Check your progress:

1) $(m + 4)(m + 5)$



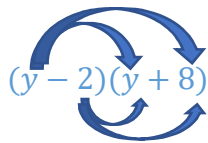
Multiply the first m through the m and 5 , and then do the same with the 4

$$m \cdot m + m \cdot 5 + 4 \cdot m + 4 \cdot 5$$

$$m^2 + 5m + 4m + 20$$

$$m^2 + 9m + 20$$

2) $(y - 2)(y + 8)$



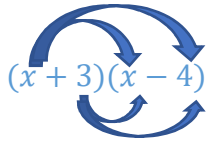
Multiply the first y through the y and 8 , and then do the same with the -2

$$y \cdot y + y \cdot 8 + -2 \cdot y + -2 \cdot 8$$

$$y^2 + 8y - 2y - 16$$

$$y^2 + 6y - 16$$

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



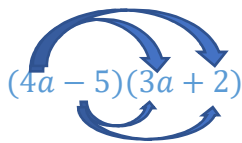
Multiply the first x through the x and -4 , and then do the same with the 3

$$x \cdot x + x \cdot -4 + 3 \cdot x + 3 \cdot -4$$

$$x^2 - 4x + 3x - 12$$

$$x^2 - x - 12$$

$$4) (4a - 5)(3a + 2)$$



Multiply the $4a$ through the $3a$ and 2 , and then do the same with the -5

$$4a \cdot 3a + 4a \cdot 2 + -5 \cdot 3a + -5 \cdot 2$$

$$12a^2 + 8a - 15a - 10$$

$$12a^2 - 7a - 10$$

Example: Area

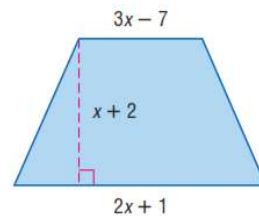
GEOMETRY The area A of a trapezoid is one half the height h times the sum of the bases, b_1 and b_2 . Write an expression for the area of the trapezoid.

Explore Identify the height and bases.

$$h = x + 2$$

$$b_1 = 3x - 7$$

$$b_2 = 2x + 1$$



Plan Now write and apply the formula.

Area	equals	one-half	height	times	sum of bases.
A	$=$	$\frac{1}{2}$	h	\cdot	$(b_1 + b_2)$

Solve	$A = \frac{1}{2}h(b_1 + b_2)$	Original formula
	$= \frac{1}{2}(x + 2)[(3x - 7) + (2x + 1)]$	Substitution
	$= \frac{1}{2}(x + 2)(5x - 6)$	Add polynomials in the brackets.
	$= \frac{1}{2}[x(5x) + x(-6) + 2(5x) + 2(-6)]$	FOIL Method
	$= \frac{1}{2}(5x^2 - 6x + 10x - 12)$	Multiply.
	$= \frac{1}{2}(5x^2 + 4x - 12)$	Combine like terms.
	$= \frac{5}{2}x^2 + 2x - 6$	Distributive Property

Check The area of the trapezoid is $\frac{5}{2}x^2 + 2x - 6$ square units.

Check your progress:

Write an expression for the area of a triangle with a base of $2x + 3$ and a height of $3x - 1$.

$$A = \frac{1}{2}bh$$

$$A = \frac{1}{2}(2x + 3)(3x - 1)$$

$$A = \frac{1}{2}(2x \cdot 3x + 2x \cdot -1 + 3 \cdot 3x + 3 \cdot -1)$$

$$A = \frac{1}{2}(6x^2 - 2x + 9x - 3)$$

$$A = \frac{1}{2}(6x^2 + 7x - 3)$$

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

Example: The Distributive Property

Find each product.

a. $(4x + 9)(2x^2 - 5x + 3)$

$$(4x + 9)(2x^2 - 5x + 3)$$

$$= 4x(2x^2 - 5x + 3) + 9(2x^2 - 5x + 3) \quad \text{Distributive Property}$$

$$= 8x^3 - 20x^2 + 12x + 18x^2 - 45x + 27 \quad \text{Distributive Property}$$

$$= 8x^3 - 2x^2 - 33x + 27 \quad \text{Combine like terms.}$$

b. $(y^2 - 2y + 5)(6y^2 - 3y + 1)$

$(y^2 - 2y + 5)(6y^2 - 3y + 1)$

$= y^2(6y^2 - 3y + 1) - 2y(6y^2 - 3y + 1) + 5(6y^2 - 3y + 1)$

$= 6y^4 - 3y^3 + y^2 - 12y^3 + 6y^2 - 2y + 30y^2 - 15y + 5$

$= 6y^4 - 15y^3 + 37y^2 - 17y + 5$

Check your progress:

1) $(3x - 5)(2x^2 + 7x - 8)$

$(3x - 5)(2x^2 + 7x - 8)$

Multiply the $3x$ through the $2x^2$, $7x$ and -8 , and then do the same with the -5

$3x \cdot 2x^2 + 3x \cdot 7x + 3x \cdot -8 + -5 \cdot 2x^2 + -5 \cdot 7x + -5 \cdot -8$

$6x^3 + 21x^2 - 24x - 10x^2 - 35x + 40$

$6x^3 + 11x^2 - 59x + 40$

2) $(m^2 + 2m - 3)(4m^2 - 7m + 5)$

$(m^2 + 2m - 3)(4m^2 - 7m + 5)$

Multiply the y^2 through the $6y^2$, $-3y$ and 1 , and then do the same with the $-2y$ and the 5 .

$m^2 \cdot 4m^2 + m^2 \cdot -7m + m^2 \cdot 5 + 2m \cdot 4m^2 + 2m \cdot -7m + 2m \cdot 5 + -3 \cdot 4m^2 + -3 \cdot -7m + -3 \cdot 5$

$4m^4 - 7m^3 + 5m^2 + 8m^3 - 14m^2 + 10m - 12m^2 + 21m - 15$

$4m^4 + m^3 - 21m^2 - 31m - 15$

Practice

Find the product.

1) $(y + 4)(y + 3)$

$y^2 + 3y + 4y + 12$

$y^2 + 7y + 12$

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

$x^2 + 6x - 2x - 12$

$x^2 + 4x - 12$

3) $(a - 8)(a + 5)$

$$a^2 + 5a - 8a - 40$$

$$a^2 - 3a - 40$$

4) $(4h + 5)(h + 7)$

$$4h^2 + 28h + 5h + 35$$

$$4h^2 + 33h + 35$$

5) $(9p - 1)(3p - 2)$

$$27p^2 - 18p - 3p + 2$$

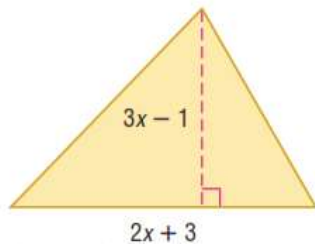
$$27p^2 - 21p + 2$$

6) $(2g + 7)(5g - 8)$

$$10g^2 - 16g + 35g - 56$$

$$10g^2 + 19g - 56$$

- 7) The area A of a triangle is half the product of the base b times the height h . Write a polynomial expression that represents the area of the triangle.



$$A = \frac{1}{2}bh = \frac{1}{2}(3x - 1)(2x + 3)$$

$$A = \frac{1}{2}(6x^2 + 9x - 2x - 3)$$

$$A = \frac{1}{2}(6x^2 + 7x - 3)$$

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

8) $(3k - 5)(2k^2 + 4k - 3)$

$$6k^3 + 12k^2 - 9k - 10k^2 - 20k + 15$$

$$6k^3 + 2k^2 - 29k + 15$$

9) $(4x^2 - 2)(2x^2 + 6x + 1)$

$$8x^4 + 24x^3 + 4x^2 - 4x^2 - 12x - 2$$

$$8x^4 + 24x^3 - 12x - 2$$

10) $(y^2 - 5y + 3)(4y^2 + 2y - 6)$

$$4y^4 + 2y^3 - 6y^2 - 20y^3 - 10y^2 + 30y + 12y^2 + 6y - 18$$

$$4y^4 - 18y^3 - 4y^2 + 36y - 18$$

11) $(3m^2 + 2m - 7)(5m^2 + m + 9)$

$$15m^4 + 3m^3 + 27m^2 + 10m^3 + 2m^2 + 18m - 35m^2 - 7m - 63$$

$$15m^4 + 13m^3 - 6m^2 + 11m - 63$$