

Do Now

WALT expand algebraic expressions using the distributive law

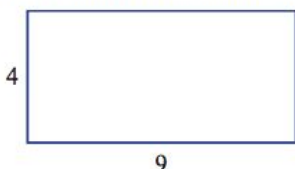
Success Criteria I know everything inside the bracket gets multiplied by the term outside the bracket.

Let's check your understanding


Understanding

1 What is the area of each of the following rectangles?

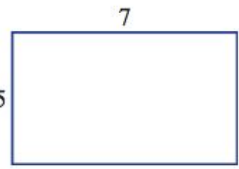
a



b



c



Expanding expressions explained

2 The rectangle shown has height 4 and width $5 + 3$.

- a** What is the area of the yellow rectangle?
- b** What is the area of the blue rectangle?
- c** What is the total combined area?



Example 12

 Expanding brackets by simplifying repeated terms

Write the expression $3(2m + 5)$ in full without brackets and simplify the result.

Solution

$$\begin{aligned} 3(2m + 5) &= 2m + 5 + 2m + 5 + 2m + 5 \\ &= 6m + 15 \end{aligned}$$

Explanation

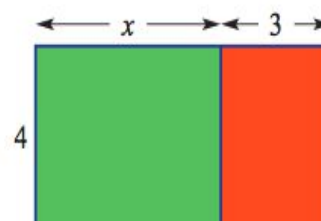
Three repeats of the expression $2m + 5$.
Simplify by collecting the like terms.

3 The expression $3(a + 2)$ can be written as $(a + 2) + (a + 2) + (a + 2)$.

- a** Simplify this expression by collecting like terms.
- b** Write $2(x + y)$ out in full without brackets and simplify the result.
- c** Write $4(p + 1)$ out in full without brackets and simplify the result.
- d** Write $3(4a + 2b)$ out in full without brackets and simplify the result.

4 The area of the rectangle shown can be written as $4(x + 3)$.

- a** What is the area of the green rectangle?
- b** What is the area of the red rectangle?
- c** Write the total area as an expression without using brackets.
- d** Fill in the blank: The expressions $4(x + 3)$ and $4x + 12$ are _____ expressions.



Example 14 Expanding using the distributive law

Expand the following expressions.

a $5(x+3)$

b $3(a-4)$

c $2(3p-7q)$

Solution

a $5(x+3) = 5x + 5 \times 3$

$$= 5x + 15$$

b $3(a-4) = 3a - 3 \times 4$


$$= 3a - 12$$

c $2(3p-7q) = 2 \times 3p - 2 \times 7q$

$$= 6p - 14q$$


Explanation

Using the distributive law

$$5(x+3) = 5x + 5 \times 3$$


Simplify the result.

Using the distributive law

$$3(a-4) = 3a - 3 \times 4$$


Simplify the result.

Using the distributive law

$$2(3p-7q) = 2 \times 3p - 2 \times 7q$$

Simplify the result, remembering $2 \times 3p = 6p$ and $2 \times 7q = 14q$.**6** Use the distributive law to expand the following.

a $6(y+8)$

b $7(l+4)$

c $9(a+7)$

d $2(t+6)$

7 Use the distributive law to expand the following.

a $2(m-10)$

b $8(y-3)$

c $3(e-7)$

d $7(e-3)$

8 Use the distributive law to expand the following.

a $10(6g-7)$

b $5(3e-8)$

c $5(7w+10)$

d $5(2u+5)$

e $7(8x-2)$

f $3(9v-4)$

g $7(2q-4)$

h $4(5c-v)$

i $4(2+5x)$

j $3(7+2y)$

k $8(9-3x)$

l $11(2-4k)$

9 Fill in the missing number in the following expansions.

a $4(x+5) = 4x + \square$

b $3(x+2) = 3x + \square$

c $5(3a+2) = 15a + \square$

d $7(4x-2) = 28x - \square$

Challenge

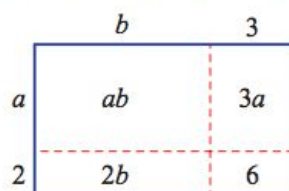
- 10** The perimeter of a rectangle is given by the expression $2(l + w)$ where l is the length and w is the width. What is an equivalent expression for this?
- 11** Expand the brackets in the following and then simplify the result.
- $3(x + 2) + 4x$
 - $4(a + 3) - 2a$
 - $5(3b - 2) + 10$
 - $6(2c + 4) - 2c$
- 12** Write an expression for each of the following and then expand it.
- A number x has 3 added to it and the result is multiplied by 5.
 - A number b has 6 added to it and the result is doubled.
 - A number z has 4 subtracted from it and the result is multiplied by 3.
 - A number y is subtracted from 10 and the result is multiplied by 7.
- 13** When expanded, $4(2a + 6b)$ gives $8a + 24b$. Find two other expressions that expand to $8a + 24b$.

You can combine like terms.



★ Bigger expansions

- 14** The diagram below helps to demonstrate that $(a + 2)(b + 3) = ab + 2b + 3a + 6$.



Use a diagram like the one above to expand the following expressions.

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

More practice

Exercise 11D

- 1** Complete the following to expand the expressions.

a $5(d + 4) = \underline{\quad} \times d + \underline{\quad} \times 4$
 $= \underline{\quad} + \underline{\quad}$

b $4(y - 3) = \underline{\quad} \times y - \underline{\quad} \times 3$
 $= \underline{\quad} - \underline{\quad}$

c $3(6 - m) = \underline{\quad} \times 6 - \underline{\quad} \times m$
 $= \underline{\quad} - \underline{\quad}$

d $2(q + 7) = 2 \times \underline{\quad} + 2 \times \underline{\quad}$
 $= \underline{\quad} + \underline{\quad}$

e $6(b - 2) = 6 \times \underline{\quad} - 6 \times \underline{\quad}$
 $= \underline{\quad} - \underline{\quad}$



- 2** Expand the following expressions.

a $4(b + 3)$

b $12(k + 8)$

c $7(c - 5)$

d $6(d - 3)$

e $2(y - 11)$

f $9(a + 10)$

g $10(j + 9)$

h $8(m + 2)$

i $7(q - 2)$

j $5(l - 6)$

k $4(2 - c)$

l $3(r + 6)$

m $9(7 - t)$

n $4(v + 12)$

o $6(8 - n)$

p $6(x - 2)$

3 Complete the following to expand.

a $4(3z + 2) = \underline{\quad} \times 3z + \underline{\quad} \times 2$
 $= \underline{\quad} + \underline{\quad}$

b $5(2y - 3) = \underline{\quad} \times 2y - \underline{\quad} \times 3$
 $= \underline{\quad} - \underline{\quad}$

c $3(6 + 4k) = 3 \times \underline{\quad} + 3 \times \underline{\quad}$
 $= \underline{\quad} + \underline{\quad}$

4 Expand the following expressions.

a $3(2m + 6)$

b $5(4d + 5)$

c $9(3p + 8)$

d $7(5c - 4)$

e $10(2p - 2)$

f $12(4c - 3)$

g $6(6k + 10)$

h $2(13n + 5)$

i $10(7a - 6)$

j $8(7l - 3)$

k $11(2h + 8)$

l $4(15k - 5)$

m $13(6x + 2)$

n $7(10w - 9)$

o $5(11j + 7)$

p $3(9q - 4)$

5 Explain the difference between each pair of expressions.

a $2x + 1$ and $2(x + 1)$

b $5p - 8$ and $5(p - 8)$

6 Complete the following to expand.

a $m(m + 3) = \underline{\quad} \times m + \underline{\quad} \times 3$
 $= \underline{\quad} + \underline{\quad}$

b $p(q - r) = \underline{\quad} \times q - \underline{\quad} \times r$
 $= \underline{\quad} - \underline{\quad}$

7 Expand the following expressions.

a $x(x + 5)$

b $q(q + 13)$

c $a(a + 8)$

d $z(z + 11)$

e $t(t - 6)$

f $m(m - 10)$

g $d(3 - d)$

h $r(r - 17)$

i $a(c - 4)$

j $b(d + a)$

k $x(y - z)$

l $m(n + c)$

m $j(k - h)$

n $d(f + g)$

o $e(c - d)$

p $r(x - y)$

8 Complete the following to expand.

a $4t(t - 3) = \underline{\quad} \times t - \underline{\quad} \times 3$
 $= \underline{\quad} - \underline{\quad}$

b $3x(2y + 5z) = \underline{\quad} \times 2y + \underline{\quad} \times 5z$
 $= \underline{\quad} + \underline{\quad}$

9 Expand the following expressions.

a $8m(m + 3)$

b $5c(c + 6)$

c $3r(11 + r)$

d $11q(q - 1)$

e $4x(2 - x)$

f $10a(7 - a)$

g $4a(2a + 7)$

h $9b(11b + 5)$

i $5f(4 - 4f)$

j $6d(d - f)$

k $3k(8 - 4k)$

l $12l(3 - 2l)$

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

n $7c(5c + 2d)$

o $6n(6m - 5n)$

p $4x(4x - 3z)$

10 Complete the following to simplify.

a $3(x + 5) + 2x - 7$
 $= \underline{\quad} \times x + \underline{\quad} \times 5 + 2x - 7$
 $= \underline{\quad}x + \underline{\quad} + 2x - 7$
 $= \underline{\quad} + \underline{\quad}$

b $2(p + 5) + 4(p - 3)$
 $= \underline{\quad} \times p + \underline{\quad} \times 5 + \underline{\quad} \times p - \underline{\quad} \times 3$
 $= \underline{\quad}p + \underline{\quad} + \underline{\quad}p - \underline{\quad}$
 $= \underline{\quad} - \underline{\quad}$

11 Expand and simplify by collecting like terms.

a $7(a + 8) + 5a$

b $9(p - 5) - 3$

c $6(c + 8) + 4c$

d $8(d - 7) - 4d$

e $5(q + 4) + 10q$

f $11(m - 7) + 15$

g $4(n + 6) + 3n - 10$

h $2(b - 7) + 3b + 12$

i $3x - 19 + 3(5 - 2x)$

j $7w - 8 + 5(w + 1)$

k $9(f - 3) + 8 - 6f$

l $6n - 10 + 2(n - 7)$

m $10y + 22 + 2(y - 10) + 3y$

n $7c + 3(6 - 4c) + 11 - 2c$

o $4(y - 6) - 3 + 5y$

12 Expand and simplify by collecting like terms.

a $2(x + 7) + 4(x + 8)$

b $4(d + 5) + 3(d - 2)$

c $8(n - 3) + 7(n - 4)$

d $3(q - 6) + 9(q - 7)$

e $7(f - 8) + 2(f - 9)$

f $10(c - 6) + 2(c - 2)$

g $x(x + 5) + 2(x - 4)$

h $y(y - 6) + 4(y + 2)$

i $w(w - 8) + w(w - 9)$

j $5(2m + 7) + 3(4m - 8)$

k $4(3t + 6) + 3(2t + 4)$

l $9(2a - 1) + 10(4a + 7)$

m $10(4a - 2) + 2a(3a - 5)$

n $6c(c - 7) + 2c(c + 8)$

o $4d(3 - 2d) + 3d(2d + 1)$

13 Complete the following to expand.

a $-4(y + 3)$

$= (\quad) \times y + (\quad) \times 3$

$= -4y + (-12)$

$= \underline{\quad} - \underline{\quad}$

b $-x(x - y)$

$= (\quad) \times x - (\quad) \times y$

$= \underline{\quad} - (\underline{\quad})$

$= \underline{\quad} + \underline{\quad}$

c $-(4k + 3m)$

$= (\quad) \times 4k + (\quad) \times 3m$

$= \underline{\quad} + (\underline{\quad})$

$= \underline{\quad} - \underline{\quad}$

Extension

14 Expand the following.

a $-6(a + 10)$

b $-4(b + 8)$

c $-9(k + 9)$

d $-3(c - 3)$

e $-5(f - 7)$

f $-10(d - 6)$

g $-7(m + 5)$

h $-2(n + 10)$

i $-11(h + 11)$

j $-10(2p - 7)$

k $-8(3m - 3)$

l $-5(7q - 8)$

15 Expand the following.

a $-p(p + 7)$

b $-w(w + 8)$

c $-d(d + 11)$

d $-s(s - 3)$

e $-x(x - 6)$

f $-f(f - 14)$

g $-m(n + 5)$

h $-a(y + 2)$

i $-k(m + 10)$

j $-3t(2t - p)$

k $-4y(5y - c)$

l $-8n(8n - 4m)$

16 Expand the following.

a $-(x + 2)$

b $-(y + 3)$

c $-(a + 7)$

d $-(n - 11)$

e $-(g - 5)$

f $-(b - 4)$

g $-(6 + g)$

h $-(3 + k)$

i $-(l + 13)$

j $-(2p - 7)$

k $-(5n - 8)$

l $-(10d - 11)$

17 Expand and collect like terms.

a $5(p + 7) + 3p$

c $4x + 7(x - 5) + 10$

e $3(q - 4) + 2q + 9$

g $10(n + 8) - (6n - 3)$

i $16s - 17 - 5(s - 4) + 6$

k $11(w + 2) - (w - 2)$

m $2(d - 7) + 5(d - 8)$

o $8(p - 6) - 3(p - 10)$

q $n(n - 3) - 2(n - 6)$

s $5c(2c - 6) - 3c(c - 7)$

u $10d(d + 2) - 7d(2d - 4)$

w $5c(c + 7) - 8(c - 9)$

b $12(c - 8) + 29$

d $6(d - 1) + 2d$

f $15 + 2(m - 7) - 5m$

h $9a + 14 + 2(a - 9)$

j $9(x - 8) - (x + 12)$

l $3(z + 12) - (z + 18)$

n $4(k + 2) - 2(k + 3)$

p $y(y + 8) - y(y - 9)$

r $w(w + 4) - 5(w - 7)$

t $8a(2a - 1) - 2a(3a + 4)$

v $4f - 7(f + 6) - 3(f - 10)$

x $12 + 3(n - 1) - 2(n - 6)$

18 Expand and simplify each expression by collecting like terms.

a $4(x + 7) - 3(x - 5) + 2(x - 9)$

c $8(n - 6) + 12 - 5n - 4(n - 14)$

e $-5(d - 11) - 8(d + 7) - 2(d - 5)$

g $-7y(y - 4) - 6y(2y + 8) + 12y$

i $-9k + 15 + 3k(4 - 2k) - 6k(7 + 2k)$

b $2(c + 13) - 5(c + 4) + 9(c - 6)$

d $12f + 30 + 4(f - 12) + 11 - 9f$

f $-(p - 7) - 3(p + 5) + 17 - 10p$

h $2a(a - 3) + 5a(a + 6) - 3a(9 - 2a)$

j $4b(2c + 8b) - 2c(5b - 7c) + 2b(9c - 3b)$

Check your answers

- 1 a** 36 **b** 20 **c** 35
2 a 20 **b** 12 **c** 32
3 a $3a + 6$ **b** $2x + 2y$ **c** $4p + 4$ **d** $12a + 6b$
4 a $4x$ **b** 12 **c** $4x + 12$ **d** equivalent
5 a $4(x + 2) = 4x + 8$ **b** $3(a + 1) = 3a + 3$
c $4(k + 7) = 4k + 28$ **d** $3(b + 5) = 3b + 15$
6 a $6y + 48$ **b** $7l + 28$ **c** $9a + 63$ **d** $2t + 12$
7 a $2m - 20$ **b** $8y - 24$ **c** $3e - 21$ **d** $7e - 21$
8 a $60g - 70$ **b** $15e - 40$ **c** $35w + 50$ **d** $10u + 25$
e $56x - 14$ **f** $27v - 12$ **g** $14q - 28$ **h** $20c - 4v$
i $8 + 20x$ **j** $21 + 6y$ **k** $72 - 24x$ **l** $22 - 44k$
9 a 20 **b** 6 **c** 10 **d** 14
10 $2l + 2w$
11 a $7x + 6$ **b** $2a + 12$ **c** $15b$ **d** $10c + 24$
12 a $5(x + 3) = 5x + 15$ **b** $2(b + 6) = 2b + 12$
c $3(z - 4) = 3z - 12$ **d** $7(10 - y) = 70 - 7y$
13 $2(4a + 12b)$ and $8(a + 3b)$. Others possible.
14 a $ab + 4b + 2a + 8$ **b** $xy + 3y + 5x + 15$
c $6ac + 15c + 4a + 10$ **d** $20ab + 5b + 12a + 3$

- 1 a $5 \times d + 5 \times 4 = 5d + 20$
 b $4 \times y - 4 \times 3 = 4y - 12$
 c $3 \times 6 - 3 \times m = 18 - 3m$
 d $2 \times q + 2 \times 7 = 2q + 14$
 e $6 \times b - 6 \times 2 = 6b - 12$
- 2 a $4b + 12$ b $12k + 96$ c $7c - 35$
 d $6d - 18$ e $2y - 22$ f $9a + 90$
 g $10j + 90$ h $8m + 16$ i $7q - 14$
 j $5l - 30$ k $8 - 4c$ l $3r + 18$
 m $63 - 9t$ n $4v + 48$ o $48 - 6n$
 p $6x - 12$
- 3 a $4 \times 3z + 4 \times 2 = 12z + 8$
 b $5 \times 2y - 5 \times 3 = 10y - 15$
 c $3 \times 6 + 3 \times 4k = 18 + 12k$
- 4 a $6m + 18$ b $20d + 25$
 c $27p + 72$ d $35c - 28$
 e $20p - 20$ f $48c - 36$
 g $36k + 60$ h $26n + 10$
 i $70a - 60$ j $56l - 24$
 k $22h + 88$ l $60k - 20$
 m $78x + 26$ n $70w - 63$
 o $55j + 35$ p $27q - 12$
- 5 a $2(x + 1) = 2x + 2 \neq 2x + 1$
 b $5(p - 8) = 5p - 40 \neq 5p - 8$
- 6 a $m \times m + m \times 3 = m^2 + 3m$
 b $p \times q - p \times r = pq - pr$

- 7 a $x^2 + 5x$ b $q^2 + 13q$
 c $a^2 + 8a$ d $z^2 + 11z$
 e $t^2 - 6t$ f $m^2 - 10m$
 g $3d - d^2$ h $r^2 - 17r$
 i $ac - 4a$ j $bd + ba$
 k $xy - xz$ l $mn + mc$
 m $jk - jh$ n $df + dg$
 o $ec - ed$ p $rx - ry$
- 8 a $4t \times t - 4t \times 3 = 4t^2 - 12t$
 b $3x \times 2y + 3x \times 5z = 6xy + 15xz$
- 9 a $8m^2 + 24m$ b $5c^2 + 30c$
 c $33r + 3r^2$ d $11q^2 - 11q$
 e $8x - 4x^2$ f $70a - 10a^2$
 g $8a^2 + 28a$ h $99b^2 + 45b$
 i $20f - 20f^2$ j $6d^2 - 6df$
 k $24k - 12k^2$ l $36l - 24l^2$
 m $10p^2 - 15pn$ n $35c^2 + 14cd$
 o $36mn - 30n^2$ p $16x^2 - 12xz$
- 10 a $3 \times x + 3 \times 5 + 2x - 7$
 $= 3x + 15 + 2x - 7 = 5x + 8$
 b $2 \times p + 2 \times 5 + 4 \times p - 4 \times 3$
 $= 2p + 10 + 4p - 12 = 6p - 2$
- 11 a $12a + 56$ b $9p - 48$
 c $10c + 48$ d $4d - 56$
 e $15q + 20$ f $11m - 62$
 g $7n + 14$ h $5b - 2$
 i $-3x - 4$ j $12w - 3$
 k $3f - 19$ l $8n - 24$
 m $15y + 2$ n $-7c + 29$
 o $9y - 27$

- 13 a $(-4) \times y + (-4) \times 3$
 $= -4y + (-12) = -4y - 12$
 b $(-x) \times x - (-x) \times y$
 $= -x^2 - (-xy) = -x^2 + xy$
 c $(-1) \times 4k + (-1) \times 3m$
 $= -4k + (-3m) = -4k - 3m$
- 14 a $-6a - 60$ b $-4b - 32$
 c $-9k - 81$ d $-3c + 9$
 e $-5f + 35$ f $-10d + 60$
 g $-7m - 35$ h $-2n - 20$
 i $-11h - 121$ j $-20p + 70$
 k $-24m + 24$ l $-35q + 40$
- 15 a $-p^2 - 7p$ b $-w^2 - 8w$
 c $-d^2 - 11d$ d $-s^2 + 3s$
 e $-x^2 + 6x$ f $-f^2 + 14f$
 g $-mn - 5m$ h $-ay - 2a$
 i $-km - 10k$ j $-6t^2 + 3pt$
 k $-20y^2 + 4cy$ l $-64n^2 + 32mn$
- 16 a $-x - 2$ b $-y - 3$
 c $-a - 7$ d $-n + 11$
 e $-g + 5$ f $-b + 4$
 g $-6 - g$ h $-3 - k$
 i $-l - 13$ j $-2p + 7$
 k $-5n + 8$ l $-10d + 11$

- 17 a $8p + 35$ b $12c - 67$
 c $11x - 25$ d $8d - 6$
 e $5q - 3$ f $-3m + 1$
 g $4n + 83$ h $11a - 4$
 i $11s + 9$ j $8x - 84$
 k $10w + 24$ l $2z + 18$
 m $7d - 54$ n $2k + 2$
 o $5p - 18$ p $17y$
 q $n^2 - 5n + 12$ r $w^2 - w + 35$
 s $7c^2 - 9c$ t $10a^2 - 16a$
 u $-4d^2 + 48d$ v $-6f - 12$
 w $5c^2 + 27c + 72$ x $-n + 21$
- 18 a $3x + 25$ b $6c - 48$
 c $n + 20$ d $7f - 7$
 e $-15d + 9$ f $-14p + 9$
 g $-19y^2 - 8y$ h $13a^2 - 3a$
 i $-18k^2 - 39k + 15$ j $26b^2 + 14c^2 + 16bc$