# Worksheet - Expanding binomials and taking out common factors

Year: Year 9 · 20

Show your working.

## Question 1

**Question 1 – Single brackets** *(Section A · Skills practice)*

Multiply every term inside the bracket by the term outside. Expand each expression.

a. $3(x+5)$
b. $4(2y-3)$
c. $-2(a+6)$
d. $x(x+7)$

## Question 2

**Question 2 – Expand and simplify** *(Section A · Skills practice)*

Expand the brackets, then collect like terms. Show the expanded line before you simplify.

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

## Question 3

**Question 3 – Double brackets** *(Section A · Skills practice)*

Expand and simplify. Use the grid method or the four-term method (first, outside, inside, last).

a. $(x+3)(x+5)$
b. $(x+4)(x-2)$
c. $(x-3)(x-6)$
d. $(2x+1)(x+4)$

## Question 4

**Question 4 – Squares and the difference of two squares** *(Section A · Skills practice)*

Remember that $(x+a)^2$ means $(x+a)(x+a)$, not $x^2+a^2$.

a. $(x+4)^2$
b. $(x-5)^2$
c. $(x+6)(x-6)$
d. $(3x+2)^2$

## Question 5

**Question 5 – Taking out common factors** *(Section A · Skills practice)*

Factorise each expression fully: take the highest common factor outside a bracket.

a. $6x+9$
b. $8y-12$
c. $x^2+5x$
d. $12ab+18a$

## Question 6

**Question 6 – Check by expanding** *(Section A · Skills practice)*

Expanding is the reverse of factorising, so you can check a factorised answer. Answer these questions.

a. Is $5(x+2)=5x+2$? Expand to check.
b. Factorise $2x^2+6x$ and check by expanding.
c. Factorise $x^2-49$.
d. Factorise $4x^2-9$ using the difference of two squares.

## Question 7

**Question 7 – The school garden** *(Section B · Real-life practice)*

The school garden is a rectangle measuring $(x+6)$ metres by $(x+2)$ metres. Mrs Evans wants to know its area and the cost of fencing.

a. Show that the area is $x^2+8x+12$ square metres.
b. Find the area when $x=4$ and check using the original lengths.
c. Write a simplified expression for the perimeter.
d. Fencing costs £8.50 per metre. Find the cost when $x=4$.

## Question 8

**Question 8 – Covering the school hall** *(Section B · Real-life practice)*

The school hall is $(2x+1)$ metres long and $(x+4)$ metres wide. The caretaker is ordering floor varnish.

a. Show that the area of the floor is $2x^2 + 9x + 4$ square metres.
b. Find the area when $x = 5$ using the expression and using the lengths.
c. One tin of varnish covers 20 m². How many tins are needed when $x = 5$?
d. Each tin costs £14.20. Find the total cost.

## Question 9

**Question 9 – A framed picture** *(Section B · Real-life practice)*

Ali has a square picture with sides of $x$ cm. He puts it in a square frame so that there is a 3 cm border on every side.

a. Write an expression for the side length of the whole frame.
b. Expand the area of the whole frame.
c. Show that the area of the border alone is $12x + 36$.
d. Find the area of the border when $x = 20$ and check with the numbers.

## Question 10

**Question 10 – Tickets at the school fair** *(Section B · Real-life practice)*

At the school fair, a child ticket costs £$x$ and an adult ticket costs £$(x + 2)$. The Brown family buys 2 adult tickets and 3 child tickets.

a. Write and simplify an expression for the total cost.
b. Find the total cost when $x = 3$.
c. The Green family buys 4 adult tickets and 6 child tickets. Write and simplify the total cost, then factorise it.
d. What does your factorised answer tell you about the two families?

## Question 11

**Question 11 – Mental maths tricks** *(Section B · Real-life practice)*

Leila's teacher shows the class how to use algebra for quick calculations, such as $103 \times 97 = (100 + 3)(100 - 3)$.

a. Use the difference of two squares to work out $103 \times 97$.
b. Work out $52^2$ by writing it as $(50 + 2)^2$.
c. Work out $48 \times 52$.
d. Work out $99^2$.

## Question 12

**Question 12 – Packing the bakery boxes** *(Section B · Real-life practice)*

A baker packs each box with $x$ muffins and 3 cookies. Each day she fills 4 boxes in the morning and 6 boxes in the afternoon.

a. Write an expression for the number of items in one box.
b. Write and simplify an expression for the total number of items packed in a day.
c. Factorise your answer.
d. Find the total number of items when $x = 9$.

## Question 13

**Question 13 – The packing box** *(Section B · Real-life practice)*

A factory makes a cuboid box with dimensions $x$ cm, $(x + 2)$ cm and $(x + 3)$ cm.

a. Expand $(x + 2)(x + 3)$.
b. Hence show that the volume is $x^3 + 5x^2 + 6x$ cm$^3$.
c. Find the volume when $x = 4$ both ways.
d. The box is made of card costing 0.2p per cm$^2$ of surface area. When $x = 4$ the surface area is 188 cm$^2$. Find the cost of the card.

## Question 14

**Question 14 – Saving up** *(Section B · Real-life practice)*

Jade saves £$(2x + 5)$ each week for 4 weeks. Ben saves £$(x + 8)$ each week for 3 weeks.

a. Write an expression for Jade's total savings.
b. Write an expression for Ben's total savings.
c. Find and simplify the total saved by both of them, and factorise the answer.
d. Find the total when $x = 6$.

## Question 15

**Question 15 – Patterns in double brackets** *(Section C · Problem solving)*

Maya expands four double brackets and records the answers in a table.

| Brackets | Expansion |
|---|---|
| $(x + 2)(x + 3)$ | $x^2 + 5x + 6$ |
| $(x - 2)(x + 3)$ | ? |
| $(x + 2)(x - 3)$ | ? |
| $(x - 2)(x - 3)$ | ? |

a. Complete the table.
b. What is the link between the numbers in the brackets and the coefficient of $x$ and the constant term in the answer?
c. Use your rule to write down the expansion of $(x + 4)(x + 7)$ without working.
d. Use your rule to predict, then check by expanding, $(x - 5)(x + 8)$.

## Question 16

**Question 16 – Find the errors** *(Section C · Problem solving)*

Four pupils expand or factorise. One answer is correct for each pupil, but the others have mistakes.

| Pupil | Working | Verdict |
|---|---|---|
| Ali | $(x+3)^2 = x^2 + 9$ | ? |
| Bea | $3(x-4) = 3x - 4$ | ? |
| Cal | $(x-2)(x+2) = x^2 - 4$ | ? |
| Dev | $-3(x-2) = -3x - 6$ | ? |

a. Decide whether each is right or wrong.
b. Correct each wrong answer, showing the correct working.
c. Explain Ali's mistake using $x = 1$.
d. Which of the correct answers is a difference of two squares?

## Question 17

**Question 17 – The missing side** *(Section C · Problem solving)*

A rectangular patio has an area of $(6x^2 + 9x)$ m$^2$. One side is $3x$ metres long.

a. Factorise $6x^2 + 9x$ fully.
b. Write the length of the other side.
c. Find the perimeter of the patio in terms of $x$.
d. Find the dimensions and area when $x = 2$ and check the area.
e. Slabs cost £7.50 per m$^2$. Find the cost of covering the patio when $x = 2$.

## Question 18

**Question 18 – Think of a number** *(Section C · Problem solving)*

Zara's teacher says: "Think of a number $n$. Add 4. Square the answer. Subtract 16. Divide by your original number." Zara tries some numbers.

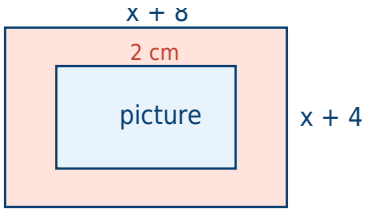
| Start $n$ | 2 | 5 | 10 |
|---|---|---|---|
| Final answer | 10 | 13 | 18 |

a. Check the first two entries in the table.
b. Write the steps as an algebraic expression.
c. Expand and simplify the top line, then factorise it.
d. Show that the final answer is always $n + 8$.
e. Explain why the trick fails when $n = 0$.

## Question 19

**Question 19 – The poster border** *(Section C · Problem solving)*

A rectangular picture on a poster is $x$ cm wide and $(x + 4)$ cm tall. There is a border of width 2 cm all the way round.




a. Write expressions for the width and height of the whole poster.
b. Expand the area of the whole poster.
c. Show that the border area is $8x + 32$ and factorise it.
d. Find the border area when $x = 12$, and check with the numbers.
e. Border paper costs 0.5p per cm$^2$. Find the cost when $x = 12$.

## Question 20

**Question 20 – Challenge: consecutive odd numbers** *(Section D · Challenge)*

Any odd number can be written as $2k + 1$. The next odd number is $2k + 3$.

a. Expand $(2k + 3)^2$ and $(2k + 1)^2$.
b. Show that the difference between the squares of two consecutive odd numbers is $8k + 8$.
c. Hence show that the difference is always a multiple of 8.
d. Test your result with $7^2 - 5^2$.
e. Use the difference of two squares to work out $51^2 - 49^2$, and check it is a multiple of 8.