# Worksheet - Expanding brackets and substitution

Year: Year 7 · 20

Show your working.

## Question 1

**Question 1 – Substituting into expressions** *(Section A · Skills practice)*

Work out the value of each expression when x = 4, y = -2 and z = 5.

a. $3x + 7$
b. $2x - 5y$
c. $x^2 + z$
d. $xy + z$
e. $\frac{3x}{6} - y$
f. $2(x + y)$

## Question 2

**Question 2 – Expanding single brackets** *(Section A · Skills practice)*

Expand each expression.

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

## Question 3

**Question 3 – Expand and simplify** *(Section A · Skills practice)*

Expand the brackets and simplify.

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

## Question 4

**Question 4 – Factorising** *(Section A · Skills practice)*

Factorise each expression fully by taking out the highest common factor.

a. $6x + 9$
b. $10a - 15$
c. $4y^2 + 8y$
d. $12ab + 18b$
e. $x^2 - 5x$
f. $15m^2n + 10mn^2$

## Question 5

**Question 5 – Using formulae** *(Section A · Skills practice)*

Use each formula to work out the value required.

a. $v = u + at$. Find v when u = 5, a = 3 and t = 4.
b. $A = \frac{1}{2}bh$. Find A when b = 8 and h = 5.
c. $P = 2(l + w)$. Find P when l = 7.5 and w = 4.
d. $s = ut + \frac{1}{2}at^2$. Find s when u = 2, t = 3 and a = 4.

## Question 6

**Question 6 – Order of operations in expressions** *(Section A · Skills practice)*

Work out the value of each expression when a = 3 and b = -4. Take care with the order of operations.

a. $2a + b^2$
b. $(2a + b)^2$
c. $ab - b$
d. $a^2 - b^2$
e. $3(a - b)$

## Question 7

**Question 7 – The mobile phone bill** *(Section B · Real-life practice)*

A phone company uses the formula C = 15 + 0.04m to work out the monthly cost, C pounds, for using m minutes of calls beyond a free allowance.

a. Work out the cost when m = 200.
b. Work out the cost when m = 0. What does this number tell you?
c. One month Amira pays £27. How many minutes did she use? Rearrange the

formula or use trial and improvement.
d. Sofia uses 350 minutes. Her mum says that it costs more than £30. Is she right?

## Question 8

**Question 8 – Taxi fares** *(Section B · Real-life practice)*

A taxi firm in Leeds charges £3.20 for pick-up plus £1.80 for every mile. The formula for the cost is C = 3.2 + 1.8m.

a. Work out the cost of a 5 mile journey.
b. Work out the cost of a 12.5 mile journey.
c. A passenger pays £21.20. How far did the taxi travel?
d. A different firm charges £2 for pick-up and £2 per mile. Write a formula for its cost and decide which is cheaper for 10 miles.

## Question 9

**Question 9 – The garden path** *(Section B · Real-life practice)*

A rectangular lawn is x metres long and (x - 2) metres wide. A path of width 1 metre goes round the outside, so the large rectangle is (x + 2) metres long and x metres wide.

a. Write an expression for the area of the lawn and expand it.
b. Write an expression for the area of the large rectangle (lawn and path) and expand it.
c. Find an expression for the area of the path and simplify.
d. Work out the area of the path when x = 8.

## Question 10

**Question 10 – The school trip money** *(Section B · Real-life practice)*

Year 7 pupils pay £x each for a trip plus £5 for lunch. A group of 30 pupils goes on the trip. The teacher writes the expression 30(x + 5) for the total money collected.

a. Expand the expression.
b. Work out the total when x = 12.
c. The total collected is £630. Find x.
d. The teacher wants to check: he works out 30x + 5 instead of 30(x + 5). What is the difference between the two when x = 12? Why is it wrong?

## Question 11

**Question 11 – Number puzzle for the maths club** *(Section B · Real-life practice)*

The maths club plays a game. "Think of a number n. Add 4. Multiply the result by 3.

Subtract 12. Divide by 3."

a. Write an expression for the final answer in terms of n and simplify it.
b. What happens when you start with n = 9?
c. Use algebra to show that this game always gives back the number you started with.
d. Make up your own number puzzle where the answer is always double your starting number.

## Question 12

**Question 12 – Cooking temperatures** *(Section B · Real-life practice)*

A recipe book gives the formula F = 1.8C + 32 to convert from degrees Celsius (C) to degrees Fahrenheit (F).

a. Convert 180 °C into Fahrenheit.
b. Convert 20 °C and 100 °C into Fahrenheit.
c. An oven is set to 392 °F. What is the temperature in Celsius?
d. Is there a temperature that is the same in both scales? Try -40.

## Question 13

**Question 13 – Building blocks** *(Section B · Real-life practice)*

The nth pattern in a sequence of block towers uses 4n + 3 blocks. A teacher builds the first few towers and records them in a table.

| Tower number n | 1 | 2 | 3 | 4 | 10 |
|---|---|---|---|---|---|
| Blocks | 7 | 11 | 15 | | |

a. Complete the table.
b. How many blocks are needed for tower 25?
c. Which tower uses 83 blocks?
d. Alfie says that tower 6 uses 28 blocks. Is he right? Show your working.

## Question 14

**Question 14 – The cinema deal** *(Section B · Real-life practice)*

The cinema sells a family pack. A family of 2 adults and 3 children pay £(2a + 3c), where a is the adult price and c is the child price. A group deal costs 4(a + c) − 5.

a. Expand and simplify the group deal formula.
b. Adult tickets cost £9 and child tickets cost £6. Work out the cost of the family pack.
c. Work out the cost using the group deal formula.
d. How much do 4 adults and 4 children pay without the deal, and how much does the deal save?

## Question 15

**Question 15 – Algebraic perimeter and area** *(Section C · Problem solving)*

A rectangle has length (2x + 3) cm and width (x + 1) cm.

a. Write an expression for the perimeter and simplify.
b. Expand to find an expression for the area.
c. Work out the perimeter and area when x = 4.
d. The perimeter is 50 cm. Find x and the dimensions of the rectangle.

## Question 16

**Question 16 – Comparing mobile plans** *(Section C · Problem solving)*

Two phone companies advertise these plans. Plan A costs £8 plus £0.10 per minute. Plan B costs £2 plus £0.15 per minute.

| Minutes | 40 | 80 | 120 | 160 |
|---|---|---|---|---|
| Plan A (£) | | | | |
| Plan B (£) | | | | |

a. Write a formula for each plan with m minutes.
b. Complete the table.
c. For how many minutes do the two plans cost the same?
d. Maya uses about 100 minutes a month. Which plan is better for her? By how much?

## Question 17

**Question 17 – Spotting errors in expanding** *(Section C · Problem solving)*

Four pupils each made one mistake. Find the mistake and write the correct answer.

a. Ali: $3(x+5) = 3x + 5$
b. Beth: $-2(x-4) = -2x - 8$
c. Carl: $(x+3)^2 = x^2 + 9$
d. Dina: $x^2$ when $x = -3$ is $-9$

## Question 18

**Question 18 – Fencing a field** *(Section C · Problem solving)*

A farmer has a field in the shape of a rectangle with sides x and x + 10 metres. He wants to put a fence round it. The fence costs £6.50 per metre. He also puts a gate that costs £75.

a. Write and simplify an expression for the length of fencing needed.
b. Write a formula for the total cost T of the fence and gate.

c. Work out the cost when x = 40.
d. The farmer has £1 000. Find the greatest whole value of x for which the cost does not exceed £1 000.

## Question 19

**Question 19 – The school fete profit** *(Section C · Problem solving)*

At the school fete, the Year 7 stall sells n cups of hot chocolate. Each cup costs the school 35p to make and is sold for £1.20. The stall also has a fixed cost of £15 for the table and decorations.

| Cups sold n | 20 | 40 | 60 | 80 |
|---|---|---|---|---|
| Profit P (£) | | | | |

a. Write a formula for the profit P pounds in terms of n.
b. Complete the table.
c. How many cups must be sold to make a profit of £100? Give your answer to the nearest whole cup, rounded up.
d. The teacher says that selling 18 cups will cover the costs. Check by substituting n = 18.

## Question 20

**Question 20 – Challenge: the magic of squares** *(Section D · Challenge)*

Zara notices a pattern: 5 x 5 = 25, 4 x 6 = 24, 6 x 6 = 36, 5 x 7 = 35.

a. Complete: 10 × 10 = ..., 9 × 11 = ... What do you notice?
b. Let the middle number be n. Write 9 × 11 in the form (n − 1)(n + 1) and expand.
c. Use algebra to prove that (n − 1)(n + 1) is always one less than $n^2$.
d. Use this to work out 49 × 51 quickly.