Worksheet - Algebraic notation and simplifying expressions

Year: Year 7 · 20

Show your working.

Question 1

Question 1 – Algebra shorthand *(Section A · Skills practice)*

In algebra we leave out multiplication signs and write letters next to numbers. Rewrite each expression using algebraic notation.

a. $a \times b$
b. 5 times n
c. $p \times p$
d. $3 \times x \times y$
e. $m \div 4$
f. $(x + 2) \times 5$

Question 2

Question 2 – Forming expressions *(Section A · Skills practice)*

Write an expression for each situation.

a. A pen costs £p. Find the cost of 7 pens.
b. A pupil is n years old. How old will she be in 6 years?
c. Bags of sweets each contain s sweets. Write the total number of sweets in 4 bags and 3 loose sweets.
d. A rectangle has length l cm and width 5 cm less than the length. Write its width and its perimeter in simplest form.

Question 3

Question 3 – Collecting like terms *(Section A · Skills practice)*

Simplify each expression by collecting like terms.

a. $3a + 5a$
b. $7x - 2x + 4x$
c. $4a + 3b + 2a - b$
d. $5p + 2 - 3p + 7$
e. $6x^2 + 3x - 2x^2 + x$
f. $3ab + 4ba - 2ab$

Question 4

Question 4 – Multiplying and dividing terms *(Section A · Skills practice)*

Simplify each expression.

a. $3a \times 4b$
b. $2x \times 5x$
c. $6p \times (-2q)$
d. $12xy \div 3x$
e. $\dfrac{20a^2}{5a}$
f. $(-4m) \times (-3m)$

Question 5

Question 5 – Understanding terms *(Section A · Skills practice)*

Look at the expression $5x^2 - 3x + 7$.

a. How many terms does it have?
b. What is the coefficient of x?
c. What is the constant term?
d. Which of these are like terms: $4x,\ 4x^2,\ -x,\ 9,\ 2xy$?
e. Write an expression with three terms, in x and y, that simplifies to $3x + 2y$.

Question 6

Question 6 – Expressions and powers *(Section A · Skills practice)*

Write each of these as a power or in a simpler form.

a. $y \times y \times y$
b. $2 \times a \times a \times b$
c. $(3x)^2$
d. $3x^2$ when $x = 4$
e. $(3x)^2$ when $x = 4$

Question 7

Question 7 – Cinema tickets *(Section B · Real-life practice)*

A cinema charges £c for a child ticket and £a for an adult ticket. A family buys tickets for their trip.

a. Write an expression for the cost of 3 child tickets and 2 adult tickets.
b. Another family buys 2 child tickets and 3 adult tickets. Write an expression for the total cost of both families.
c. Simplify your expression from (b).

d. A child ticket costs £6 and an adult ticket costs £9. Work out the cost for both families.

Question 8

Question 8 – Mobile phone plan *(Section B · Real-life practice)*

A phone company charges a fixed £12 per month plus 5p for every text message over the allowance and 8p for every minute over the minutes allowance. Last month Ravi sent t texts over and used m minutes over.

a. Write an expression for his bill in pounds.
b. Work out the bill when t = 40 and m = 25.
c. Ravi's sister has a bill of £12 and 5p texts only, with 60 texts over. Work out her bill.
d. Write a formula for Ravi's bill B in terms of t and m.

Question 9

Question 9 – Fencing the garden *(Section B · Real-life practice)*

Sam is planning a rectangular vegetable patch in the school garden. The length is x metres and the width is (x - 3) metres.

a. Write an expression for the perimeter and simplify it.
b. Write an expression for the area of the patch.
c. Work out the perimeter when x = 10.
d. Fencing costs £8 per metre. Write an expression for the cost of fencing the patch and work out the cost when x = 10.

Question 10

Question 10 – School trip costs *(Section B · Real-life practice)*

A coach for a school trip costs £150 plus £4 for each pupil who goes. Entry to the museum costs £7 per pupil. n pupils go on the trip.

a. Write an expression for the cost of the coach.
b. Write an expression for the cost of the entry tickets.
c. Write and simplify an expression for the total cost.
d. Work out the total cost when n = 30.
e. The head teacher has a budget of £500. What is the largest whole number of pupils that can go?

Question 11

Question 11 – Pocket money and savings *(Section B · Real-life practice)*

Priya gets £x pocket money per week. Her brother gets £2 more than Priya each week. Their cousin gets twice what Priya gets.

a. Write an expression for the brother's pocket money.
b. Write an expression for the cousin's pocket money.
c. Write a simplified expression for the total of all three children's weekly pocket money.
d. Work out the total when x = £5.
e. The three children together get £22 a week. Is x = 5 possible? Explain.

Question 12

Question 12 – Number tricks *(Section B · Real-life practice)*

Ben shows his friends a number trick. "Think of a number. Multiply it by 3. Add 6. Divide by 3. Take away the number you started with. The answer is always 2."

a. Let the number you think of be n. Write an expression for each step.
b. Simplify to show that the answer is always 2.
c. Create your own trick that always gives the answer 5.
d. Check your trick with the starting number 7.

Question 13

Question 13 – Building patterns with matchsticks *(Section B · Real-life practice)*

Matchsticks are used to make a row of squares. One square uses 4 matchsticks, two squares joined use 7, and three squares joined use 10.

a. How many matchsticks are needed for 4 squares?
b. Write an expression for the number of matchsticks needed for n squares.
c. How many matchsticks are needed for 20 squares?
d. Maya has 100 matchsticks. What is the largest number of squares she can make?

Question 14

Question 14 – Perimeter of an L-shape *(Section B · Real-life practice)*

A six-sided shape has sides of lengths 3x, 2x, x + 2, x, 2x - 2 and x + 2 centimetres.

a. Add up all six sides and simplify to find the perimeter.
b. Work out the perimeter when x = 5.
c. The perimeter is 74 cm. Form and solve an equation to find x.

Question 15

Question 15 – Rectangles in algebra *(Section C · Problem solving)*

Three rectangles are drawn side by side. The lengths of their bases are 2a, 3a and a

(all in centimetres) and each rectangle has height h centimetres.

Rectangle	Base	Height	Area
A	2a	h	?
B	3a	h	?
C	a	h	?

a. Complete the table with the area of each rectangle.
b. Write the total area of the three rectangles as a single term.
c. The three rectangles are joined to form one big rectangle. Write an expression for its perimeter and simplify.
d. Work out the total area and the perimeter when a = 4 and h = 5.

Question 16

Question 16 – The taxi fare *(Section C · Problem solving)*

A taxi company charges a £3 starting fee plus £2 for every mile. A second company charges a £1 starting fee plus £2.50 per mile.

Miles	2	4	6	8
Company A (£)				
Company B (£)				

a. Write an expression for the cost with each company for m miles.
b. Complete the table.
c. For which number of miles are the costs the same? Form an equation and solve it.
d. Which company is cheaper for a 10-mile journey? By how much?

Question 17

Question 17 – Expressions for a market stall *(Section C · Problem solving)*

At a market a fruit stall sells apples at £a per kilogram, bananas at £b per kilogram and grapes at £g per kilogram. Mrs Clarke buys 3 kg of apples, 2 kg of bananas and 1 kg of grapes. Mr Dean buys 1 kg of apples, 4 kg of bananas and 2 kg of grapes.

a. Write an expression for the cost of Mrs Clarke's shopping.
b. Write an expression for the cost of Mr Dean's shopping.
c. Write a simplified expression for the total of both bills.
d. Apples cost £2, bananas £1.50 and grapes £4. Work out each bill and check the total from (c).

Question 18

Question 18 – Find the error *(Section C · Problem solving)*

Four pupils simplify expressions. Each has made one mistake. Find the mistake and write the correct answer.

a. Zoe: $3x + 4y = 7xy$
b. Adam: $5a - 2a^2 = 3a^2$
c. Beth: $2x \times 3x = 6x$
d. Carl: $-(x - 3) = -x - 3$

Question 19

Question 19 – Algebraic reasoning *(Section C · Problem solving)*

The expressions below describe the number of sweets in some packets. Packet A has x sweets. Packet B has 3 more than twice packet A. Packet C has half as many as packet B.

a. Write an expression for packet B.
b. Write an expression for packet C and simplify it.
c. Write the total number of sweets in all three packets as a simplified expression.
d. Work out the total when x = 5. Is the total in packet C a whole number for every whole value of x? Explain.

Question 20

Question 20 – Challenge: algebra pyramids *(Section D · Challenge)*

In an algebra pyramid each block is the sum of the two blocks directly underneath it. The bottom row of a three-row pyramid reads a, 2a and 3a.

a. Write the middle row.
b. Write the top block in simplest form.
c. Another pyramid has bottom row x, y, x. Write the top block.
d. The top block of the pyramid with bottom row x, 4, x is 24. Find x.