Worksheet - Algebra: expressions and factorising

Year: Year 8 · 20

Show your working.

Question 1

Question 1 – Collecting like terms *(Section A · Skills practice)*

Aisha is tidying up some algebra from her homework. Simplify each expression fully.

a. $4a + 7a - 3a$
b. $5x + 2y + 3x - 6y$
c. $8p^2 - 3p + 2p^2 + 9p$
d. $3ab + 4ba - 2a$

Which of your answers still contains two different kinds of term? Explain why they cannot be combined.

Question 2

Question 2 – Multiplying and dividing terms *(Section A · Skills practice)*

Simplify each of these using the index laws.

a. $3a \times 5b$
b. $4x \times 2x^2$
c. $\dfrac{12m^3}{4m}$
d. $\dfrac{18pq}{6p}$
e. $(2y)^3$

Question 3

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

Expand each bracket. Write down each stage of your working.

a. $4(x + 6)$
b. $3(2a - 5)$
c. $-2(y + 7)$
d. $x(x - 9)$
e. $5p(2p + 3q)$

Question 4

Question 4 – Expand and simplify *(Section A · Skills practice)*

Expand the brackets and then collect like terms.

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

Question 5

Question 5 – Factorising *(Section A · Skills practice)*

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

a. $6x+15$
b. $12a-8$
c. x^2+7x
d. $10pq-4p$
e. $9m^2n+12mn^2$

Question 6

Question 6 – Substitution *(Section A · Skills practice)*

Find the value of each expression when $a=3$, $b=-2$ and $c=5$.

a. $4a+b$
b. $2c-3b$
c. a^2+b^2
d. $ab+c$
e. $3(a-b)$

Question 7

Question 7 – Planning a birthday party *(Section B · Real-life practice)*

Maya is organising a party. Hiring the village hall costs £30 plus £8 for each hour. Food costs £4 for each guest. She invites g guests and hires the hall for h hours.

a. Write an expression for the cost of the hall.
b. Write an expression for the cost of the food.
c. Write a simplified expression for the total cost, C.
d. Find the total cost when $g=15$ and $h=3$.
e. Maya has £150. Can she afford 20 guests for 4 hours? Show your working.

Question 8

Question 8 – Fencing the allotment *(Section B · Real-life practice)*

Mr Khan has a rectangular allotment. The width is x metres and the length is $(x + 6)$ metres. He wants to put a fence round the edge.

a. Write an expression for the perimeter and simplify it.
b. Write an expression for the area, and expand it.
c. The fence costs £12 per metre. Find the cost when $x = 4$.
d. Find the area when $x = 4$.

Question 9

Question 9 – Mobile phone deals *(Section B · Real-life practice)*

Two phone companies offer these monthly deals. Both have a fixed charge plus a charge per gigabyte (GB) of data used.

Company	Fixed charge	Cost per GB
Blue Mobile	£6	£2
Red Mobile	£10	£1.50

a. Write an expression for the monthly cost with Blue Mobile when d GB are used.
b. Write an expression for Red Mobile.
c. Complete: when $d = 8$, Blue costs £___ and Red costs £___.
d. Which company is cheaper when $d = 10$? By how much?

Question 10

Question 10 – Tiling the kitchen floor *(Section B · Real-life practice)*

Ben is laying square tiles in the kitchen. Each side of a tile is t centimetres. A pattern uses 5 rows of tiles with 8 tiles in each row.

a. Write an expression for the length of one row.
b. Write an expression for the length of one column of 5 tiles.
c. Write an expression for the area of the whole pattern.
d. Find the area when $t = 30$ cm. Give your answer in square metres.

Question 11

Question 11 – School shop prices *(Section B · Real-life practice)*

At the school shop a pencil costs p pence and a rubber costs r pence. Layla buys 3 pencils and 2 rubbers. Josh buys 5 pencils and 4 rubbers.

a. Write an expression for what Layla pays.
b. Write an expression for what Josh pays.

c. Write a simplified expression for the total they pay together.
d. A pencil costs 20p and a rubber costs 35p. Find the total.
e. How much more does Josh pay than Layla? Use algebra first, then check with numbers.

Question 12

Question 12 – Pocket money savings *(Section B · Real-life practice)*

Tom has £6 saved and adds £4 every week. His sister Ella starts with £30 but spends £2 each week on sweets.

a. Write an expression for Tom's money after w weeks.
b. Write an expression for Ella's money after w weeks.
c. Complete a table for $w = 0, 2, 4, 6$.
d. After how many weeks do they have the same amount? Use your table, then check by forming an equation.

Question 13

Question 13 – Rectangular garden pond *(Section B · Real-life practice)*

A garden designer sketches a rectangular patio of length $(3x + 2)$ metres and width 4 metres. A pond of width x metres and length 5 metres is cut out of the patio.

a. Write and expand an expression for the area of the whole patio.
b. Write an expression for the area of the pond.
c. Find a simplified expression for the area that is left to be paved.
d. Find the paved area when $x = 3$.

Question 14

Question 14 – Cinema group booking *(Section B · Real-life practice)*

A cinema charges £a for an adult ticket and £c for a child ticket. A group has 4 adults and 6 children.

a. Write an expression for the cost of the group.
b. The cinema offers a discount of £1 off every ticket. Write a new expression for the cost.
c. Expand and simplify your answer to part (b).
d. If $a = 9$ and $c = 6$, find the cost with and without the discount.

Question 15

Question 15 – Number puzzle: think of a number *(Section C · Problem solving)*

Zara says: "Think of a number n. Add 3. Multiply the answer by 4. Subtract 8. Divide by

4. Subtract the number you started with."

a. Write an expression for each stage, starting with n.
b. Simplify the final expression. What do you notice?
c. Test your result with $n = 7$ and $n = -2$.
d. Zara changes the puzzle: "Multiply by 6 instead of 4, and divide by 6 at the end." Does the puzzle still always give the same answer? Explain.

Question 16

Question 16 – Spot the mistake *(Section C · Problem solving)*

Four pupils each expanded and simplified $3(x + 4) - 2(x - 1)$. Their answers are shown below.

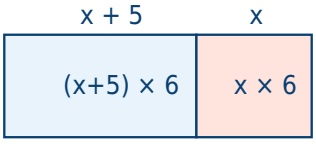
Pupil	Answer
Ali	$x + 10$
Bea	$x + 14$
Cal	$5x + 10$
Dev	$x + 12$

a. Work out the correct answer.
b. Which pupil is right?
c. Find the mistake made by each of the other pupils.
d. Check the correct answer by substituting $x = 5$ into the original expression and into your answer.

Question 17

Question 17 – Perimeter and area of a compound shape *(Section C · Problem solving)*

A shape is made from two rectangles joined side by side. The left rectangle is $(x + 5)$ cm by 6 cm. The right rectangle is x cm by 6 cm.



a. Write the total width of the shape and simplify.
b. Write and simplify an expression for the perimeter.
c. Write and expand an expression for the total area.
d. The total area is 90 cm². Form and solve an equation to find x.

Question 18

Question 18 – Boxes of doughnuts *(Section C · Problem solving)*

A bakery packs doughnuts in boxes of 6 and boxes of 4. The table shows how many boxes are packed.

Day	Boxes of 6	Boxes of 4
Monday	x	y
Tuesday	$2x$	$y + 3$

a. Write an expression for the number of doughnuts packed on Monday.
b. Write an expression for Tuesday and simplify it.
c. Write a simplified expression for the total over the two days.
d. If $x = 5$ and $y = 8$, find the total number of doughnuts packed in the two days.

Question 19

Question 19 – Concert tickets *(Section C · Problem solving)*

A school sells tickets for the summer concert. Adult tickets cost £$5x$ and child tickets cost £$3x$, where x depends on the day of the week. A family buys 2 adult and 3 child tickets.

a. Write and simplify an expression for the cost of the family's tickets.
b. Find the cost when $x = 2$.
c. On a different day the family pays £57. Find x.
d. Another family buys a adult and c child tickets. Write an expression for their cost and factorise it.

Question 20

Question 20 – Challenge: the magic algebra square *(Section D · Challenge)*

In this algebra square every row, column and diagonal adds up to the same total.

$x + 2$	$x + 7$	$x + 6$
$x + 9$	$x + 5$	$x + 1$
$x + 4$	$x + 3$	$x + 8$

a. Find the sum of the top row and simplify it.
b. Check the middle row and the first column. Do they give the same total?
c. Check both diagonals.
d. The magic total is 33. Form and solve an equation to find x, then write down the completed square.