Collecting like terms

Quick quiz

Tick each expression that can be simplified.

$d + d$ ☐ $a + b$ ☐ $x^2 + x^2$ ☐ $x^2 + y^2$ ☐

Collecting like terms — Grades 1–2

1. Simplify

(a) $d + d + d$ **[1 mark]** = 3.....

(b) $t + 2t + t + t$ **[1 mark]** = ... t

2. Circle the expression that is **not** equivalent to $a + a + a + a$. **[1 mark]**

a^4 $4a$ $4 \times a$ $3a + a$

If the variables are the same, you can add the coefficients.

3. Simplify

(a) $2c + 3c + 4c$ **[1 mark]**

(b) $5e + e - 10e$ **[1 mark]**

(c) $7g - 4g - 8g$ **[1 mark]**

4. Simplify

(a) $3f + 4 - 2f + 6$ **[2 marks]**

(b) $3x + 8y + x - 2y$ **[2 marks]** = $3x + x + 8y - 2y$

(c) $3x - 5y + x + 4y$ **[2 marks]**

(d) $5f + 7 - 6f - 4$ **[2 marks]**

5. Jane simplifies $3ef + 5ef - ef$ to get $9ef$. Explain why Jane is wrong. **[2 marks]**

Think how you would have simplified the expression and then what Jane might have done differently.

Collecting terms with powers — Grade 2

6. Simplify

(a) $m^2 + m^2 + m^2$ **[1 mark]**

There are three lots of m^2.

(b) $3a^2 + 2h + a^2 - 3h$ **[1 mark]**

(c) $5x^2 - 4y + 3x^2 - 3y$ **[2 marks]**

Exam focus
Always give your answer in its simplest form.

(d) $9p^2 + 2t - 2p^2 + 3t$ **[2 marks]**

(e) $3x^2 - 5y + x^2 + 4y$ **[2 marks]**

(f) $3x^2 + 7y^2 + 2x^2 - y^2$ **[2 marks]**

Simplifying expressions

Quick quiz

Fill in the gaps.

(a) $a \times a = a$ ..... **(b)** $ab = a$ ..... b **(c)** $a \times c = a$ ..... **(d)** $a^3 = a \times$ ....

Simplifying with single operations — Grade 1

1. Simplify

(a) $5 \times e \times f$ **[1 mark]**

$= 5 \times ef$

..... **(b)** $7 \times 2t$ **[1 mark]**

$= 7 \times 2 \times t$

..... **(c)** $5 \times 3g$ **[1 mark]**

$=$ ..... $\times$ ..... $\times g$

.....

When multiplying, remember that letters in algebra are generally written next to each other in alphabetical order.

2. Simplify

(a) $2m \times 3n$ **[1 mark]**

$= 2 \times 3 \times m \times n$

$=$ ..... $\times mn$

..... **(b)** $2e \times 3f$ **[1 mark]**

..... **(c)** $3 \times c \times c$ **[1 mark]**

$=$ ..... $\times c$ .....

.....

Multiply the coefficients and multiply the letters.

Remember the index laws: $c \times c = c^2$

3. Simplify

(a) $24x \div 3$ **[1 mark]**

$= \frac{24x}{3}$

$= 8$ .....

..... **(b)** $15a \div 5$ **[1 mark]**

..... **(c)** $36y \div 12$ **[1 mark]**

.....

Exam focus

Simplifying with division:

Step 1: Write the expression as a fraction.

Step 2: Cancel the numbers, then the letters.

Step 3: Use the index laws.

(d) $48g^2 \div 4g$ **[1 mark]** ..... **(e)** $10a^4 \div 5a^2$ **[1 mark]** ..... **(f)** $42t^3 \div 7t^2$ **[1 mark]** ..... **(g)** $25x^2 \div 5x^2$ **[1 mark]** .....

Mixed operations — Grade 2

4. Simplify

(a) $\frac{25x^3y^2}{xy}$ **[2 marks]**

..... **(b)** $\frac{24a^4b^3}{12ab}$ **[2 marks]**

$= \frac{24 \times a^4 \times b^3}{12 \times a \times b}$

$= 2 \times a^3 \times$ .....

$=$ .....

..... **(c)** $\frac{30c^4d^5}{10c^3d^2}$ **[2 marks]** ..... **(d)** $\frac{42g^5h}{g^3}$ **[2 marks]** .....

(e) $\frac{84t^7v^5}{12v^5}$ **[2 marks]**

..... **(f)** $\frac{15s^5t^4}{s^2t^3}$ **[2 marks]**

..... **5.** Ben simplifies $\frac{14m^5n^8}{2m^3n^6}$ to get $7m^8n^{14}$

Explain why Ben is wrong. **[2 marks]**

.....

Writing expressions

Quick quiz

Given that $x = 4$, $y = 3$ and $t = 5$, find the value of

(a) $10 \times x$ ..... **(b)** $5 + y$ ..... **(c)** $15 \div t$ .....

Using information — Grade 3

1. Bruno has x counters. Saira has three times as many counters as Bruno. Dylan has three more counters than Bruno.

Write an expression, in terms of x, for the total number of counters Bruno, Saira and Dylan have. **[2 marks]**

Number of counters:

Bruno has x counters

Saira has 3..... counters

Dylan has $x +$ ..... counters

So an expression for the total number of counters is $x + 3x + x + 3 =$ .....

The expression for Bruno's counters is x.
Use that to write expressions for Saira and Dylan's counters.
The expression for the total will be all of these added together.

2. There are 6 pens in a box of pens. There are 9 pencils in a box of pencils.

Nita buys m boxes of pens and n boxes of pencils.

Write an expression for the total number of pens and pencils that Nita buys. **[1 mark]**

.....

3. Sweets are sold in packets and in boxes. There are 8 sweets in a packet. There are 12 sweets in a box.

Frank buys x packets of sweets and y boxes of sweets.

Write an expression for the total number of sweets that Frank buys. **[1 mark]**

.....

4. Rachel uses this rule to work out the cost in £ of hiring a car for n days:

Multiply the number of days by £45, then add £60

(a) Write an expression for the cost of hiring a car. **[1 mark]**

45 × number of days + 60

45..... + ...

£.....

(b) Imran hired a car for 12 days. Using your expression, work out the cost that Imran has to pay. **[1 mark]**

Input 12 as n

$45 \times 12 + 60 =$ .....

£.....

5. At the start of the week, the value in £ of a number of shares in a gas company can be worked out using this rule:

Multiply the number of shares by 3.5

(a) Write an expression for the value of n shares. **[1 mark]**

£.....

(b) Use your expression to work out the value of 250 shares. **[1 mark]**

£.....

By Thursday, the value of each share has dropped by 50p.

(c) Write an expression for the new value of n shares. **[2 marks]**

Value of each share = (3.5 − 0.5)

£.....

Algebraic formulae

Quick quiz

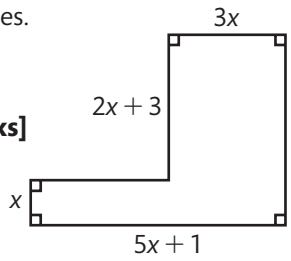
Simplify each expression.

(a) $x + 5 - x$ ..... **(b)** $3 \times x$ ..... **(c)** $2x + x + 6$ ..... **(d)** $x + 2 + x - 3$ .....

Working out the perimeter — Grade 3

1. The diagram shows a shape made from rectangles.
All the measurements are in centimetres.

Write down an expression, in terms of x, for the perimeter of the shape. **[3 marks]**



Use the lengths you are given to work out the missing lengths.
Add all the lengths together.
List them in order, so you won't miss any.

Exam focus
Give your answer in its simplest form.

Perimeter $= x + (2x + 1) + (2x + 3) + 3x + (3x + 3) + (5x + 1)$

$= \ldots\ldots x + \ldots\ldots$

.....cm

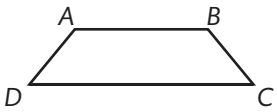
2. Simon sent x parcels on Monday.
On Tuesday, he sent twice as many parcels as on Monday. On Wednesday, he sent 6 fewer parcels than on Monday.
It cost £8 to send each parcel. The total cost of sending all the parcels is £T.

Write down a formula for T in terms of x. **[3 marks]**

.....

3. The diagram shows a trapezium.
$AD = x$ cm. BC is the same length as AD.
AB is twice the length of AD. DC is 5 cm longer than AB.
The perimeter of the trapezium is P cm.

Write down a formula for P in terms of x. **[3 marks]**



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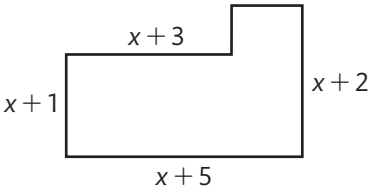
Problem solving
Write the length of each side on the diagram in the order you read them.
$AB = 2 \times x$
$DC = 5 + (2 \times x)$
Then add them together to equal P.

Deriving expressions — Grade 5

4. The diagram shows a shape made from rectangles.
All the measurements are in centimetres. All the corners are right angles.
The area of the shape is A cm^2.
Write down a formula for A in terms of x.

Give your answer in its simplest form. **[4 marks]**



To work out the area you will need to know how to expand two brackets. Practise expanding brackets on page 26.

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Algebraic indices

2 Quick quiz

Simply each expression fully.

(a) $a \times a \times a \times a$ ..... **(b)** $\frac{a \times a \times a \times a \times a \times a}{a \times a}$ ..... **(c)** $6 \times a \times 3 \times a \times b$ ..... **(d)** $3 \times a \times a \times b \times b \times b$ .....

10 Applying laws of indices — Grades 4–5

1. Simplify these expressions.

(a) $p^2 \times p^7$ **[1 mark]**

$= p^{2+7}$

$= p^{\square}$

(b) $x^8 \div x^3$ **[1 mark]**

$= x^{8-3}$

$= x^{\square}$

.....

.....

2. Simplify $\frac{p^7 \times p^3}{p^6}$

Circle your answer. **[1 mark]**

p^{16} p^4 p^{-4} $p^{3.5}$

You can combine powers when the bases are the same. When you multiply, add the powers.

When you divide, subtract the powers.

3. Simplify these expressions.

(a) $\frac{q^3 \times q^4 \times q}{q^2}$ **[2 marks]** **(b)** $(y^4)^3$ **[2 marks]** **(c)** $(3x^2)^3$ **[2 marks]**

.....

.....

.....

(d) $3x^2y \times 5xy^3$ **[2 marks]** **(e)** $\frac{20x^5y^3}{12xy}$ **[2 marks]**

.....

.....

When you raise a power to a power, multiply the powers.

In part **(c)** you need to raise a number **and** a power of x to a power.

10 Solving problems with indices — Grade 5

4. $p^5 \times p^x = p^{12}$

Work out the value of x. **[2 marks]**

.....

5. $(5^3)^y = 5^{15}$

Work out the value of y. **[2 marks]**

.....

6. Given that $x = 5^p$ and $y = 5^q$, express the following in terms of x and y.

(a) 5^{p+q} **[1 mark]** **(b)** 5^{3q} **[1 mark]** **(c)** 5^{2p+1} **[1 mark]**

.....

.....

.....

Problem solving

The bases in x and y are the same. For **(a)** find the index law in which you would add the indices together.

7. Write these numbers in order of size. Start with the lowest number. **[2 marks]**

2^{-1} 0.2 -2 2^0

....

Expanding brackets

Quick quiz

Simplify each expression.

(a) $x \times 4$ ..... **(b)** $5 \times y$ ..... **(c)** $v \times v$ ..... **(d)** $a \times 4a$ .....

Expanding brackets — Grades 2–3

1. Expand

(a) $3(a + 5)$ **[1 mark]** **(b)** $5(b - 4)$ **[1 mark]** **(c)** $-4(c + 1)$ **[1 mark]**

Multiply the terms inside the bracket by the term outside the bracket.

$= 3 \times a + 3 \times 5$

$= 3\ldots\ldots + \ldots\ldots$

$= -4 \times \ldots\ldots + -4 \times \ldots\ldots$

$= \ldots\ldots$

Exam focus
Write down your method step by step.

2. Expand these expressions.

(a) $e(e + 2)$ **[1 mark]** **(b)** $2f(f - 3)$ **[1 mark]** **(c)** $-4g(g + 2)$ **[1 mark]** **(d)** $-3h(h - p)$ **[1 mark]**

$2f \times f + 2f \times -3$

$= \ldots\ldots - \ldots\ldots$

Expanding brackets and simplifying expressions — Grade 4

3. Expand and simplify

(a) $8a + 3(a - 2b)$ **[2 marks]** **(b)** $5(x + 7) + 3(x - 2)$ **[2 marks]**

(b) has two sets of brackets separated by an addition. Expand them separately and simplify by collecting like terms.

$= 5 \times x + 5 \times 7 + 3 \times x + 3 \times -2$

$= 5x + \ldots\ldots + 3x + \ldots\ldots$

$= \ldots\ldots + \ldots\ldots$

(c) $5(y - 2) + 2(y - 3)$ **[2 marks]** **(d)** $3m(m + 4) - 2m(4m + 1)$ **[2 marks]** **(e)** $5x(2x + 1) - 3x(3x - 1)$ **[2 marks]**

4. Taylor expands and simplifies $3x(2x - 5) - 4x(x + 3)$. Her working is shown here:

$3x(2x - 5) - 4x(x + 3) = 6x^2 - 5 - 4x^2 - 7x = 2x^2 - 7x - 5$

Identify two mistakes in Taylor's working. **[2 marks]**