NSW CURRICULUM

Year 7

2024 Edition

Sample Teacher Notes & Worked Solutions

Chapter 8

Big Ideas

Big ideas and essential understanding

Big idea

Algebraic expressions serve as the fundamental units of algebra, enabling the representation and analysis of real-world scenarios.

- (8.01) Variables are used to represent unknown values in algebra, allowing them to write and simplify expressions, and solve problems involving unknown quantities.

- (8.02) Algebraic expressions are combinations of variables, coefficients, and constant terms representing unknown numbers, which can be manipulated through basic operations to solve mathematical problems.

- (8.03) Evaluating algebraic expressions using substitution involves replacing the variable with a number and simplifying the answer.

- (8.04) Combining terms with the same variables and powers, known as like terms, is a basic algebra skill that aids in simplifying expressions and preparing for more advanced math problems.

8.04 Collect like terms

Teacher Notes

Lesson narrative

In this lesson, students will explore the concept of like terms in algebraic expressions and learn how to combine like terms using addition and subtraction. They will understand that two algebraic terms are called like terms if they have the same variables with the same powers, regardless of the order the variables are in. Students will practice identifying like terms and learn the process of collecting like terms to simplify expressions.

Through various examples and worked solutions, students will gain confidence in simplifying expressions containing both positive and negative terms. They will also learn the importance of keeping the negative or positive sign on the left of the term with the term. By the end of the lesson, students will be able to effectively combine like terms to simplify algebraic expressions.

Learning objectives

Students will be able to:

- identify like terms.
- combine like terms using addition and subtraction in order to simplify expressions.

Key vocabulary

like terms **collecting like terms**

Essential understanding

Combining terms with the same variables and powers, known as like terms, is a basic algebra skill that aids in simplifying expressions and preparing for more advanced math problems.

Standards

This subtopic addresses the following NSW Curriculum standards.

Content standards

MA4-ALG-C-01.3

extend and apply the laws and properties of arithmetic to algebraic terms and expressions

Teacher introduction

Suggested review

Depending on your students' level of prior knowledge, consider revisiting the following lessons:

7: 8.02 Build algebraic expressions.

Tools

You may find these tools helpful:

- Algebra tiles

Lesson supports

The following supports may be useful for this lesson. More specific supports may appear throughout the lesson:

Combine like terms
Targeted instructional strategies

Literacy exercise: stronger and clearer each time
English language learner support

Simplified instructions and key vocabulary reinforcement
Student with disabilities support

Terms with the same variables
Address student misconceptions

Ideas

Like terms

Combine like terms

Like terms

This section discusses like terms in algebra, which are terms that have the same variables and the same powers, regardless of the order of the variables. It provides examples of like terms and demonstrates how to determine whether or not two terms are like terms.

Combine like terms

This section focuses on combining like terms in algebraic expressions using addition or subtraction to simplify the expressions.

8.04 Collect like terms

Lesson

Introduction

This lesson on adding and subtracting like terms continues from 7: 8.02 Build algebraic expressions.

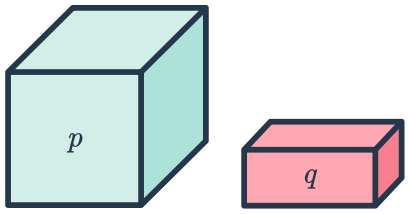
Ideas

Like terms

Combine like terms

Like terms

Algebraic terms are called **like terms** if they have exactly the same variables with the same powers. It doesn't matter what order the variables are in.



p and q are not like terms

$5a$ and $3a$ are like terms.

$-2b$ and $4c$ are not like terms.

$8ab$ and $-2ba$ are like terms.

Examples

Example 1

Are the following like terms: $9y$ and $10y$?

Apply the idea

$9y$ and $10y$ are like terms, because they have the same representation of variables.

Example 2

Are $9uv$ and $5vu$ like terms?

A Yes **B** No

Apply the idea

Because $u \times v$ is always the same as $v \times u$ we can combine terms that have the same variables multiplied by each other, even if the order in which they appear is different.

They have the same representation of variables.

So the answer is option A: Yes

Idea summary

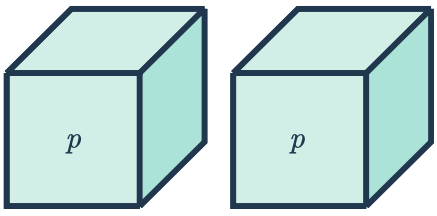
Two algebraic terms are called **like terms** if they have exactly the same variables and the variables have the same power.

It doesn't matter what order the variables are in.

Combine like terms

Like terms can be combined using addition or subtraction to simplify an expression.

For example:



$$p + p = 2p$$

This is called **collecting like terms**.

To simplify the expression $2p + 3p$ we could write out all the p's:

$$2p + 3p = (p + p) + (p + p + p)$$

$$= p + p + p + p + p$$

$$= 5p$$

But it's much quicker to just do:

$$2p + 3p = 5p$$

.

To simplify $2a + 3b + 4a$ we can combine the like terms of $2a$ and $+4a$.

$$2a + 3b + 4a = 6a + 3b$$

To simplify $4x + 3y - 3x$ we combine the x's by doing $4x - 3x$ because there is a negative sign on the left of the $3x$. It's important that the negative or positive sign on the left of any term remains with it.

$$4x + 3y - 3x = x + 3y$$

To simplify $9xy + 4b - 5xy + 2b$ we have two pairs of like terms.

We can combine $9xy$ and $-5xy$ and also $4b$ and $+2b$.

$$9xy + 4b - 5xy + 2b = 4xy + 6b$$

Examples

Example 3

Which of following options correctly simplifies the expression $4b + 3b$?

A $12b$ **B** $7b$ **C** $7bb$ **D** $12b^2$

Create a strategy

We can add the terms all together by finding the sum of their coefficients.

Apply the idea

$$4b + 3b = (4 + 3)b \quad \text{Find the sum of the coefficients}$$

$$= 7b \quad \text{Evaluate the addition}$$

The correct option is B: $7b$.

Example 4

Simplify the expression: $8x + 6y - 2y - 4x$

Create a strategy

To simplify an expression collect all the like terms and subtract.

Apply the idea

$$8x + 6y - 2y - 4x = (8x - 4x) + (6y - 2y) \quad \text{Collect like terms}$$

$$= 4x + 4y \quad \text{Evaluate the subtraction}$$

Example 5

Simplify the expression: $35x \div 5$

Create a strategy

Divide the coefficient of the variable x by the second number.

Apply the idea

$$35x \div 5 = \frac{35}{5}x \quad \text{Divide the coefficient of } x \text{ by } 5$$

$$= 7x \quad \text{Evaluate the division}$$

Idea summary

Like terms can be combined using addition or subtraction to simplify an expression.

It's important that the negative or positive sign on the left of the term stays with the term.

8.04 Collect like terms

Worksheet

Understanding

1 Use the words "same" or "different" to complete:

Like terms have the ⬚ variables raised to the ⬚ power.

2 Describe the following pairs as like terms or unlike terms:

a $7y$ and $6y$

b 2 and -4

c $-13uv$ and $17vu$

d $10z$ and $10b$

e $8y$ and $5y$

f $5ab$ and $-3cb$

g $12mn$ and $18nm$

h $11pr$ and $22rp$

Example 1, 2

3 Write down any pairs of like terms in the following expressions:

a $10m + 2 + 8m + 3$

b $9s - r - 6s + 1$

c $k + 7j - 5 + 4k$

d $10y + 4 + 5x + 3 - y$

e $9 + 9a - 7b + 20 - 11a - 15b$

f $2a - 3b + 9 - 10c$

g $11mn - 15op - 8mn + 22$

h $21 - 17ab - 3cd - 5ab + 7cd$

Fluency

4 Are the following expressions equal to $11y$?

a $5y + 6y$

b $6y - 5y$

c $9 + y + 10y - 9$

d $10y + 1$

5 Are the following expressions equal to $8r + 9$?

a $9 + 8r$

b $17r$

c $9r + 8 - r + 1$

d $10r + 2 - 2r + 7$

6 Are the following expressions equal to $9rt + 8$?

a $5r + 4t + 8$

b $8 + 4rt + 5rt$

c $9r + 8t$

d $17rt$

7 For each of the following expressions:

i Name any pairs of like terms.

ii Simplify the expression.

a $5u + 7 + 8u + 8$

b $7u + 2v - 7u$

c $4x - 6 + 5x$

d $12 + 6x + 7y - 8$

8 Simplify the following where possible:

a $2a + 5a$

b $2b + 3b$

c $7 + 6a$

d $4x + 7x - 5$

e $15b - 7b + 10 + 1$

f $9 + 7m - 2 + 3m$

g $9 + 7m - 2p + 3q$

h $10x + 12 + 6x - 7$

i $12y - 3y + 1$

j $3c + 4c + 7c$

k $15x - 6x - 2x$

l $19b - 12b - 6b$

m $-3n + 6n + 3n$

n $8x - 3x + 7x$

o $4xy + 10xy - 9xy$

p $10ab + 3ab - 8ba$

Example 3

9 Simplify:

a $7m + 8n + 3m + 2n$

b $11m + 8n + 14m$

c $9xy + 20 + 12yx - 3$

d $6p + 8q - 6p$

e $8x + 9y - 5x + 10y$

f $7a + 11a + 9b - b$

g $8x + 6y - 2y - 4x + 2 + 3$

h $10m + 7 + 9n + 5m + 10n$

i $8x + 10 - 7y - 6z + 10z + 3$

j $19a + 8b - 4c - 8a + b$

k $2ab - 7c + ab + 9c$

l $12j + 7 + 9k - 7k + 11j - 2$

m $18x - 9y + 7x + 11y + 11$

n $11y - 6z + y + 6z + 12 - 10$

o $13m + 2n - 8m + 10n$

p $-3s + 6t + 9s - 4t$

Example 4

10 Simplify:

a $x + x + x + x$

b $2n + n + n$

c $3m + 2m + m$

d $4k + k + 3k$

e $y \times 2$

f $9 \times l$

g $15 \times h$

h $21 \times x$

i $18z \div 3$

j $36a \div 6$

k $\frac{16b}{4}$

l $\frac{40c}{5}$

Example 5

11 Simplify:

a $5x - 2y + 8x + 4 + 6z + 3y + 4z + 2$

b $2xy + 5yz + 4xz + 8xy + 2xz - 3yz + 3$

c $20 + 9x - 4y + 6y + 7x + 21$

d $9mn - 8m - 7n + 7n + 10m + 2nm$

e $11s + 6t + 3st - 2ts + t + 10 - 4s - 5$

f $13ab - 8bc + 6ba - 9b + 11cb$

Reasoning

12 Why do you think we write y and not $1y$ when using algebra?

13 Are the following like terms: $5abc$ and $-9acb$? Explain your answer.

14 Substitute the values $x = 5, x = 100$ and $x = 0.5$ and show that $6x + 2x - x$ is equal to $7x$.

15

a Simplify the following:

i $5x + 5x + 5x$

ii $4p + 4p + 4p + 4p + 4p$

iii $-3c - 3c - 3c - 3c$

iv $0.5k + 0.5k + 0.5k$

b Review your results for part (a) and explain how the answer to $7 \times 5m$ can be calculated.

Problem-solving

16 Complete the following statements:

a $2x + \square = 8x$

b $3y + 3 + \square + 5 = 8y + 8$

c $7x - 5x + 10 - \square = 2x + 1$

d $9x + 4y + \square = 9x + 6y$

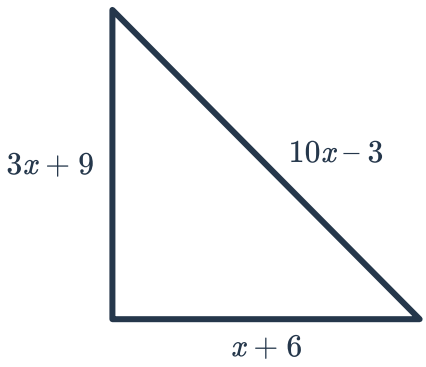
e $7x + \square + 10y - \square = 11x + 6y$

f $8ab + \square + 9b + 6ab = \square + 11b$

17 Consider the triangle shown.

a Write an expression for the perimeter of the triangle in terms of x.

b Simplify the expression.



18 Each side of a square is $3a$ metres in length. Calculate the distance around the outside of the square.

19 A library has a courtyard in the shape of an equilateral triangle with sides of length $5y$ metres. Calculate the distance around the outside of the courtyard.

20 Sam and Max each exercise for x minutes per day. Sam burns 8 calories per minute and Max burns 10 calories per minute.

- **a** Write an expression for the number of calories Sam burns in one day.
- **b** Write an expression for the number of calories Max burns in one day.
- **c** Write a simplified expression for the total number of calories Sam and Max burn in one day.

21 Ali, Ben and Mohammed each work for h hours per day. Ali earns $\$15$ per hour, Ben earns $\$20$ per hour and Mohammed earns $\$35$ per hour.

- **a** Write an expression for the amount Ali earns in one day.
- **b** Write an expression for the amount Ben earns in one day.
- **c** Write an expression for the amount Mohammed earns in one day.
- **d** Write a simplified expression for the total amount the three employees earn in one day.
- **e** If they work 8 hours in one day, how much do they earn altogether?

22 Sarah and Emily each read n pages per day. Sarah reads 15 pages per hour and Emily reads 20 pages per hour.

- **a** Write an expression for the number of hours Sarah spends reading in one day.
- **b** Write an expression for the number of hours Emily spends reading in one day.
- **c** Write a simplified expression for the total number of hours Sarah and Emily spend reading in one day.
- **d** If they read a total of 120 pages, how many hours did they spend reading altogether?

8.04 Collect like terms

Worked Solutions

Understanding

1 Like terms have the same variables raised to the same power because they can be combined through addition or subtraction due to their similar structure. In other words, like terms have the same variable part, which allows them to be added or subtracted. For example, $3x$ and $5x$ are like terms because they both have the variable x raised to the power of 1.

2

a Like terms, because both terms have the same variable y.

b Like terms, because both terms are constants without any variables.

c Like terms, because both terms have the same variables u and v.

d Unlike terms, because the terms have different variables z and b.

e Like terms, because both terms have the same variable y.

f Unlike terms, because the terms have different variables a and c.

g Like terms, because both terms have the same variables m and n.

h Like terms, because both terms have the same variables p and r.

Example 1, 2

3

a Like terms in the expression $10m + 2 + 8m + 3$ are $10m$ and $8m$, because they both have the same variable m. The constants 2 and 3 are also like terms because they are both constants without any variables.

b Like terms in the expression $9s - r - 6s + 1$ are $9s$ and $-6s$, because they both have the same variable s.

c Like terms in the expression $k + 7j - 5 + 4k$ are k and $4k$, because they both have the same variable k. The constants $7j$ and -5 are not like terms because they have different variables or no variables.

d Like terms in the expression $10y + 4 + 5x + 3 - y$ are $10y$ and $-y$, because they both have the same variable y. The constants 4 and 3 are also like terms because they are both constants without any variables.

e Like terms in the expression $9 + 9a - 7b + 20 - 11a - 15b$ are $9a$ and $-11a$, because they both have the same variable a. The terms $-7b$ and $-15b$ are also like terms because they both have the same variable b. The constants 9 and 20 are like terms because they are both constants without any variables.

f The expression $2a - 3b + 9 - 10c$ does not contain any like terms, because all the terms have different variables or no variables.

g Like terms in the expression $11mn - 15op - 8mn + 22$ are $11mn$ and $-8mn$, because they both have the same variables mn.

h Like terms in the expression $21 - 17ab - 3cd - 5ab + 7cd$ are $-17ab$ and $-5ab$, because they both have the same variables ab. The terms $-3cd$ and $7cd$ are also like terms because they both have the same variables cd.

Fluency

4

a

$$5y + 6y = 11y \quad \text{Combine the like terms}$$

Yes, because $5y + 6y$ is equal to $11y$ when you combine the like terms.

b

$$6y - 5y = y \quad \text{Subtract the like terms}$$

No, because $6y - 5y$ is equal to y, which is not equal to $11y$.

c

$$9 + y + 10y - 9 = 11y \quad \text{Combine the like terms and eliminate the constants}$$

Yes, because $9 + y + 10y - 9$ simplifies to $11y$ when you combine the like terms and eliminate the constants.

d No, because $10y + 1$ is not equal to $11y$ as there is an additional constant term.

5

a Yes, because $9 + 8r$ is equal to $8r + 9$ when you rearrange the terms.

b No, because $17r$ is not equal to $8r + 9$ as there is no constant term.

c

$$9r + 8 - r + 1 = 8r + 9 \quad \text{Combine the like terms and constants}$$

Yes, because $9r + 8 - r + 1$ simplifies to $8r + 9$ when you combine the like terms and constants.

d

$$10r + 2 - 2r + 7 = 8r + 9 \quad \text{Combine the like terms and constants}$$

Yes, because $10r + 2 - 2r + 7$ simplifies to $8r + 9$ when you combine the like terms and constants.

6

a No, because $5r + 4t + 8$ is not equal to $9rt + 8$ as the terms are not like terms.

b

$$8 + 4rt + 5rt = 9rt + 8 \quad \text{Combine the like terms and constants}$$

Yes, because $8 + 4rt + 5rt$ simplifies to $9rt + 8$ when you combine the like terms and constants.

c No, because $9r + 8t$ is not equal to $9rt + 8$ as the terms are not like terms.

d No, because $17rt$ is not equal to $9rt + 8$ as there is no constant term.

7

a

i $5u$ and $8u$, 7 and 8

ii

$$\begin{aligned} 5u + 7 + 8u + 8 &= (5u + 8u) + (7 + 8) && \text{Combine like terms} \\ &= 13u + 15 && \text{Evaluate the addition} \end{aligned}$$

b

i $7u$ and $-7u$

ii

$$\begin{aligned} 7u + 2v - 7u &= (7 - 7)u + 2v && \text{Combine coefficients of like terms} \\ &= 2v && \text{Evaluate the subtraction} \end{aligned}$$

c

i $4x$ and $5x$

ii

$$\begin{aligned} 4x - 6 + 5x &= (4x + 5x) - 6 && \text{Combine like terms} \\ &= 9x - 6 && \text{Evaluate the addition} \end{aligned}$$

d

i 12 and -8

ii

$$\begin{aligned} 12 + 6x + 7y - 8 &= 6x + 7y + (12 - 8) && \text{Combine like terms} \\ &= 6x + 7y + 4 && \text{Subtract the constants} \end{aligned}$$

8 Simplify the following where possible:

a

$$2a + 5a = (2 + 5)a \quad \text{Combine coefficients of like terms}$$

$$= 7a \quad \text{Evaluate the addition}$$

b

$$2b + 3b = (2 + 3)b \quad \text{Combine coefficients of like terms}$$

$$= 5b \quad \text{Evaluate the addition}$$

c

$$7 + 6a = 7 + 6a \quad \text{No like terms to combine}$$

d

$$4x + 7x - 5 = (4 + 7)x - 5 \quad \text{Combine coefficients of like terms}$$

$$= 11x - 5 \quad \text{Evaluate the addition}$$

e

$$15b - 7b + 10 + 1 = (15 - 7)b + (10 + 1) \quad \text{Combine coefficients of like terms and constants}$$

$$= 8b + 11 \quad \text{Evaluate}$$

f

$$9 + 7m - 2 + 3m = (9 - 2) + (7 + 3)m \quad \text{Combine constants and coefficients of like terms}$$

$$= 10m + 7 \quad \text{Evaluate}$$

g

$$9 + 7m - 2p + 3q = 9 + 7m - 2p + 3q \quad \text{No like terms to combine}$$

h

$$10x + 12 + 6x - 7 = (10 + 6)x + (12 - 7) \quad \text{Combine coefficients of like terms and constants}$$

$$= 16x + 5 \quad \text{Evaluate}$$

i

$$12y - 3y + 1 = (12 - 3)y + 1 \quad \text{Combine coefficients of like terms}$$

$$= 9y + 1 \quad \text{Evaluate the subtraction}$$

j

$$3c + 4c + 7c = (3 + 4 + 7)c \quad \text{Combine coefficients of like terms}$$

$$= 14c \quad \text{Evaluate the addition}$$

k

$$15x - 6x - 2x = (15 - 6 - 2)x \quad \text{Combine coefficients of like terms}$$

$$= 7x \quad \text{Evaluate the subtraction}$$

l

$$19b - 12b - 6b = (19 - 12 - 6)b \quad \text{Combine coefficients of like terms}$$

$$= b \quad \text{Evaluate the subtraction}$$

m

$$-3n + 6n + 3n = (-3 + 6 + 3)n \quad \text{Combine coefficients of like terms}$$

$$= 6n \quad \text{Evaluate the addition}$$

n

$$8x - 3x + 7x = (8 - 3 + 7)x \quad \text{Combine coefficients of like terms}$$

$$= 12x \quad \text{Evaluate}$$

o

$$4xy + 10xy - 9xy = (4 + 10 - 9)xy \quad \text{Combine coefficients of like terms}$$

$$= 5xy \quad \text{Evaluate}$$

p

$$10ab + 3ab - 8ba = (10 + 3 - 8)ab \quad \text{Combine coefficients of like terms}$$

$$= 5ab \quad \text{Evaluate}$$

Example 3

9 Simplify:

a

$$7m + 8n + 3m + 2n = (7 + 3)m + (8 + 2)n \quad \text{Combine coefficients of like terms}$$

$$= 10m + 10n \quad \text{Evaluate the addition}$$

b

$$11m + 8n + 14m = (11 + 14)m + 8n \quad \text{Combine coefficients of like terms}$$

$$= 25m + 8n \quad \text{Evaluate the addition}$$

c

$$9xy + 20 + 12yx - 3 = (9 + 12)xy + (20 - 3) \quad \text{Combine coefficients of like terms and constants}$$

$$= 21xy + 17 \quad \text{Evaluate}$$

d

$$6p + 8q - 6p = (6 - 6)p + 8q \quad \text{Combine coefficients of like terms}$$

$$= 8q \quad \text{Evaluate the subtraction}$$

e

$$8x + 9y - 5x + 10y = (8 - 5)x + (9 + 10)y \quad \text{Combine coefficients of like terms}$$

$$= 3x + 19y \quad \text{Evaluate}$$

f

$$7a + 11a + 9b - b = (7 + 11)a + (9 - 1)b \quad \text{Combine coefficients of like terms}$$

$$= 18a + 8b \quad \text{Evaluate}$$

g

$$8x + 6y - 2y - 4x + 2 + 3 = (8 - 4)x + (6 - 2)y + (2 + 3) \quad \text{Combine coefficients of like terms and constants}$$

$$= 4x + 4y + 5 \quad \text{Evaluate}$$

h

$$10m + 7 + 9n + 5m + 10n = (10 + 5)m + (9 + 10)n + 7 \quad \text{Combine coefficients of like terms and constants}$$

$$= 15m + 19n + 7 \quad \text{Evaluate the addition}$$

i

$8x + 10 - 7y - 6z + 10z + 3 = 8x - 7y + (10 - 6)z + (10 + 3)$ Combine coefficients of like terms and constants

$= 8x - 7y + 4z + 13$ Evaluate

j

$19a + 8b - 4c - 8a + b = (19 - 8)a + (8 + 1)b - 4c$ Combine coefficients of like terms

$= 11a + 9b - 4c$ Evaluate

k

$2ab - 7c + ab + 9c = (2 + 1)ab + (-7 + 9)c$ Combine coefficients of like terms

$= 3ab + 2c$ Evaluate the addition

l

$12j + 7 + 9k - 7k + 11j - 2 = (12 + 11)j + (9 - 7)k + (7 - 2)$ Combine coefficients of like terms and constants

$= 23j + 2k + 5$ Evaluate

m

$18x - 9y + 7x + 11y + 11 = (18 + 7)x + (-9 + 11)y + 11$ Combine coefficients of like terms and constants

$= 25x + 2y + 11$ Evaluate

n

$11y - 6z + y + 6z + 12 - 10 = (11 + 1)y + (-6 + 6)z + (12 - 10)$ Combine coefficients of like terms and constants

$= 12y + 2$ Evaluate

o

$13m + 2n - 8m + 10n = (13 - 8)m + (2 + 10)n$ Combine coefficients of like terms

$= 5m + 12n$ Evaluate

p

$$-3s + 6t + 9s - 4t = (-3 + 9)s + (6 - 4)t \quad \text{Combine coefficients of like terms}$$

$$= 6s + 2t \quad \text{Evaluate}$$

Example 4

10 Simplify:

a

$$x + x + x + x = (1 + 1 + 1 + 1)x \quad \text{Add the coefficients}$$

$$= 4x \quad \text{Evaluate the addition}$$

b

$$2n + n + n = (2 + 1 + 1)n \quad \text{Add the coefficients}$$

$$= 4n \quad \text{Evaluate the addition}$$

c

$$3m + 2m + m = (3 + 2 + 1)m \quad \text{Add the coefficients}$$

$$= 6m \quad \text{Evaluate the addition}$$

d

$$4k + k + 3k = (4 + 1 + 3)k \quad \text{Add the coefficients}$$

$$= 8k \quad \text{Evaluate the addition}$$

e

$$y \times 2 = 2y \quad \text{Multiply the variable by the coefficient}$$

f

$$9 \times l = 9l \quad \text{Multiply the variable by the coefficient}$$

g

$$15 \times h = 15h \quad \text{Multiply the variable by the coefficient}$$

h

$$21 \times x = 21x \quad \text{Multiply the variable by the coefficient}$$

i

$$18z \div 3 = \frac{18}{3}z \quad \text{Divide the coefficient of } z \text{ by } 3$$

$$= 6z \quad \text{Evaluate the division}$$

j

$$36a \div 6 = \frac{36}{6}a \quad \text{Divide the coefficient of } a \text{ by } 6$$

$$= 6a \quad \text{Evaluate the division}$$

k

$$\frac{16b}{4} = \frac{16}{4}b \quad \text{Divide the coefficient of } b \text{ by } 4$$

$$= 4b \quad \text{Evaluate the division}$$

l

$$\frac{40c}{5} = \frac{40}{5}c \quad \text{Divide the coefficient of } c \text{ by } 5$$

$$= 8c \quad \text{Evaluate the division}$$

Example 5

11

a

$$5x - 2y + 8x + 4 + 6z + 3y + 4z + 2 = (5x + 8x) + (-2y + 3y) + (6z + 4z) + (4 + 2) \quad \text{Group like terms}$$

$$= 13x + y + 10z + 6 \quad \text{Simplify the grouped terms}$$

b $2xy + 5yz + 4xz + 8xy + 2xz - 3yz + 3 = (2xy + 8xy) + (5yz - 3yz) + (4xz + 2xz) + 3$ Group like terms

$$= 10xy + 2yz + 6xz + 3 \quad \text{Simplify the grouped terms}$$

c

$$20 + 9x - 4y + 6y + 7x + 21 = (9x + 7x) + (-4y + 6y) + (20 + 21)$$ Group like terms

$$= 16x + 2y + 41$$ Simplify the grouped terms

d

$$9mn - 8m - 7n + 7n + 10m + 2nm = (9mn + 2nm) + (-8m + 10m) + (-7n + 7n)$$ Group like terms

$$= 11mn + 2m$$ Simplify the grouped terms

e

$$11s + 6t + 3st - 2ts + t + 10 - 4s - 5 = (11s - 4s) + (6t + t) + (3st - 2ts) + (10 - 5)$$ Group like terms

$$= 7s + 7t + st + 5$$ Simplify the grouped terms

f

$$13ab - 8bc + 6ba - 9b + 11cb = (13ab + 6ba) + (-8bc + 11cb) - 9b$$ Group like terms

$$= 19ab + 3bc - 9b$$ Simplify the grouped terms

Reasoning

12 In the expression $1 \times y$, the coefficient of y is 1. Since any number multiplied by 1 is itself, the expression simplifies to just y. Therefore, the 1 is not needed, and the simplified expression is y.

13 The expressions $5abc$ and $-9acb$ are like terms because they have the same variables (a, b, and c), and each variable is raised to the same power (1). The order of multiplication does not matter, so abc is equivalent to acb. Since they have the same variables raised to the same power, they are like terms.

14 To show that $6x + 2x - x = 7x$, we can test the equality for different values of x:

$$\begin{aligned} 7x &= 6(5) + 2(5) - 5 && \text{Substitute } x = 5 \text{ into the expression} \\ &= 30 + 10 - 5 && \text{Perform the multiplication} \\ &= 35 && \text{Perform the addition and subtraction} \\ 7(5) &= 35 && \text{Check if the result is equal to } 7x \text{ when } x = 5 \end{aligned}$$

We can repeat this process for other values of x, such as $x = 100$ and $x = 0.5$, and find that the equality holds true for these values as well. Therefore, we can conclude that $6x + 2x - x = 7x$.

15

a Simplify the following:

i To simplify $5x + 5x + 5x$, we can add the coefficients of the like terms, which are all x terms. There are three $5x$ terms, so the simplified expression is $15x$.

ii To simplify $4p + 4p + 4p + 4p + 4p$, we can add the coefficients of the like terms, which are all p terms. There are five $4p$ terms, so the simplified expression is $20p$.

iii To simplify $-3c - 3c - 3c - 3c$, we can add the coefficients of the like terms, which are all c terms. There are four $-3c$ terms, so the simplified expression is $-12c$.

iv To simplify $0.5k + 0.5k + 0.5k$, we can add the coefficients of the like terms, which are all k terms. There are three $0.5k$ terms, so the simplified expression is $1.5k$.

b To calculate the answer to $7 \times 5m$, we can multiply the coefficient of the m term, which is 5, by the number 7. This gives us $35m$ as the simplified expression.

Problem-solving

16

a To complete the statement $2x + \square = 8x$, we need to find the missing term that makes the equation true. Since there are $2x$ on the left side and $8x$ on the right side, the missing term should be $6x$. So, the completed statement is $2x + 6x = 8x$.

b To complete the statement $3y + 3 + \square + 5 = 8y + 8$, we need to find the missing term that makes the equation true. Since there are $3y$ on the left side and $8y$ on the right side, the missing term should be $5y$. So, the completed statement is $3y + 3 + 5y + 5 = 8y + 8$.

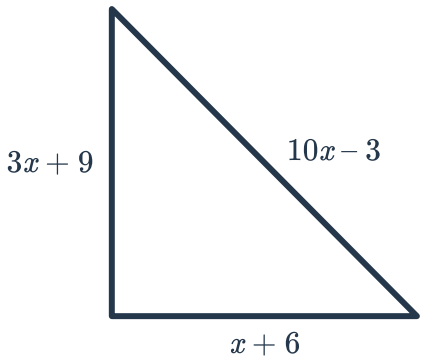
c To complete the statement $7x - 5x + 10 - \square = 2x + 1$, we need to find the missing term that makes the equation true. Since there are $7x - 5x = 2x$ on the left side and $2x$ on the right side, the missing term should be 9. So, the completed statement is $7x - 5x + 10 - 9 = 2x + 1$.

d To complete the statement $9x + 4y + \square = 9x + 6y$, we need to find the missing term that makes the equation true. Since there are $4y$ on the left side and $6y$ on the right side, the missing term should be $2y$. So, the completed statement is $9x + 4y + 2y = 9x + 6y$.

e To complete the statement $7x + \square + 10y - \square = 11x + 6y$, we need to find the missing terms that make the equation true. Since there are $7x$ on the left side and $11x$ on the right side, the first missing term should be $4x$. Since there are $10y$ on the left side and $6y$ on the right side, the second missing term should be $4y$. So, the completed statement is $7x + 4x + 10y - 4y = 11x + 6y$.

f To complete the statement $8ab + \square + 9b + 6ab = \square + 11b$, we need to find the missing terms that make the equation true. Since there are $8ab + 6ab = 14ab$ on the left side, the first missing term should be $14ab$. Since there are $9b$ on the left side and $11b$ on the right side, the second missing term should be $2b$. So, the completed statement is $8ab + 2b + 9b + 6ab = 14ab + 11b$.

17



a To write an expression for the perimeter of the triangle in terms of x, we need to add the side lengths of the triangle. So, the expression is $3x + 9 + 10x - 3 + x + 6$.

b To simplify the expression, we need to combine like terms. So, the simplified expression is $14x + 12$.

18 Each side of a square is $3a$ metres in length. To calculate the distance around the outside of the square, we need to add the lengths of all four sides. Since each side is $3a$, the total distance around the square is $3a + 3a + 3a + 3a$, which simplifies to $12a$ metres.

19 A library has a courtyard in the shape of an equilateral triangle with sides of length $5y$ metres. To calculate the distance around the outside of the courtyard, we need to add the lengths of all three sides. Since each side is $5y$, the total distance around the courtyard is $5y + 5y + 5y$, which simplifies to $15y$ metres.

20

a To write an expression for the number of calories Sam burns in one day, we need to multiply the number of minutes Sam exercises by the number of calories burned per minute. So, the expression is $8x$.

b To write an expression for the number of calories Max burns in one day, we need to multiply the number of minutes Max exercises by the number of calories burned per minute. So, the expression is $10x$.

c To write a simplified expression for the total number of calories Sam and Max burn in one day, we need to add the expressions for the number of calories each of them burns. So, the expression is $8x + 10x$, which simplifies to $18x$.

21

a To write an expression for the amount Ali earns in one day, we need to multiply the number of hours Ali works by the hourly wage. So, the expression is $15h$.

b To write an expression for the amount Ben earns in one day, we need to multiply the number of hours Ben works by the hourly wage. So, the expression is $20h$.

c To write an expression for the amount Mohammed earns in one day, we need to multiply the number of hours Mohammed works by the hourly wage. So, the expression is $35h$.

d To write a simplified expression for the total amount the three employees earn in one day, we need to add the expressions for the amount each of them earns. So, the expression is $15h + 20h + 35h$, which simplifies to $\$70h$.

e If they work 8 hours in one day, we need to substitute the value of h in the expression $\$70h$. So, the total amount they earn is $\$70(8)$, which simplifies to $\$560$.

22

a To write an expression for the number of hours Sarah spends reading in one day, we need to divide the number of pages Sarah reads by the number of pages per hour. So, the expression is $\frac{n}{15}$.

b To write an expression for the number of hours Emily spends reading in one day, we need to divide the number of pages Emily reads by the number of pages per hour. So, the expression is $\frac{n}{20}$.

c To write a simplified expression for the total number of hours Sarah and Emily spend reading in one day, we need to add the expressions for the number of hours each of them spends reading. So, the expression is $\frac{n}{15} + \frac{n}{20}$, which simplifies to $\frac{7n}{60}$.

d If they read a total of 120 pages, we need to substitute the value of n in the expression $\frac{7n}{60}$. So, the total number of hours they spend reading is $\frac{7(120)}{60}$, which simplifies to 14 hours.

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