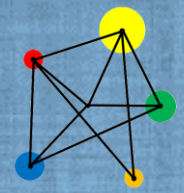
Simplifying Expressions



Recognise like terms

Simplify an expression by collecting like terms

Vocabulary

Expression
A collection of letters and numbers.

Collecting like terms – key facts

In an expression, we use the phrase **like terms** to describe parts of the expression that can be collected together.

$a + a = 2a$

$b + 2b = 3b$

$2c^2 + 5c^2 = 7c^2$

Example

Collect like terms to simplify this expression.

$$3x + 2y + 6x + z + 5y$$

Solution

$3x + 2y + 6x + z + 5y$

$= 9x + 7y + z$

You try…

Simplify these expressions:

a) $b + b + b$

b) $c + 2d + 4c - 5d$

c) $x^2 + x + 3x^2 - 6x$

d) $pqr + qrp + rpq$

Solutions

Simplify these expressions:

a) $b + b + b$

$= 3b$

b) $c + 2d + 4c - 5d$

$= 5c - 3d$

c) $x^2 + x + 3x^2 - 6x$

$= 4x^2 - 5x$

d) $pqr + qrp + rpq$

$= 3pqr$

Discuss

Separate these expressions into three groups of like terms.

$3x^2$ 3 $2x^2$

$3x$ $-2x$ 5

1	
2	
3	

Solution

Separate these expressions into three groups of like terms.

1	3	5
2	3x	-2x
3	$2x^2$	3x2

Question

Which of these expressions are equivalent to 6y?

$y + 5$

$2y \times 3$

$3y + 2y$

$2y \times 3y$

$12y \div 2$

$8y - 2y$

$7y - 1$

Solution

Which of these expressions are equivalent to 6y?

$y + 5$

$2y \times 3$ ✓

$3y + 2y$

$2y \times 3y$

$12y \div 2$ ✓

$8y - 2y$ ✓

$7y - 1$

Exercise

Simplify these expressions:

1. $x + x + x + x$
2. $y + 2y$
3. $3m + 4m$
4. $6c - c$
5. $5t - t + t$
6. $4b - b - 3b$

Simplify these expressions:

1. $2m + 3m - 4m$
2. $x + y + x - y$
3. $4p - 6p + 3p$
4. $8n - 15n$
5. $8 - q - q - q$

Simplify these expressions:

1. $-a - 2a - 3a$
2. $\frac{2c + 8 + 4c + 1}{3}$
3. $\mathrm{r} + 2 \times r$

Solutions

Simplify these expressions:

1. $x + x + x + x = \mathbf{4x}$
2. $y + 2y = \mathbf{3y}$
3. $3m + 4m = \mathbf{7m}$
4. $6c - c = \mathbf{5c}$
5. $5t - t + t = \mathbf{5t}$
6. $4b - b - 3b = \mathbf{0}$

Simplify these expressions:

1. $2m + 3m - 4m = \mathbf{m}$
2. $x + y + x - y = \mathbf{2x}$
3. $4p - 6p + 3p = \mathbf{p}$
4. $8n - 15n = \mathbf{-7n}$
5. $8 - q - q - q = \mathbf{8 - 3q}$

Simplify these expressions:

1. $-a - 2a - 3a = \mathbf{-6a}$
2. $\dfrac{2c + 8 + 4c + 1}{3} = \mathbf{2c + 3}$
3. $\mathrm{r} + 2 \times r = \mathbf{3r}$

Simplify each expression by collecting like terms.

1. $c + c + c + c$
2. $e + 2e - e + 5e$
3. $p + q + p + q$
4. $6t + w + 4t + v$
5. $10 + a + 5 - a$
6. $d^2 + d + d^2 + 2d$
7. $5p + p^2 - 2p^2 + p$
8. $a^3 + a^2 – a^3 + a^2$
9. $2d^3 + 6d^2 – 4d^3 + d^2$
10. $t^2 + t^2 + t^2$
11. $2a + 3b^2 – 2a^2 + 3a + b^2$
12. $w + w^2 + w^3$

Simplify each expression by collecting like terms.

1. $c + c + c + c$

   $= 4c$

2. $e + 2e - e + 5e$

   $= 7e$

3. $p + q + p + q$

   $= 2p + 2q$

4. $6t + w + 4t + v$

   $= 10t + v + w$

5. $10 + a + 5 - a$

   $= 15$

6. $d^2 + d + d^2 + 2d$

   $= 2d^2 + 3d$

7. $5p + p^2 - 2p^2 + p$

   $= 6p - p^2$

8. $a^3 + a^2 - a^3 + a^2$

   $= 2a^2$

9. $2d^3 + 6d^2 - 4d^3 + d^2$

   $= 7d^2 - 2d^3$

10. $t^2 + t^2 + t^2$

    $= 3t^2$

11. $2a + 3b^2 - 2a^2 + 3a + b^2$

    $= 5a - 2a^2 + 4b^2$

12. $w + w^2 + w^3$

    Cannot be simplified

Multiplying Expressions

Simplify these expressions:

$a \times a \times a \times a$

$k^3 \times k^5$

$2m^3 \times m^3$

Multiplying Expressions

Simplify these expressions:

$a \times a \times a \times a$

$= a^4$

$k^3 \times k^5$

$= k^8$

$2m^3 \times m^3$

$= 2m^6$

Exercise

Simplify these expressions:

1. $d \times d$
2. $c \times c \times c$
3. $a \times b \times c$
4. $2a \times 2b$
5. $3c \times 4c$
6. $t^2 \times t^9$

Simplify these expressions:

1. $6fg \times f$
2. $18cd \times cd$
3. $w \times 2w \times 3w$
4. $(2x)^2$
5. $(3t^5)^3$

True or false:

1. $2x > x^2$
2. $(2p)^2$ is sometimes odd when p is an integer

Solutions

Simplify these expressions:

1. $d \times d = \boldsymbol{d^2}$
2. $c \times c \times c = \boldsymbol{c^3}$
3. $a \times b \times c = \boldsymbol{abc}$
4. $2a \times 2b = \boldsymbol{4ab}$
5. $3c \times 4c = \boldsymbol{12c^2}$
6. $t^2 \times t^9 = \boldsymbol{t^{11}}$

Simplify these expressions:

1. $6fg \times f = \boldsymbol{6f^2g}$
2. $18cd \times cd = \boldsymbol{18c^2d^2}$
3. $w \times 2w \times 3w = \boldsymbol{6w^3}$
4. $(2x)^2 = \boldsymbol{4x^2}$
5. $(3t^5)^3 = \boldsymbol{27t^{15}}$

True or false:

1. $2x > x^2$

   $\boldsymbol{True\ only\ for\ 0 < x < 2}$

2. $(2p)^2$ is sometimes odd when p is an integer $\boldsymbol{False}$

Dividing expressions

Simplify these expressions:

a) $\frac{5c}{10}$

b) $\frac{9x^2}{6x}$

c) $\frac{2m^5n}{8m^2n^2}$

Dividing expressions

Simplify these expressions:

a) $\frac{5c}{10}$

$= \boldsymbol{\frac{c}{2}}$

b) $\frac{9x^2}{6x}$

$= \boldsymbol{\frac{3x}{2}}$

c) $\frac{2m^5n}{8m^2n^2}$

$= \boldsymbol{\frac{m^3}{4n}}$

Simplify these expressions:

1. $\frac{4b}{2}$
2. $\frac{2x}{4}$
3. $\frac{def}{ef}$
4. $\frac{4x^3}{2x}$
5. $8a^2b \div 2ab$
6. $\frac{t^8}{t^5}$

Simplify these expressions:

1. $\frac{4m^2n}{2mn}$
2. $\frac{8^7}{8^4}$
3. $\frac{w^2 \times w^7}{w^3}$
4. $\frac{6p^3 \times 2ap}{4a}$
5. $\frac{3d^2 \times 6d^3}{7d^2}$
6. $\frac{2}{b} \div \frac{b^2}{4}$

Copy and complete:

1. $\frac{10y^8}{\square} = 5y^4$
2. $\frac{4x^2z^3 \times \square}{2xz^3} = 2x^2z$

Simplify these expressions:

1. $\frac{4b}{2} = \mathbf{2b}$
2. $\frac{2x}{4} = \mathbf{\frac{x}{2}}$
3. $\frac{def}{ef} = \mathbf{d}$
4. $\frac{4x^3}{2x} = \mathbf{2x^2}$
5. $8a^2b \div 2ab = \mathbf{4a}$
6. $\frac{t^8}{t^5} = \mathbf{t^3}$

Simplify these expressions:

1. $\frac{4m^2n}{2mn} = \mathbf{2m}$
2. $\frac{8^7}{8^4} = \mathbf{8^3}$
3. $\frac{w^2 \times w^7}{w^3} = \mathbf{w^6}$
4. $\frac{6p^3 \times 2ap}{4a} = \mathbf{3p^4}$
5. $\frac{3d^2 \times 6d^3}{7d^2} = \mathbf{\frac{18d^3}{7}}$
6. $\frac{2}{b} \div \frac{b^2}{4} = \mathbf{\frac{8}{b^3}}$

Copy and complete:

1. $\frac{10y^8}{\boxed{\mathbf{2y^4}}} = 5y^4$
2. $\frac{4x^2z^3 \times \boxed{\mathbf{xz}}}{2xz^3} = 2x^2z$

Exercise

Simplify these expressions:

1. $b + b + b$
2. $c \times c \times c$
3. $m^2 + m^2 + m^2$
4. $d + d^2 + d + d^2$
5. $p^3 + p^2 - p^3 + 2p^2$
6. $4xy + xy$

Simplify these expressions:

1. $bc + cb$
2. $2x^2 + y - 4x^2 - y$
3. $10 - 5q^2 - q^2$
4. $2(a + b) + b$
5. $t \times t \times t + t^3$

Simplify these expressions:

1. $(a + 1)^2$
2. $\sqrt{x^{10}}$
3. $\dfrac{(a + 3)}{2(a + 3)}$

Solutions

Simplify these expressions:

1. $b + b + b$ $= \mathbf{3b}$
2. $c \times c \times c$ $= \mathbf{c^3}$
3. $m^2 + m^2 + m^2$ $= \mathbf{3m^2}$
4. $d + d^2 + d + d^2$ $= \mathbf{2d + 2d^2}$
5. $p^3 + p^2 - p^3 + 2p^2$ $= \mathbf{3p^2}$
6. $4xy + xy$ $= \mathbf{5xy}$

Simplify these expressions:

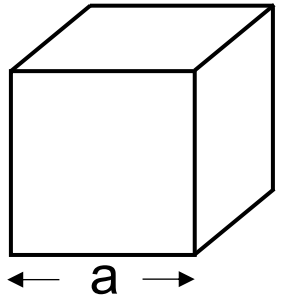
1. $bc + cb$ $= \mathbf{2bc}$
2. $2x^2 + y - 4x^2 - y$ $= \mathbf{-2x^2}$
3. $10 - 5q^2 - q^2$ $= \mathbf{10 - 6q^2}$
4. $2(a + b) + b$ $= \mathbf{2a + 3b}$
5. $t \times t \times t + t^3$ $= \mathbf{2t^3}$

Simplify these expressions:

1. $(a + 1)^2$ $= \mathbf{a^2 + 2a + 1}$
2. $\sqrt{x^{10}}$ $= \mathbf{x^5}$
3. $\dfrac{(a + 3)}{2(a + 3)}$ $= \mathbf{\dfrac{1}{2}}$

Extension

Here is a cube.

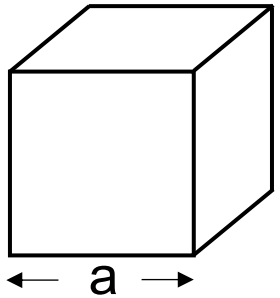


Write down expressions for the surface area and volume of the cube.

Simplify your expressions as far as possible.

Solution

Here is a cube.



Write down expressions for the surface area and volume of the cube.

Simplify your expressions as far as possible.

Surface area = $6a^2$ **Volume = a^3**

Exam Style Question

(a) Simplify $c \times d \times 5$

(b) Simplify $a \times a \times a \times a$

(c) Simplify fully $\dfrac{6 \times j \times j \times j \times j \times k}{4 \times j \times j \times k \times k}$

Solution

(a) Simplify $c \times d \times 5$ **$5cd$**

(b) Simplify $a \times a \times a \times a$ **a^4**

(c) Simplify fully $\dfrac{6 \times j \times j \times j \times j \times k}{4 \times j \times j \times k \times k}$ **$\dfrac{3j^2}{2k}$**