



Recognising equivalent algebraic expressions

Mana Maths

Equivalent Expressions - What It Means

Key idea

Two expressions are **equivalent** when they have the same value for **every** value of the variable.

We write it with $\equiv$: $3(x + 2) \equiv 3x + 6$.

Quick examples

$$a + a + a + a \equiv 4a$$

$$7x - 2x \equiv 5x$$

$$4(y + 3) \equiv 4y + 12$$

Common mistake

Equal for **one** value is not equivalent.

$x^2 = 2x$ when $x = 2$, but at $x = 3$, $9 \neq 6$.

Prove It By Simplifying



Key idea

To check, **simplify both** expressions: collect like terms and expand.

If they reduce to the same form, they are equivalent for every value.

Example

Are $2(x + 4) + x$ and $3x + 8$ equivalent?

$$2(x + 4) + x = 2x + 8 + x = 3x + 8$$

Yes — the left side becomes the right side.

Common mistake

Distribute to **every** term:

$$4(a + 2) \equiv 4a + 8, \text{ not } 4a + 2.$$



= copy this into your book. Boxes without a pencil are just to read.

Find A Missing Value



Key idea



If two expressions are equivalent for every value, their **matching coefficients** must be equal.

Example



Find k if $k(2y + 5) \equiv 6y + 15$.

$$2ky + 5k \equiv 6y + 15$$

Match coefficients: $2k = 6$ and $5k = 15$, so $k = 3$.

Common mistake

Equal **once** is not equivalent:
 $3x + 5 = 5x - 1$ only when $x = 3$.



= copy this into your book. Boxes without a pencil are just to read.

Start Tasks



1 Identify equivalent expressions and justify each decision.

1. Which is equivalent to $a + a + a + a$: $4a$, $a + 4$, or a^4 ?

2. Which is equivalent to $5b$: $b + b + b + b + b$, $5 + b$, or b^5 ?

3. Is $3x$ equivalent to $x \times 3$? State yes or no.

4. Is $2m + 2m$ equivalent to $4m$? State yes or no.

5. Is $p + p + p + 2$ equivalent to $4p$? State yes or no.

6. Choose the odd one out: $6c$, $c \times 6$, $c + c + c + c + c + c$, $c + 6$.

Start Tasks – Answers



Compare each result with your reasoning and correct any differences.

1. Which is equivalent to $a + a + a + a$: $4a$, $a + 4$, or a^4 ?

Answer: $4a$.

2. Which is equivalent to $5b$: $b + b + b + b + b$, $5 + b$, or b^5 ?

Answer:
 $b + b + b + b + b = 5b$.

3. Is $3x$ equivalent to $x \times 3$?
State yes or no.

Yes. Multiplication is commutative: $3x = x \times 3$.

4. Is $2m + 2m$ equivalent to $4m$? State yes or no.

Yes. $2m + 2m = 4m$.

5. Is $p + p + p + 2$ equivalent to $4p$? State yes or no.

No. $p + p + p + 2 = 3p + 2$, not $4p$.

6. Choose the odd one out:
 $6c$, $c \times 6$,

$c + c + c + c + c + c$, $c + 6$.

Odd one out: $c + 6$; the others equal $6c$.

Start Tasks



1 *Identify equivalent expressions and justify each decision.*

7. Complete with $=$ or $\neq$:
 $d + d + d \square 3d$.

8. Complete with $=$ or $\neq$:
 $4 + 4n \square 8n$.

9. Complete with $=$ or $\neq$:
 $7q - q \square 6q$.

10. Simplify $3a + 2a$, then name an equivalent expression.

11. Simplify $8x - 3x$, then name an equivalent expression.

12. Simplify $4m + m + 2m$, then name an equivalent expression.

Start Tasks – Answers



Compare each result with your reasoning and correct any differences.

7. Complete with = or $\neq$:

$$d + d + d \square 3d.$$

Answer: =.

8. Complete with = or $\neq$:

$$4 + 4n \square 8n.$$

Answer: $\neq$.

9. Complete with = or $\neq$:

$$7q - q \square 6q.$$

Answer: =, since
 $7q - q = 6q$.

10. Simplify $3a + 2a$, then name an equivalent expression.

Answer: $5a$.

11. Simplify $8x - 3x$, then name an equivalent expression.

Answer: $5x$.

12. Simplify $4m + m + 2m$, then name an equivalent expression.

Answer: $7m$.

Start Tasks



1 Identify equivalent expressions and justify each decision.

13. Which is equivalent to $2p + 5p$: $7p$, $7p^2$, or $7 + p$?

14. Which is equivalent to $9t - 4t$: $5t$, 5 , or $13t$?

15. Choose the odd one out: $3y + 2y$, $5y$, $y + y + y + y + y$, $5 + y$.

16. Match $a + a + b + b + b$ to:
 $2a + 3b$, $5ab$, or $3a + 2b$.

17. Match $4r - r + 2$ to:
 $3r + 2$, $5r + 2$, or $3r$.

18. Are $2x + 3x$ and $4x + x$ equivalent? Briefly explain.

Start Tasks – Answers



Compare each result with your reasoning and correct any differences.

13. Which is equivalent to $2p + 5p$: $7p$, $7p^2$, or $7 + p$?

Answer: $7p$.

14. Which is equivalent to $9t - 4t$: $5t$, 5 , or $13t$?

Answer: $5t$.

15. Choose the odd one out: $3y + 2y$, $5y$, $y + y + y + y + y$, $5 + y$.

Odd one out: $5 + y$; the others equal $5y$.

16. Match $a + a + b + b + b$ to: $2a + 3b$, $5ab$, or $3a + 2b$.

Answer: $2a + 3b$.

17. Match $4r - r + 2$ to: $3r + 2$, $5r + 2$, or $3r$.

Answer: $3r + 2$.

18. Are $2x + 3x$ and $4x + x$ equivalent? Briefly explain.

Yes. Both simplify to $5x$.

Start Tasks



1 *Identify equivalent expressions and justify each decision.*

19. Expand $2(a + 3)$.
Which expression is equivalent?

20. Expand $3(x + 2)$.
Which expression is equivalent?

21. Expand $4(m - 1)$.
Which expression is equivalent?

22. Complete:
 $5(p + 2) \equiv 5p + \square$.

23. Complete:
 $3(q - 4) \equiv 3q - \square$.

24. Is $2(x + 5)$ equivalent to $2x + 5$? Explain the difference.

Start Tasks – Answers



Compare each result with your reasoning and correct any differences.

19. Expand $2(a + 3)$. Which expression is equivalent?

Answer: $2(a + 3) = 2a + 6$.

20. Expand $3(x + 2)$. Which expression is equivalent?

Answer: $3(x + 2) = 3x + 6$.

21. Expand $4(m - 1)$. Which expression is equivalent?

Answer: $4(m - 1) = 4m - 4$.

22. Complete:

$$5(p + 2) \equiv 5p + \square.$$

Answer: 10.

23. Complete:

$$3(q - 4) \equiv 3q - \square.$$

Answer: 12.

24. Is $2(x + 5)$ equivalent to $2x + 5$? Explain the difference.

No. $2(x + 5) = 2x + 10$.

Start Tasks



1 *Identify equivalent expressions and justify each decision.*

25. For $x = 3$, compare $4x$ and $x + x + x + x$. What do you notice?

26. For $a = 2$, compare $3(a + 1)$ and $3a + 3$. What do you notice?

27. Correct the statement $5m + m \equiv 5m^2$.

Start Tasks – Answers



Compare each result with your reasoning and correct any differences.

25. For $x = 3$, compare $4x$ and $x + x + x + x$. What do you notice?

Both give 12. This supports the equivalence.

26. For $a = 2$, compare $3(a + 1)$ and $3a + 3$. What do you notice?

Both give 9. This supports the equivalence.

27. Correct the statement $5m + m \equiv 5m^2$.

Correction: $5m + m = 6m$.

Build Tasks



2 Identify equivalent expressions and justify each decision.

1. Simplify both expressions and decide: $4a + 3a$ and $9a - 2a$.

2. Simplify both expressions and decide: $6x - 2x + 1$ and $4x + 1$.

3. Simplify both expressions and decide: $3m + 2 - m$ and $2m + 2$.

4. Which is not equivalent to $8p$: $4p + 4p$, $10p - 2p$, $2(4p)$, or $8 + p$?

5. Which is not equivalent to $5x + 10$: $5(x + 2)$, $10 + 5x$, $15x$, or $3x + 2x + 10$?

6. Match $7a - 2a + 3$ to its simplest equivalent expression.

Build Tasks – Answers



Compare each result with your reasoning and correct any differences.

1. Simplify both expressions and decide: $4a + 3a$ and $9a - 2a$.

Both simplify to $7a$, so they are equivalent.

2. Simplify both expressions and decide: $6x - 2x + 1$ and $4x + 1$.

Both simplify to $4x + 1$, so they are equivalent.

3. Simplify both expressions and decide: $3m + 2 - m$ and $2m + 2$.

Both simplify to $2m + 2$, so they are equivalent.

4. Which is not equivalent to $8p$: $4p + 4p$, $10p - 2p$, $2(4p)$, or $8 + p$?

Not equivalent: $8 + p$.

5. Which is not equivalent to $5x + 10$: $5(x + 2)$, $10 + 5x$, $15x$, or $3x + 2x + 10$?

Not equivalent: $15x$.

6. Match $7a - 2a + 3$ to its simplest equivalent expression.

Answer: $5a + 3$.

Build Tasks



2 Identify equivalent expressions and justify each decision.

7. Match $2x + 4 + 3x - 1$ to its simplest equivalent expression.

8. Match $9m - (4m + 2)$ to its simplest equivalent expression.

9. Are $4(2y + 1)$ and $8y + 4$ equivalent? Show a simplification.

10. Are $3(2a - 5)$ and $6a - 15$ equivalent? Show a simplification.

11. Are $5(x + 2) - x$ and $4x + 10$ equivalent? Show a simplification.

12. Are $2(3p + 4) + p$ and $7p + 8$ equivalent? Show a simplification.

Build Tasks – Answers



Compare each result with your reasoning and correct any differences.

7. Match $2x + 4 + 3x - 1$ to its simplest equivalent expression.

Answer: $5x + 3$.

8. Match $9m - (4m + 2)$ to its simplest equivalent expression.

Answer: $5m - 2$.

9. Are $4(2y + 1)$ and $8y + 4$ equivalent? Show a simplification.

Yes. $4(2y + 1) = 8y + 4$.

10. Are $3(2a - 5)$ and $6a - 15$ equivalent? Show a simplification.

Yes. $3(2a - 5) = 6a - 15$.

11. Are $5(x + 2) - x$ and $4x + 10$ equivalent? Show a simplification.

Yes. $5(x + 2) - x = 4x + 10$.

12. Are $2(3p + 4) + p$ and $7p + 8$ equivalent? Show a simplification.

Yes. $2(3p + 4) + p = 7p + 8$.

Build Tasks



2 Identify equivalent expressions and justify each decision.

13. Complete:

$$4(x + \square) \equiv 4x + 20.$$

14. Complete:

$$\square(2a - 3) \equiv 10a - 15.$$

15. Complete:

$$7m + \square m \equiv 12m.$$

16. Find k :

$$3(x + 4) \equiv 3x + k.$$

17. Find k :

$$k(2y + 5) \equiv 6y + 15.$$

18. Find k :

$$8a - 3a + 2 \equiv ka + 2.$$

Build Tasks – Answers



Compare each result with your reasoning and correct any differences.

13. Complete:

$$4(x + \square) \equiv 4x + 20.$$

Answer: 5.

14. Complete:

$$\square(2a - 3) \equiv 10a - 15.$$

Answer: 5.

15. Complete:

$$7m + \square m \equiv 12m.$$

Answer: 5.

16. Find k : $3(x + 4) \equiv 3x + k$.

$$3(x + 4) = 3x + 12, \text{ so } k = 12.$$

17. Find k :

$$k(2y + 5) \equiv 6y + 15.$$

$k = 3$, since

$$3(2y + 5) = 6y + 15.$$

18. Find k :

$$8a - 3a + 2 \equiv ka + 2.$$

$$8a - 3a + 2 = 5a + 2, \text{ so}$$

$$k = 5.$$

Build Tasks



2 Identify equivalent expressions and justify each decision.

19. A student says $2x \times 3x \equiv 6x$. Correct the error.

20. A student says $4(a + 2) \equiv 4a + 2$. Correct the error.

21. A student says $7p - 2p \equiv 5$. Correct the error.

22. Give two different expressions equivalent to $6x + 12$.

23. Give an expanded and a factorised expression equivalent to $9a + 18$.

24. Write an expression equivalent to $4m + 7$ that contains like terms.

Build Tasks – Answers



Compare each result with your reasoning and correct any differences.

19. A student says $2x \times 3x \equiv 6x$. Correct the error.

Correction: $2x \times 3x = 6x^2$.

20. A student says $4(a + 2) \equiv 4a + 2$. Correct the error.

Correction:
 $4(a + 2) = 4a + 8$.

21. A student says $7p - 2p \equiv 5$. Correct the error.

Correction: $7p - 2p = 5p$.

22. Give two different expressions equivalent to $6x + 12$.

For example, $2(3x + 6)$ and $3(2x + 4)$.

23. Give an expanded and a factorised expression equivalent to $9a + 18$.

Expanded: $9a + 18$.
Factorised: $9(a + 2)$.

24. Write an expression equivalent to $4m + 7$ that contains like terms.

For example, $2m + 2m + 7$.

Build Tasks



2 Identify equivalent expressions and justify each decision.

25. Use $x = 2$ and $x = 5$ to test whether $3(x + 1)$ and $3x + 1$ are equivalent.

26. Use simplification to decide whether $2(a + 4) + a$ and $3a + 8$ are always equivalent.

27. Which method proves equivalence here: testing one value or simplifying? Explain briefly.

Build Tasks – Answers



Compare each result with your reasoning and correct any differences.

25. Use $x = 2$ and $x = 5$ to test whether $3(x + 1)$ and $3x + 1$ are equivalent.

At $x = 2$: $9 \neq 7$. At $x = 5$:
 $18 \neq 16$. Not equivalent.

26. Use simplification to decide whether $2(a + 4) + a$ and $3a + 8$ are always equivalent.

Yes. $2(a + 4) + a = 3a + 8$.

27. Which method proves equivalence here: testing one value or simplifying? Explain briefly.

Simplifying proves equality for every value; one test value does not.

Push Tasks



3 Identify equivalent expressions and justify each decision.

1. Find k so

$k(x + 3) \equiv 4x + 12$ for every x .

2. Find k so

$3(2x + k) \equiv 6x + 15$ for every x .

3. Find k so

$5x - 2(x - k) \equiv 3x + 8$ for every x .

4. Find a and b so

$a(x + b) \equiv 4x + 20$.

5. Find a and b so

$a(2x - 3) \equiv 6x + b$.

6. Find p and q so

$p(x + 2) + qx \equiv 7x + 10$.

Push Tasks – Answers



Compare each result with your reasoning and correct any differences.

1. Find k so

$k(x + 3) \equiv 4x + 12$ for every x .

Matching x -coefficients
gives $k = 4$.

2. Find k so

$3(2x + k) \equiv 6x + 15$ for every x .

$3k = 15$, so $k = 5$.

3. Find k so

$5x - 2(x - k) \equiv 3x + 8$ for every x .

$5x - 2(x - k) = 3x + 2k$, so
 $2k = 8$ and $k = 4$.

4. Find a and b so

$a(x + b) \equiv 4x + 20$.

$a = 4$ and $b = 5$.

5. Find a and b so

$a(2x - 3) \equiv 6x + b$.

$2a = 6 \Rightarrow a = 3$, then
 $b = -9$.

6. Find p and q so

$p(x + 2) + qx \equiv 7x + 10$.

$2p = 10 \Rightarrow p = 5$;
 $p + q = 7 \Rightarrow q = 2$.

Push Tasks



3 Identify equivalent expressions and justify each decision.

7. Decide whether $2(x + 3) + 3(x - 1)$ and $5x + 3$ are equivalent. Prove it.

8. Decide whether $4(2a - 1) - 3a$ and $5a - 4$ are equivalent. Prove it.

9. Decide whether $3m(m + 2)$ and $3m^2 + 6m$ are equivalent. Prove it.

10. Is $x + x^2$ equivalent to $2x^2$? Give a counterexample and explain.

11. Is $(x + 2)^2$ equivalent to $x^2 + 4$? Give a counterexample and correct expansion.

12. Is $3(x - 2) + 6$ equivalent to $3x$? Justify algebraically.

Push Tasks – Answers



Compare each result with your reasoning and correct any differences.

7. Decide whether

$2(x + 3) + 3(x - 1)$ and $5x + 3$
are equivalent. Prove it.

Equivalent:

$$2x + 6 + 3x - 3 = 5x + 3.$$

8. Decide whether

$4(2a - 1) - 3a$ and $5a - 4$
are equivalent. Prove it.

Equivalent:

$$8a - 4 - 3a = 5a - 4.$$

9. Decide whether

$3m(m + 2)$ and $3m^2 + 6m$ are
equivalent. Prove it.

Equivalent:

$$3m(m + 2) = 3m^2 + 6m.$$

10. Is $x + x^2$ equivalent to
 $2x^2$? Give a counterexample
and explain.

Not equivalent. At $x = 2$, the
values are 6 and 8.

11. Is $(x + 2)^2$ equivalent to
 $x^2 + 4$? Give a
counterexample and correct
expansion.

Not equivalent. Correctly,
 $(x + 2)^2 = x^2 + 4x + 4.$

12. Is $3(x - 2) + 6$ equivalent
to $3x$? Justify algebraically.

Equivalent:

$$3(x - 2) + 6 = 3x - 6 + 6 = 3x.$$

Push Tasks



3 Identify equivalent expressions and justify each decision.

13. Create an expression equivalent to $8x + 12$ using two sets of brackets.

14. Create three structurally different expressions equivalent to $6a - 9$.

15. Write a false expression that agrees with $4x + 8$ when $x = 0$ but is not equivalent to it.

16. A student tests $x = 2$ and concludes $x^2 \equiv 2x$. Explain why the conclusion is invalid.

17. A student expands $-3(2x - 5)$ as $-6x - 15$. Diagnose and correct the error.

18. A student simplifies $2x + 3y$ to $5xy$. Explain why the expressions are not equivalent.

Push Tasks – Answers



Compare each result with your reasoning and correct any differences.

13. Create an expression equivalent to $8x + 12$ using two sets of brackets.

For example,

$$2(3x + 4) + 2(x + 2) = 8x + 12.$$

14. Create three structurally different expressions equivalent to $6a - 9$.

For example, $3(2a - 3)$, $8a - 2a - 9$, and $6(a - 1) - 3$.

15. Write a false expression that agrees with $4x + 8$ when $x = 0$ but is not equivalent to it.

For example, $x^2 + 8$: it equals 8 at $x = 0$, but is not

16. A student tests $x = 2$ and concludes $x^2 \equiv 2x$. Explain why the conclusion is invalid.

One matching value is insufficient. At $x = 3$, $x^2 = 9 \neq 6 = 2x$.

17. A student expands $-3(2x - 5)$ as $-6x - 15$. Diagnose and correct the error.

Correction:

$$-3(2x - 5) = -6x + 15.$$

18. A student simplifies $2x + 3y$ to $5xy$. Explain why the expressions are not equivalent.

$2x$ and $3y$ are unlike terms, so they cannot be combined.

Push Tasks



3 Identify equivalent expressions and justify each decision.

19. For what value of x are $3x + 5$ and $5x - 1$ equal? Are they equivalent? Explain.

20. For what value of a are $2(a + 4)$ and $3a + 1$ equal? Are they equivalent? Explain.

21. The expressions $kx + 6$ and $3(x + 2)$ are equivalent. Find k and justify.

22. The perimeter of a rectangle is $2(x + 4) + 2(x + 1)$. Show two equivalent simplified forms.

23. A cost is $5(n + 2) + 3n$. Show that it is equivalent to $8n + 10$ and interpret each term.

24. Compare $2x(x + 3)$ and $2x^2 + 6x$. Explain why equivalence holds for every x .

Push Tasks – Answers



Compare each result with your reasoning and correct any differences.

19. For what value of x are $3x + 5$ and $5x - 1$ equal? Are they equivalent? Explain.

They are equal when $x = 3$, but are not equivalent because they differ for

22. The perimeter of a rectangle is $2(x + 4) + 2(x + 1)$. Show two equivalent simplified forms.

$$2(x + 4) + 2(x + 1) = 4x + 10 = 2(2x + 5)$$

20. For what value of a are $2(a + 4)$ and $3a + 1$ equal? Are they equivalent? Explain.

They are equal when $a = 7$, but are not equivalent.

23. A cost is $5(n + 2) + 3n$. Show that it is equivalent to $8n + 10$ and interpret each term.

$5(n + 2) + 3n = 8n + 10$: $8n$ is the variable cost and 10 is fixed.

21. The expressions $kx + 6$ and $3(x + 2)$ are equivalent. Find k and justify.

$$3(x + 2) = 3x + 6, \text{ so } k = 3.$$

24. Compare $2x(x + 3)$ and $2x^2 + 6x$. Explain why equivalence holds for every x .

The distributive property gives $2x(x + 3) = 2x^2 + 6x$ for every x .

Push Tasks



3 Identify equivalent expressions and justify each decision.

25. Complete the identity:

$$4(2x - \square) + 3x \equiv 11x - 20.$$

26. Complete the identity:

$$a(3x + 2) - x \equiv 8x + 6.$$

Find a or explain why none exists.

27. State whether $2(x + y)$

and $2x + 2y$ are always, sometimes, or never equal. Justify.

Push Tasks – Answers



Compare each result with your reasoning and correct any differences.

25. Complete the identity:

$$4(2x - \square) + 3x \equiv 11x - 20.$$

The blank is 5:

$$4(2x - 5) + 3x = 11x - 20.$$

26. Complete the identity:

$a(3x + 2) - x \equiv 8x + 6$. Find a or explain why none exists.

$$2a = 6 \Rightarrow a = 3, \text{ and then}$$

$$3a - 1 = 8, \text{ so } a = 3.$$

27. State whether $2(x + y)$ and $2x + 2y$ are always, sometimes, or never equal. Justify.

Always equal, by the distributive property.