

Equivalent expressions: what they are, how to tell, and the properties

Two expressions are equivalent when they have the same value for EVERY value of the variable: $2(x + 3)$ and $2x + 6$ always agree; x^2 and $2x$ agree at $x = 2$ only. Quick test: substitute a value (not 0 or 1); a mismatch proves NOT equivalent. Proof: simplify both to the same form.

Property	Rule	Example
Commutative	$a + b = b + a$; $ab = ba$	$3 + x = x + 3$
Associative	$(a + b) + c = a + (b + c)$	$(x + 2) + 7 = x + 9$
Distributive	$a(b + c) = ab + ac$; $a(b - c) = ab - ac$	$3(x + 4) = 3x + 12$
Combining like terms	$ax + bx = (a + b)x$	$3x + 5x = 8x$
Factoring	$ab + ac = a(b + c)$	$6x + 9 = 3(2x + 3)$
Identity; inverse	$a + 0 = a$; $1 \cdot a = a$; $a - a = 0$	$x + 0 = x$; $4x - 4x = 0$
Negative outside	$-(a + b) = -a - b$	$-(x - 5) = -x + 5$

Like terms have the same variable to the same power ($3x$ and $-7x$; $4xy$ and $-xy$; constants). Subtraction and division are NOT commutative: $5 - x \neq x - 5$.

Ten worked

- [] $3(x + 4) = 3x + 12$
- [] $2x + 3x + x = 6x$
- [] $5(2y - 3) + 4 = 10y - 11$
- [] $4(2x - 3) + 5x = 13x - 12$
- [] $-2(x - 6) = -2x + 12$
- [] $7a - (3a + 2) = 4a - 2$
- [] $6x + 9 = 3(2x + 3)$
- [] $x \cdot x \cdot x = x^3$ (not $3x$)
- [] $\frac{1}{2}(8m + 4) = 4m + 2$
- [] $2(x + 3) + 3(x - 1) = 5x + 3$

The six traps

Wrong	Right	Check with $x = 1$
$3(x + 2) = 3x + 2$	$3x + 6$	9 vs 5
$(x + 3)^2 = x^2 + 9$	$x^2 + 6x + 9$	16 vs 10
$x + x = x^2$	$2x$	2 vs 1
$2x \cdot 3x = 6x$	$6x^2$	6 vs 6 (try $x = 2$: 24 vs 12)
$5 - (x + 2) = 5 - x + 2$	$3 - x$	2 vs 6
$3x + 2y = 5xy$	cannot simplify	unlike terms

From

sciencewithshobha.com/blog/equivalent-expressions-what-they-are-how-to-tell-whether-two-expressions-are-equivalent-the-properties-that-make-them-distributive-combining-like-terms-and-20-practice-questions/ · 1-on-1 online maths, KS2 to A level, Grades 3 to 12, free 30-minute first class.

20 practice questions

Simplify, or decide whether the pair is equivalent (and say why).

1. $5(x + 3)$
2. $4y + 7y - 2y$
3. $2(3a - 4) + 5$
4. Is $6(x - 2)$ equivalent to $6x - 2$?
5. $-3(2m + 5)$
6. $8x - (2x - 7)$
7. Factor $10y + 15$
8. Is $x + x + x$ equivalent to x^3 ?
9. $\frac{1}{4}(12p - 8)$
10. $3(x + 1) + 2(x + 4)$
11. Is $(x + 4)^2$ equivalent to $x^2 + 16$?
12. $5k \cdot 2k$
13. $9 - (n + 4)$
14. Is $2(x + y)$ equivalent to $2x + y$?
15. $7w - 3 + 2w + 8$
16. Factor $4x^2 + 6x$
17. Is $3 + 5x$ equivalent to $5x + 3$?
18. $6(2t - 1) - 4t$
19. Is $10 \div x$ equivalent to $x \div 10$?
20. Which is equivalent to $4(2x - 3) + 5x$: (a) $13x - 3$ (b) $13x - 12$ (c) $8x - 7$ (d) $13x + 12$?

Answers

1. $5x + 15$. 2. $9y$. 3. $6a - 3$. 4. No: $6x - 12$. 5. $-6m - 15$. 6. $6x + 7$. 7. $5(2y + 3)$. 8. No: $3x$. 9. $3p - 2$. 10. $5x + 11$. 11. No: $x^2 + 8x + 16$. 12. $10k^2$. 13. $5 - n$. 14. No: $2x + 2y$. 15. $9w + 5$. 16. $2x(2x + 3)$. 17. Yes (commutative). 18. $8t - 6$. 19. No (try $x = 2$: 5 vs 0.2). 20. (b).

Curriculum	Where
US	Grade 6 6.EE.3 and 6.EE.4; Grade 7 7.EE.1; Algebra 1
England	KS3 simplify, expand, factorise; GCSE double brackets and identities ($\equiv$)
Australia	Year 7 laws of arithmetic with algebra; Year 8 expand and factorise
CBSE	Class 7 Algebraic Expressions; Class 8 Expressions and Identities