

Algebraic Properties and Proofs

You have solved algebraic equations for a couple years now, but now it is time to justify the steps you have practiced. Remember taking action without thinking is a dangerous habit!

The following is a list of the reasons one can give for each algebraic step one may take.

ALGEBRAIC PROPERTIES OF EQUALITY	
ADDITION PROPERTY OF EQUALITY	If $a = b$, then $a + c = b + c$
SUBTRACTION PROPERTY OF EQUALITY	If $a = b$, then $a - c = b - c$
MULTIPLICATION PROPERTY OF EQUALITY	If $a = b$, then $a \cdot c = b \cdot c$
DIVISION PROPERTY OF EQUALITY	If $a = b$, then $\frac{a}{c} = \frac{b}{c}$
DISTRIBUTIVE PROPERTY OF MULTIPLICATION OVER ADDITION or OVER SUBTRACTION	$a(b + c) = ab + ac$ $a(b - c) = ab - ac$
SUBSTITUTION PROPERTY OF EQUALITY	If $a = b$, then b can be substituted for a in any equation or expression
REFLEXIVE PROPERTY OF EQUALITY	For any real number a , $a = a$
SYMMETRIC PROPERTY OF EQUALITY	If $a = b$, then $b = a$
TRANSITIVE PROPERTY OF EQUALITY	If $a = b$ and $b = c$, then $a = c$

Complete the following algebraic proofs using the reasons above. If a step requires simplification by combining like terms, write **simplify**.

Given: $3x + 12 = 8x - 18$

Prove: $x = 6$

Statement	Reasons
1. $3x + 12 = 8x - 18$	1.
2. $12 = 5x - 18$	2.
3. $30 = 5x$	3.
4. $6 = x$	4.
5. $x = 6$	5.

Given: $3k + 5 = 17$

Prove: $k = 4$

	Statement	Reasons
1.	$3k + 5 = 17$	1.
2.	$3k = 12$	2.
3.	$k = 4$	3.

Given: $-6a - 5 = -95$

Prove: $a = 15$

	Statement	Reasons

Given: $3(5x + 1) = 13x + 5$

Prove: $x = 1$

	Statement	Reasons

Given: $7y - 84 = 2y + 61$

Prove: $y = 29$

Statement	Reasons

Given: $4(5n + 7) - 3n = 3(4n - 9)$

Prove: $n = -11$

Statement	Reasons

Answer Key

	Statement	Reasons
1.	$3x + 12 = 8x - 18$	1. Given
2.	$12 = 5x - 18$	2. Subtraction property of equality
3.	$30 = 5x$	3. Addition property of equality
4.	$6 = x$	4. Division property of equality
5.	$x = 6$	5. Symmetric property of equality

Given: $3k + 5 = 17$

Prove: $k = 4$

	Statement	Reasons
1.	$3k + 5 = 17$	1. Given
2.	$3k = 12$	2. Subtraction property of equality
3.	$k = 4$	3. Division property of equality

Given: $-6a - 5 = -95$

Prove: $a = 15$

	Statement	Reasons
1.	$-6a - 5 = -95$	1. Given
2.	$-6a = -90$	2. Addition property of equality
3.	$a = 15$	3. Division property of equality

Given: $3(5x + 1) = 13x + 5$

Prove: $x = 1$

Statement	Reasons
1. $6(5x + 1) = 13x + 5$	1. <i>Given</i>
2. $15x + 3 = 13x + 5$	2. <i>Distributive property of multiplication over addition</i>
3. $15x = 13x + 2$	3. <i>Subtraction property of equality</i>
4. $2x = 2$	4. <i>Subtraction property of equality</i>
5. $x = 1$	5. <i>Division property of equality</i>

Given: $7y - 84 = 2y + 61$

Prove: $y = 29$

Statement	Reasons
1. $7y - 84 = 2y + 61$	1. <i>Given</i>
2. $5y - 84 = 61$	2. <i>Subtraction property of equality</i>
3. $5y = 145$	3. <i>Addition property of equality</i>
4. $y = 29$	4. <i>Division property of equality</i>

Given: $4(5n + 7) - 3n = 3(4n - 9)$

Prove: $n = -11$

Statement	Reasons
1. $4(5n + 7) - 3n = 3(4n - 9)$	1. <i>Given</i>
2. $20n + 28 - 3n = 12n - 27$	2. <i>Distributive property of multiplication</i>
3. $17n - 39 = 12n - 27$	3. <i>Subtraction</i>
4. $5n + 28 = -27$	4. <i>Subtraction property of equality</i>
5. $5y = -55$	5. <i>Subtraction property of equality</i>
6. $y = -11$	6. <i>Division property of equality</i>