Warm Up

Describe the steps for solving (Don't write down):

1) $2x = 8$

2) $\frac{x}{4} = 10$

3) $x - 2 = 8$

4) $x + 5 = 7$

5) $4x + 2 = 12$

Properties of Equalities

Properties of Equality	Property	Example(s)
Addition Property of Equality	If a = b, then a + c = b + c.	$x - 3 = 8$ $+3 \quad +3$ $x = 11$
Subtraction Property of Equality	If a = b, then a – c = b – c	$x + 3 = 8$ $-3 \quad -3$ $x = 5$
Multiplication Property of Equality	If a = b, then ac = bc	$4 \cdot \frac{x}{4} = 20 \cdot 4$ $x = 80$
Division Property of Equality	If a = b, then a/c = b/c	$\frac{2x}{2} = \frac{20}{2}$ $x = 10$

Properties of Operations and Identities

Properties of Operations and Identities	Property	Example(s)
Commutative Property of Addition	a + b = b + a	$3 + 4 = 4 + 3$
Commutative Property of Multiplication	a · b = b · a	$3 \cdot 4 = 4 \cdot 3$
Associative Property of Addition	a + (b + c) = (a + b) + c	$3 + (4 + 5) = (3 + 4) + 5$ $3 + 9 = 7 + 5$ $12 = 12$

Associative Property of Multiplication	$a \cdot (b \cdot c) = (a \cdot b) \cdot c$	$3 \cdot (4 \cdot 5) = (3 \cdot 4) \cdot 5$ $3 \cdot 20 = 12 \cdot 5$ $60 = 60$
Distributive Property of Multiplication over Addition	$a \cdot (b + c) = a \cdot b + a \cdot c$	$3(x+5) = 3x+15$
Additive Identity Property	$a + 0 = a$	$3+0=3$
Multiplicative Identity Property	$a \cdot 1 = a$	$3 \cdot 1 = 3$
Additive Inverse Property (opposite)	$a + (-a) = 0$	$3 + -3 = 0$
Multiplicative Inverse Property (multiply by reciprocal)	$\frac{a}{b} \bullet \frac{b}{a} = 1$	$\frac{3}{4} \cdot \frac{4}{3} = 1$
Multiplicative Property of Zero	$a \cdot 0 = 0$	$3 \cdot 0 = 0$
Exponential Property of Equality	$a^b = a^c$, then $b = c$	$4^2 = 4^x$ $x = 2$

Properties of Equality

Identify the property.

1.	$9 \cdot 7 = 7 \cdot 9$	Comm.
2.	$2 \cdot (3 \cdot 4) = (2 \cdot 3) \cdot 4$	ASSOC.
3.	$4(a + b) = 4a + 4b$	Dist
4.	$8 + (-8) = 0$	Add Inv.
5.	$3(6a) = (3 \cdot 6)a$	ASSOC.
6.	If $a = b$ then $a + 4 = b + 4$	Add. Prop. of Equality
7.	$55 + 6 = 6 + 55$	Comm.
8.	$(x + 3) + y = x + (3 + y)$	ASSOC.
9.	If $a = c$, then $a - 5 = c - 5$	Subt. POE
10.	$9 + (5 + 35) = (9 + 5) + 35$	ASSOC.
11.	$8(a + c) = 8a + 8c$	Dist.
12.	$A + B = B + A$	Comm.
13.	$4(3 \cdot z) = (4 \cdot 3)z$	ASSOC.
14.	$8 + 0 = 8$	Add. Id.
15.	$\frac{4}{5} \cdot \frac{5}{4} = 1$	Mult. Inv.

Identify the property of equality that justifies each missing step or equation in each of the following tables.

1.

Equation	Steps
x – 1.2 = 1.9	Given
+1.2 +1.2 x = 3.1	Addition

2.

Equation	Steps
5x = 37	Given
$\frac{}{5}$ $\frac{}{5}$ x = 7.4	Division

3.

Equation	Steps
2x + 3 = 15	Given
2x = 12	Subtraction
x = 6	Division

2x+3=15
−3 −3
$\frac{2x}{2}=\frac{12}{2}$

4.

Equation	Steps
2x – 7 = 19	Given
2x = 26	Addition
X= 13	Division

2x−7=19
+7 +7
2x=26

5.

Equation	Steps
4(x – 6) = 40	Given
4x−24=40 +24 +24	Distributive Property
$\frac{4x}{4}=\frac{64}{4}$	Addition Property of Equality
$\boxed{x=16}$	Division Property of Equality

6.

Equation	Steps
3(5x + 1) = 13x + 5	Given
15x+3=13x+5 −13x −13x	Distributive
2x+3=5 −3 −3	Subtraction
2x=2	Subtraction
x=1	Division

Identify the property of equality that justifies each missing step or equation in each of the following tables.

Equation	Steps
1. 8x + 12 = 3x – 18	Given
2. 5x + 12 = -18	Subtraction
3. 5x = -30	~~Addition Property of Equality~~ Subtraction
4. -6 = x	Division

Equation	Steps
1. 3k + 5 = 17	Given
2. 3k = 12	Subtraction
~~3.~~ K = 4	Division Property of Equality

Equation	Steps
1. -6a – 5 = -95 +5 +5	Given
2. -6a = -90	Addition
3. a = +15	Division

Equation	Steps
1. 7y – 84 = 2y + 61 +84 +84	Given
2. 7y = 2y + 145 -2y -2y	Addition
3. 5y = 145	Subtraction
4. y = 29	Division

Equation	Steps
1. $4x = 12x + 32$ $-12x \quad -12x$	Given
2. $-8x = 32$	Subtraction
3. $x = -4$	Division

Equation	Steps
1. $4x - 3 = 2x + 5$ $-2x \quad -2x$	Given
2. $2x - 3 = 5$	Subtraction Property of Equality
3. $2x = 8$	Addition
4. $x = 4$	Division

Equation	Steps
1. $12(x - 5) = 24$	Given
2. $12x - 60 = 24$	Distributive
3. $12x = 84$	Addition Property of Equality
4. $x = 7$	Division

Equation	Steps
1. $2x + 10 = 4x + 2$ $-4x \quad -4x$	Given
2. $-2x + 10 = 2$ $\quad\quad -10 \quad -10$	Subtraction
3. $-2x = -8$	Subtraction
4. $x = 4$	Division

Examples

1.

Equation	Step
3x + 12 = 18	Original Equation
3x = 6	Subtraction property of equality
x = 2	Division

2.

Equation	Step
3k + 5 = 17	Original Equation
3K=12	Subtraction property of equality
k = 4	Division property of equality

3.

Equation	Step
3(5x - 1) = 13x + 5	Original Equation
15x - 3 = 13x + 5	Distributive
2x - 3 = 5	Subtraction property of equality
2x = 8	Addition
x = 4	Division

4.

Equation	Step
$\frac{v+9}{3} = 8$	Original equation
v + 9 = 24	Multiplication
	Subtraction property of equality

5.

Equation	Step
2(n + 5) = -2	Original equation
2n+10=-2	Distributive
2n=-12	Subtraction
n = -6	Division

6.

Equation	Step
7y – 84 = 2y + 61	Original Equation
-2y -2y 5y-84=61	Subtraction
5y=145	Addition
y = 29	Division

7.

Equation	Step
$\frac{x+5}{6} = 2$	Original Equation
x+5=12	Multiplication
x = 7	Subtraction

8.

Equation	Step
2(12x – 1) = 4(x + 2)	Original Equation
24x-2=4x+8 -4x 4x	Distributive
20x-2=8	Subtraction
20x=10	Addition
$x = \frac{1}{2}$	Division