

Solving Linear Equations: practice solutions, Grade 9

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Written solutions to the chapter problems. Check each step, then correct yourself.

1 Evaluating expressions



- a. $3 \cdot 4 + 5 = 12 + 5 = 17$.
- b. $20 - 2 \cdot 6 = 20 - 12 = 8$.
- c. $5^2 + 5 = 25 + 5 = 30$.
- d. $4(-2 - 1) = 4 \cdot (-3) = -12$.

2 Order of operations



- a. Multiply first: $6 + 20 = 26$.
- b. Parentheses first: $10 \cdot 5 = 50$.
- c. Divide first: $18 - 3 = 15$.
- d. Parentheses, then exponent, then multiplication:
 $3 + 2 \cdot 3^2 = 3 + 2 \cdot 9 = 3 + 18 = 21$.

3 From words to algebra



- a. Twice n is $2n$, and seven more gives $2n + 7$.
- b. The difference of m and 3 is $m - 3$; the product with 5 is $5(m - 3)$.
- c. Decreased by 9 gives $k - 9$, then divided by 2 gives $\frac{k - 9}{2}$.

4 One-step equations



- a. Subtract 9: $x = 6$. Check: $6 + 9 = 15$.
- b. Add 7: $y = 19$. Check: $19 - 7 = 12$.
- c. Divide by 6: $z = 7$. Check: $6 \cdot 7 = 42$.
- d. Multiply by 4: $n = -20$. Check: $\frac{-20}{4} = -5$.

5 Name the property



- a. Addition Property of Equality (add 6 to both sides).
- b. Division Property of Equality (divide both sides by 3).
- c. Multiplication Property of Equality (multiply both sides by 5).
- d. Subtraction Property of Equality (subtract 8 from both sides: $3 - 8 = -5$).

6 Two-step equations



- a. $3x = 15$, so $x = 5$.
- b. $4y = 16$, so $y = 4$.
- c. $\frac{x}{3} = 5$, so $x = 15$.
- d. $-2k = -6$, so $k = 3$.

7 Gym membership



Let m be the number of months. The total cost is $12m + 15 = 87$. Subtract 15: $12m = 72$. Divide by 12: $m = 6$.

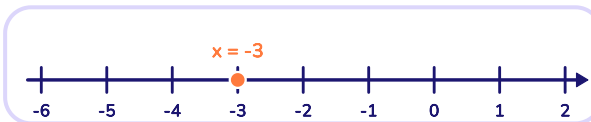
Check: $12 \cdot 6 + 15 = 87$. Maya has been a member for 6 months.

8 Solution on a number line



Subtract 9: $2x = -6$. Divide by 2: $x = -3$. Check: $2(-3) + 9 = 3$.

The solution is three units to the left of 0.



9 Distributing first



- a. $3x + 6 = 24$, so $3x = 18$ and $x = 6$.
- b. $6x - 2 = 28$, so $6x = 30$ and $x = 5$.
- c. $5x - 15 + 2 = 22$, so $5x - 13 = 22$, $5x = 35$ and $x = 7$.

10 Combining like terms



- a. $3x + 12 = 30$, so $3x = 18$ and $x = 6$.
- b. $5y + 5 = -10$, so $5y = -15$ and $y = -3$.
- c. $8 - 2n = 20$, so $-2n = 12$ and $n = -6$.

11 Fractions in equations



a. Multiply by 6: $3x + 2x = 60$, so $5x = 60$ and $x = 12$.

b. Multiply by 3: $2x - 1 = 15$, so $2x = 16$ and $x = 8$.

c. Add 2: $\frac{3}{4}x = 12$. Multiply by $\frac{4}{3}$: $x = 16$.

12 Decimals in equations



a. $0.6x = 3$, so $x = \frac{3}{0.6} = 5$.

b. $-0.5y = -1.5$, so $y = 3$.

13 Variables on both sides



a. $2x + 2 = 12$, so $2x = 10$ and $x = 5$. Check: $27 = 27$.

b. $2n - 7 = 9$, so $2n = 16$ and $n = 8$. Check: $25 = 25$.

c. $6 = 4k - 10$, so $4k = 16$ and $k = 4$. Check: $2 = 2$.

14 Find the error



The student multiplied only the first term by 3. The correct distribution is

$$3(x - 4) = 3x - 12.$$

Then $3x - 12 = 2x + 5$, so $x - 12 = 5$ and $x = 17$. Check: $3(17 - 4) = 39$ and $2 \cdot 17 + 5 = 39$.

With $x = 9$ the sides would be **15** and **23**, which confirms that 9 is wrong.

15 Perimeter of a rectangle



The perimeter is $2(2x + 3 + x) = 36$. Simplify: $2(3x + 3) = 36$, so $6x + 6 = 36$ and $x = 5$.

The width is 5 cm and the length is $2 \cdot 5 + 3 = 13$ cm. Check: $2(13 + 5) = 36$.

16 Rearranging formulas



a. $w = \frac{P - 2l}{2}$. With the values: $w = \frac{50 - 30}{2} = 10$.

b. $C = \frac{F - 32}{1.8}$. With $F = 86$: $C = \frac{54}{1.8} = 30$.

c. $x = \frac{y - b}{m}$. With the values: $x = \frac{11 + 3}{2} = 7$.

17 A general equation



Subtract cx and b : $ax - cx = d - b$. Factor: $x(a - c) = d - b$. Divide by $a - c$ (not zero):
 $x = \frac{d - b}{a - c}$.

With the values: $x = \frac{13 - 1}{7 - 3} = 3$. Check: $7 \cdot 3 + 1 = 22$ and $3 \cdot 3 + 13 = 22$.

18 How many solutions?



a. $4x + 4 = 4x + 7$ gives $4 = 7$, false: **no solution**.

b. $3(x - 2) = 3x - 6$, so both sides are identical: **infinitely many solutions**.

c. $9 = 3x$, so $x = 3$: **one solution**. Check: $11 = 11$.

d. The left side is $6x - 6 - 2x = 4x - 6$, identical to the right side: **infinitely many solutions**.

19 Choosing a parameter



The right side is $3x + 12$. Subtracting $3x$ leaves $k = 12$.

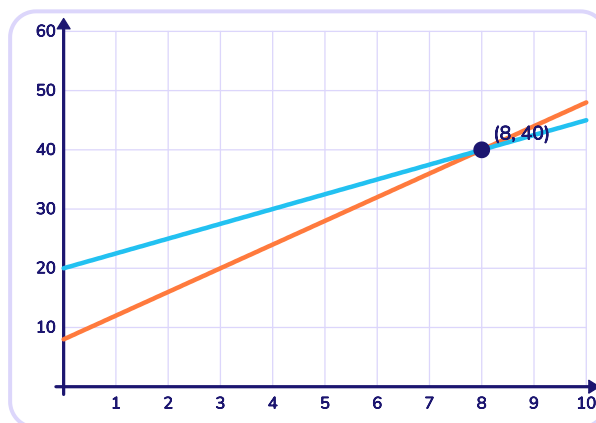
- a. If $k = 12$, the statement $12 = 12$ is always true: infinitely many solutions.
- b. If $k \neq 12$, the statement $k = 12$ is false: no solution. For example, $k = 5$ gives $5 = 12$.

20 Bike rental



Let h be the number of hours: $8 + 4h = 20 + 2.5h$. Subtract $2.5h$: $8 + 1.5h = 20$. Subtract 8: $1.5h = 12$. Divide: $h = 8$.

Cost: $8 + 4 \cdot 8 = 40$ and $20 + 2.5 \cdot 8 = 40$. Both shops charge \$40 for 8 hours.



21 Consecutive odd integers



Let the integers be n , $n + 2$, $n + 4$. Then $n + (n + 2) + (n + 4) = 87$, so $3n + 6 = 87$ and $3n = 81$, thus $n = 27$.

The integers are 27, 29 and 31. Check: $27 + 29 + 31 = 87$.

22 Fractions on both sides



Multiply every term by 6: $4(x - 6) = 3x - 6$. Distribute: $4x - 24 = 3x - 6$. Subtract $3x$: $x - 24 = -6$. Add 24: $x = 18$.

Check: $\frac{2}{3} \cdot 12 = 8$ and $\frac{1}{2} \cdot 18 - 1 = 8$.



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