ELMALG: Linear Equations and Inequalities

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Learning Objectives

- Solve one- and two-step linear equations
- Solve linear inequalities and graph the solution on a number line
- Apply linear equations to real-world word problems
- Check solutions by substituting back into the equation

Simplify each expression completely. Show all steps and circle your final answer.

Linear inequalities

1. Solve the inequality: 1x + 1 < 13. Express x as a fraction if needed.

$$1x + 1 < 13$$

Answer: _____

2. Solve and graph the solution: 1x + 5 > 9

$$1x + 5 > 9$$

Answer: _____

3. Solve: 4x + 9 <= 22. Write the solution in interval notation.

$$4x + 9 \leq 22$$

Answer: _____

4. Solve the inequality: 2x + 9 < 22. Express x as a fraction if needed.

$$2x + 9 < 22$$

Answer: _____

5. Solve and graph the solution: 3x + 1 > 21

$$3x + 1 > 21$$

Answer: _____

6. Solve: 5x + 4 <= 19. Write the solution in interval notation.

$$5x + 4 \leq 19$$

Answer: _____

7. Solve the inequality: 3x + 5 < 23. Express x as a fraction if needed.

$$3x + 5 < 23$$

Answer: _____

8. Solve and graph the solution: 4x + 3 > 22

$$4x + 3 > 22$$

Answer: _____

9. Solve: 5x + 3 <= 7. Write the solution in interval notation.

$$5x + 3 \leq 7$$

Answer: _____

10. Solve the inequality: 1x + 2 < 10. Express x as a fraction if needed.

$$1x + 2 < 10$$

Answer: _____

11. Solve and graph the solution: 1x + 5 > 19

$$1x + 5 > 19$$

Answer: _____

12. Solve: 3x + 9 <= 24. Write the solution in interval notation.

$$3x + 9 \leq 24$$

Answer: _____

Solving two-step equations

13. Solve for x: 3x + 5 = 5.

$$3x + 5 = 5$$

Answer: _____

14. A plumber charges $48 per hour plus a flat $24 fee. If the total bill is $202, how many hours did the job take? Solve 48x + 24 = 202.

$$48x + 24 = 202$$

Answer: _____

15. Solve for x: 4x + -8 = 8. Check your answer.

$$4x + -8 = 8$$

Answer: _____

16. Solve for x: 2x + 6 = 7.

$$2x + 6 = 7$$

Answer: _____

17. A plumber charges $22 per hour plus a flat $32 fee. If the total bill is $138, how many hours did the job take? Solve 22x + 32 = 138.

$$22x + 32 = 138$$

Answer: _____

18. Solve for x: 8x + 7 = -5. Check your answer.

$$8x + 7 = -5$$

Answer: _____

19. Solve for x: 4x + 6 = -1.

$$4x + 6 = -1$$

Answer: _____

20. A plumber charges $35 per hour plus a flat $27 fee. If the total bill is $261, how many hours did the job take? Solve 35x + 27 = 261.

$$35x + 27 = 261$$

Answer: _____

21. Solve for x: 5x + -1 = 4. Check your answer.

$$5x + -1 = 4$$

Answer: _____

Variables on both sides

22. Solve for x: 7x + 6 = 2x + 14

$$7x + 6 = 2x + 14$$

Answer: _____

23. Two friends are saving money. Alex has $42 and saves $6 per week. Jordan has $12 and saves $23 per week. After how many weeks will they have the same amount?

$$6x + 42 = 23x + 12$$

Answer: _____

24. Solve for x: 12x + 3 = 3x + 30. (Hint: m1 > m2 here, so collect x terms on the left.)

$$12x + 3 = 3x + 30$$

Answer: _____

25. Solve for x: 3x + 6 = 5x + 5

$$3x + 6 = 5x + 5$$

Answer: _____

26. Two friends are saving money. Alex has $32 and saves $14 per week. Jordan has $17 and saves $16 per week. After how many weeks will they have the same amount?

$$14x + 32 = 16x + 17$$

Answer: _____

27. Solve for x: 8x + 1 = 4x + 10. (Hint: m1 > m2 here, so collect x terms on the left.)

$$8x + 1 = 4x + 10$$

Answer: _____

28. Solve for x: 3x + 5 = 4x + 12

$$3x + 5 = 4x + 12$$

Answer: _____

29. Two friends are saving money. Alex has $27 and saves $6 per week. Jordan has $34 and saves $23 per week. After how many weeks will they have the same amount?

$$6x + 27 = 23x + 34$$

Answer: _____

30. Solve for x: 12x + 6 = 1x + 29. (Hint: m1 > m2 here, so collect x terms on the left.)

$$12x + 6 = 1x + 29$$

Answer: _____

ELMALG: Linear Equations and Inequalities

ANSWER KEY & SOLUTIONS

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Topics: Linear inequalities, Variables on both sides, Solving two-step equations. All answers verified by independent computation.

Solutions

Linear inequalities

1. Solve the inequality: 1x + 1 < 13. Express x as a fraction if needed.

$$1x + 1 < 13$$

→ *Subtract 1: 1x < 12.*
→ *Divide by 1: x < 12.*

Answer: $x < 12$

2. Solve and graph the solution: 1x + 5 > 9

$$1x + 5 > 9$$

→ *Subtract 5: 1x > 4.*
→ *Divide by 1: x > 4.*
→ *Open circle at 4, shade right.*

Answer: $x > 4$

3. Solve: 4x + 9 <= 22. Write the solution in interval notation.

$$4x + 9 \leq 22$$

→ *Subtract 9: 4x <= 13.*
→ *Divide by 4: x <= 13/4.*
→ *Closed circle at 13/4, shade left. Interval: (-inf, 13/4].*

Answer: $x \leq \frac{13}{4}$

4. Solve the inequality: 2x + 9 < 22. Express x as a fraction if needed.

$$2x + 9 < 22$$

→ *Subtract 9: 2x < 13.*
→ *Divide by 2: x < 13/2.*

Answer: $x < \frac{13}{2}$

5. Solve and graph the solution: 3x + 1 > 21

$$3x + 1 > 21$$

→ *Subtract 1: 3x > 20.*
→ *Divide by 3: x > 20/3.*
→ *Open circle at 20/3, shade right.*

Answer: $x > \frac{20}{3}$

6. Solve: 5x + 4 <= 19. Write the solution in interval notation.

$$5x + 4 \leq 19$$

→ *Subtract 4: 5x <= 15.*
→ *Divide by 5: x <= 3.*
→ *Closed circle at 3, shade left. Interval: (-inf, 3].*

Answer: $x \leq 3$

7. Solve the inequality: 3x + 5 < 23. Express x as a fraction if needed.

$$3x + 5 < 23$$

→ *Subtract 5: 3x < 18.*
→ *Divide by 3: x < 6.*

Answer: $x < 6$

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8. Solve and graph the solution: 4x + 3 > 22

$$4x + 3 > 22$$

→ *Subtract 3: 4x > 19.*
→ *Divide by 4: x > 19/4.*
→ *Open circle at 19/4, shade right.*

Answer: $x > \frac{19}{4}$

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9. Solve: 5x + 3 <= 7. Write the solution in interval notation.

$$5x + 3 \leq 7$$

→ *Subtract 3: 5x <= 4.*
→ *Divide by 5: x <= 4/5.*
→ *Closed circle at 4/5, shade left. Interval: (-inf, 4/5].*

Answer: $x \leq \frac{4}{5}$

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10. Solve the inequality: 1x + 2 < 10. Express x as a fraction if needed.

$$1x + 2 < 10$$

→ *Subtract 2: 1x < 8.*
→ *Divide by 1: x < 8.*

Answer: $x < 8$

---

11. Solve and graph the solution: 1x + 5 > 19

$$1x + 5 > 19$$

→ *Subtract 5: 1x > 14.*
→ *Divide by 1: x > 14.*
→ *Open circle at 14, shade right.*

Answer: $x > 14$

---

12. Solve: 3x + 9 <= 24. Write the solution in interval notation.

$$3x + 9 \leq 24$$

→ *Subtract 9: 3x <= 15.*
→ *Divide by 3: x <= 5.*
→ *Closed circle at 5, shade left. Interval: (-inf, 5].*

Answer: $x \leq 5$

Solving two-step equations

13. Solve for x: 3x + 5 = 5.

$$3x + 5 = 5$$

→ *Subtract 5 from both sides: 3x = 0.*
→ *Divide by 3: x = 0.*

Answer: $x = 0 \div 3 = 0$

14. A plumber charges $48 per hour plus a flat $24 fee. If the total bill is $202, how many hours did the job take? Solve 48x + 24 = 202.

$$48x + 24 = 202$$

→ *Subtract $24: 48x = 178. Divide by 48: x = 89/24 hours.*

Answer: $x = 178 \div 48 = 89/24$

15. Solve for x: 4x + -8 = 8. Check your answer.

$$4x + -8 = 8$$

→ *Subtract -8 from both sides: 4x = 16.*
→ *Divide both sides by 4: x = 4.*

Answer: $x = 16 \div 4 = 4$

16. Solve for x: 2x + 6 = 7.

$$2x + 6 = 7$$

→ *Subtract 6 from both sides: 2x = 1.*
→ *Divide by 2: x = 1/2.*

Answer: $x = 1 \div 2 = 1/2$

17. A plumber charges $22 per hour plus a flat $32 fee. If the total bill is $138, how many hours did the job take? Solve 22x + 32 = 138.

$$22x + 32 = 138$$

→ *Subtract $32: 22x = 106. Divide by 22: x = 53/11 hours.*

Answer: $x = 106 \div 22 = 53/11$

18. Solve for x: 8x + 7 = -5. Check your answer.

$$8x + 7 = -5$$

→ *Subtract 7 from both sides: 8x = -12.*
→ *Divide both sides by 8: x = -3/2.*

Answer: $x = -12 \div 8 = -3/2$

19. Solve for x: 4x + 6 = -1.

$$4x + 6 = -1$$

→ *Subtract 6 from both sides: 4x = -7.*
→ *Divide by 4: x = -7/4.*

Answer: $x = -7 \div 4 = -7/4$

20. A plumber charges $35 per hour plus a flat $27 fee. If the total bill is $261, how many hours did the job take? Solve 35x + 27 = 261.

$$35x + 27 = 261$$

→ *Subtract $27: 35x = 234. Divide by 35: x = 234/35 hours.*

Answer: $x = 234 \div 35 = 234/35$

21. Solve for x: 5x + -1 = 4. Check your answer.

$$5x + -1 = 4$$

→ *Subtract -1 from both sides: 5x = 5.*
→ *Divide both sides by 5: x = 1.*

Answer: $x = 5 \div 5 = 1$

Variables on both sides

22. Solve for x: 7x + 6 = 2x + 14

$$7x + 6 = 2x + 14$$

→ *Move x terms left: 7x - 2x = 14 - 6.*
→ *Combine: 5x = 8.*
→ *Divide by 5: x = 8/5.*

Answer: $x = \frac{8}{5}$

23. Two friends are saving money. Alex has $42 and saves $6 per week. Jordan has $12 and saves $23 per week. After how many weeks will they have the same amount?

$$6x + 42 = 23x + 12$$

→ *Set equations equal: 6x + 42 = 23x + 12.*
→ *Move x terms: 6x - 23x = 12 - 42. So -17x = -30.*
→ *x = 30/17 weeks.*

Answer: $x = \frac{30}{17}$

24. Solve for x: 12x + 3 = 3x + 30. (Hint: m1 > m2 here, so collect x terms on the left.)

$$12x + 3 = 3x + 30$$

→ *Subtract 3x from both sides: (12 - 3)x + 3 = 30.*
→ *Subtract 3: 9x = 27.*
→ *Divide by 9: x = 3.*

Answer: $x = 3$

25. Solve for x: 3x + 6 = 5x + 5

$$3x + 6 = 5x + 5$$

→ *Move x terms left: 3x - 5x = 5 - 6.*
→ *Combine: -2x = -1.*
→ *Divide by -2: x = 1/2.*

Answer: $x = \frac{1}{2}$

26. Two friends are saving money. Alex has $32 and saves $14 per week. Jordan has $17 and saves $16 per week. After how many weeks will they have the same amount?

$$14x + 32 = 16x + 17$$

→ *Set equations equal: 14x + 32 = 16x + 17.*
→ *Move x terms: 14x - 16x = 17 - 32. So -2x = -15.*
→ *x = 15/2 weeks.*

Answer: $x = \frac{15}{2}$

27. Solve for x: 8x + 1 = 4x + 10. (Hint: m1 > m2 here, so collect x terms on the left.)

$$8x + 1 = 4x + 10$$

→ *Subtract 4x from both sides: (8 - 4)x + 1 = 10.*
→ *Subtract 1: 4x = 9.*
→ *Divide by 4: x = 9/4.*

Answer: $x = \frac{9}{4}$

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28. Solve for x: 3x + 5 = 4x + 12

$$3x + 5 = 4x + 12$$

→ *Move x terms left: 3x - 4x = 12 - 5.*
→ *Combine: -1x = 7.*
→ *Divide by -1: x = -7.*

Answer: $x = -7$

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29. Two friends are saving money. Alex has $27 and saves $6 per week. Jordan has $34 and saves $23 per week. After how many weeks will they have the same amount?

$$6x + 27 = 23x + 34$$

→ *Set equations equal: 6x + 27 = 23x + 34.*
→ *Move x terms: 6x - 23x = 34 - 27. So -17x = 7.*
→ *x = -7/17 weeks.*

Answer: $x = \frac{-7}{17}$

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30. Solve for x: 12x + 6 = 1x + 29. (Hint: m1 > m2 here, so collect x terms on the left.)

$$12x + 6 = 1x + 29$$

→ *Subtract 1x from both sides: (12 - 1)x + 6 = 29.*
→ *Subtract 6: 11x = 23.*
→ *Divide by 11: x = 23/11.*

Answer: $x = \frac{23}{11}$
