INTALG: Systems and Inequalities

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Learning Objectives

- Solve 2×2 systems by substitution and elimination
- Solve compound and absolute value inequalities
- Interpret the solution of a system in context
- Graph solution sets of systems on the number line

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

Compound inequalities

1. Solve the compound inequality: 7 < 2x + 1 < 21

$$7 < 2x + 1 < 21$$

Answer: _____

2. A temperature T (in Celsius) satisfies 7 < 2T + 4 < 30. Solve for T.

$$7 < 2x + 4 < 30$$

Answer: _____

3. Solve the compound inequality: 6 < 3x + 3 < 21

$$6 < 3x + 3 < 21$$

Answer: _____

4. A temperature T (in Celsius) satisfies 7 < 3T + 2 < 26. Solve for T.

$$7 < 3x + 2 < 26$$

Answer: _____

5. Solve the compound inequality: 5 < 4x + 5 < 22

$$5 < 4x + 5 < 22$$

Answer: _____

6. A temperature T (in Celsius) satisfies 6 < 3T + 3 < 21. Solve for T.

$$6 < 3x + 3 < 21$$

Answer: _____

7. Solve the compound inequality: 5 < 2x + 2 < 16

$$5 < 2x + 2 < 16$$

Answer: _____

8. A temperature T (in Celsius) satisfies 7 < 2T + 4 < 25. Solve for T.

$$7 < 2x + 4 < 25$$

Answer: _____

Linear inequalities

9. Solve and write the solution: 4x + 9 > 23. Graph the solution on a number line.

$$4x + 9 > 23$$

Answer: _____

10. Solve and express the solution: 3x + 7 < 23.

$$3x + 7 < 23$$

Answer: _____

11. Solve and write the solution: 1x + 7 <= 7. Graph the solution on a number line.

$$1x + 7 \leq 7$$

Answer: _____

12. Solve: 4x - 2 >= 16.

$$4x - 2 \geq 16$$

Answer: _____

13. Solve and write the solution: 5x + 4 > 20. Graph the solution on a number line.

$$5x + 4 > 20$$

Answer: _____

14. Solve and express the solution: 2x + 8 < 25.

$$2x + 8 < 25$$

Answer: _____

15. Solve and write the solution: 1x + 4 <= 10. Graph the solution on a number line.

$$1x + 4 \leq 10$$

Answer: _____

16. Solve: 6x - 1 >= 18.

$$6x - 1 \geq 18$$

Answer: _____

17. Solve and write the solution: 5x + 3 > 8. Graph the solution on a number line.

$$5x + 3 > 8$$

Answer: _____

18. Solve and express the solution: 4x + 8 < 17.

$$4x + 8 < 17$$

Answer: _____

19. Solve and write the solution: 4x + 2 <= 26. Graph the solution on a number line.

$$4x + 2 \leq 26$$

Answer: _____

20. Solve: 5x - 5 >= 12.

$$5x - 5 \geq 12$$

Answer: _____

21. Solve and write the solution: 3x + 9 > 25. Graph the solution on a number line.

$$3x + 9 > 25$$

Answer: _____

Systems of equations

22. Solve the system by elimination. Add the two equations to eliminate y.

$$\begin{cases} 3x - 2y = 0 \\ 3x + 2y = 12 \end{cases}$$

Answer: _____

23. Solve the system by elimination: 1x + 3y = 8 4x + 1y = -1

$$\begin{cases} x + 3y = 8 \\ 4x + y = -1 \end{cases}$$

Answer: _____

24. Solve the system by substitution.

$$\begin{cases} y = 0x + 0 \\ 3x + 2y = 6 \end{cases}$$

Answer: _____

25. Solve the system by elimination. Add the two equations to eliminate y.

$$\begin{cases} x - 3y = 4 \\ x + 2y = -1 \end{cases}$$

Answer: _____

26. Solve the system by elimination: 2x + 2y = -4 2x + 1y = -4

$$\begin{cases} 2x + 2y = -4 \\ 2x + y = -4 \end{cases}$$

Answer: _____

27. Solve the system by substitution.

$$\begin{cases} y = -2x - 3 \\ 4x + y = -5 \end{cases}$$

Answer: _____

28. Solve the system by elimination. Add the two equations to eliminate y.

$$\begin{cases} x - 3y = 3 \\ 4x + 2y = 12 \end{cases}$$

Answer: _____

29. Solve the system by elimination: 1x + 1y = -1 4x + 4y = -4

$$\begin{cases} x + y = -1 \\ 4x + 4y = -4 \end{cases}$$

Answer: _____

30. Solve the system by substitution.

$$\begin{cases} y = 2x + 3 \\ x + 2y = 0 \end{cases}$$

Answer: _____

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ANSWER KEY & SOLUTIONS

Topics: Compound inequalities, Linear inequalities, Systems of equations. All answers verified by independent computation.

Solutions

Compound inequalities

1. Solve the compound inequality: 7 < 2x + 1 < 21

$$7 < 2x + 1 < 21$$

→ *Subtract 1 from all three parts: 7 - 1 < 2x < 21 - 1.*
→ *Divide all three parts by 2.*
→ *Solution: 3 < x < 10.*

Answer: $3 < x < 10$

---

2. A temperature T (in Celsius) satisfies 7 < 2T + 4 < 30. Solve for T.

$$7 < 2x + 4 < 30$$

→ *Subtract 4 throughout: 7 - 4 < 2T < 30 - 4.*
→ *Divide by 2: solution is 3/2 < x < 13.*
→ *The temperature T falls in this interval.*

Answer: $\frac{3}{2} < x < 13$

---

3. Solve the compound inequality: 6 < 3x + 3 < 21

$$6 < 3x + 3 < 21$$

→ *Subtract 3 from all three parts: 6 - 3 < 3x < 21 - 3.*
→ *Divide all three parts by 3.*
→ *Solution: 1 < x < 6.*

Answer: $1 < x < 6$

---

4. A temperature T (in Celsius) satisfies 7 < 3T + 2 < 26. Solve for T.

$$7 < 3x + 2 < 26$$

→ *Subtract 2 throughout: 7 - 2 < 3T < 26 - 2.*
→ *Divide by 3: solution is 5/3 < x < 8.*
→ *The temperature T falls in this interval.*

Answer: $\frac{5}{3} < x < 8$

---

5. Solve the compound inequality: 5 < 4x + 5 < 22

$$5 < 4x + 5 < 22$$

→ *Subtract 5 from all three parts: 5 - 5 < 4x < 22 - 5.*
→ *Divide all three parts by 4.*
→ *Solution: 0 < x < 17/4.*

Answer: $0 < x < \frac{17}{4}$

---

6. A temperature T (in Celsius) satisfies 6 < 3T + 3 < 21. Solve for T.

$$6 < 3x + 3 < 21$$

→ *Subtract 3 throughout: 6 - 3 < 3T < 21 - 3.*
→ *Divide by 3: solution is 1 < x < 6.*
→ *The temperature T falls in this interval.*

Answer: $1 < x < 6$

---

7. Solve the compound inequality: 5 < 2x + 2 < 16

$$5 < 2x + 2 < 16$$

→ *Subtract 2 from all three parts: 5 - 2 < 2x < 16 - 2.*
→ *Divide all three parts by 2.*
→ *Solution: 3/2 < x < 7.*

Answer: $\frac{3}{2} < x < 7$

---

8. A temperature T (in Celsius) satisfies 7 < 2T + 4 < 25. Solve for T.

$$7 < 2x + 4 < 25$$

→ *Subtract 4 throughout: 7 - 4 < 2T < 25 - 4.*
→ *Divide by 2: solution is 3/2 < x < 21/2.*
→ *The temperature T falls in this interval.*

Answer: $\frac{3}{2} < x < \frac{21}{2}$

Linear inequalities

9. Solve and write the solution: 4x + 9 > 23. Graph the solution on a number line.

$$4x + 9 > 23$$

→ *Subtract 9 from both sides: 4x > 14.*
→ *Divide both sides by 4: x > 7/2.*
→ *Open circle at 7/2, shade to the right.*

Answer: $x > \frac{7}{2}$

10. Solve and express the solution: 3x + 7 < 23.

$$3x + 7 < 23$$

→ *Subtract 7: 3x < 16. Divide by 3: x < 16/3.*

Answer: $x < \frac{16}{3}$

11. Solve and write the solution: 1x + 7 <= 7. Graph the solution on a number line.

$$1x + 7 \leq 7$$

→ *Subtract 7 from both sides: 1x <= 0.*
→ *Divide both sides by 1: x <= 0.*
→ *Closed circle at 0, shade to the left.*

Answer: $x \leq 0$

12. Solve: 4x - 2 >= 16.

$$4x - 2 \geq 16$$

→ *Add 2: 4x >= 18. Divide by 4: x >= 9/2.*

Answer: $x \geq \frac{9}{2}$

13. Solve and write the solution: 5x + 4 > 20. Graph the solution on a number line.

$$5x + 4 > 20$$

→ *Subtract 4 from both sides: 5x > 16.*
→ *Divide both sides by 5: x > 16/5.*
→ *Open circle at 16/5, shade to the right.*

Answer: $x > \frac{16}{5}$

14. Solve and express the solution: 2x + 8 < 25.

$$2x + 8 < 25$$

→ *Subtract 8: 2x < 17. Divide by 2: x < 17/2.*

Answer: $x < \frac{17}{2}$

15. Solve and write the solution: 1x + 4 <= 10. Graph the solution on a number line.

$$1x + 4 \leq 10$$

→ *Subtract 4 from both sides: 1x <= 6.*
→ *Divide both sides by 1: x <= 6.*
→ *Closed circle at 6, shade to the left.*

Answer: $x \leq 6$

---

16. Solve: 6x - 1 >= 18.

$$6x - 1 \geq 18$$

→ *Add 1: 6x >= 19. Divide by 6: x >= 19/6.*

Answer: $x \geq \frac{19}{6}$

---

17. Solve and write the solution: 5x + 3 > 8. Graph the solution on a number line.

$$5x + 3 > 8$$

→ *Subtract 3 from both sides: 5x > 5.*
→ *Divide both sides by 5: x > 1.*
→ *Open circle at 1, shade to the right.*

Answer: $x > 1$

---

18. Solve and express the solution: 4x + 8 < 17.

$$4x + 8 < 17$$

→ *Subtract 8: 4x < 9. Divide by 4: x < 9/4.*

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

---

19. Solve and write the solution: 4x + 2 <= 26. Graph the solution on a number line.

$$4x + 2 \leq 26$$

→ *Subtract 2 from both sides: 4x <= 24.*
→ *Divide both sides by 4: x <= 6.*
→ *Closed circle at 6, shade to the left.*

Answer: $x \leq 6$

---

20. Solve: 5x - 5 >= 12.

$$5x - 5 \geq 12$$

→ *Add 5: 5x >= 17. Divide by 5: x >= 17/5.*

Answer: $x \geq \frac{17}{5}$

---

21. Solve and write the solution: 3x + 9 > 25. Graph the solution on a number line.

$$3x + 9 > 25$$

→ *Subtract 9 from both sides: 3x > 16.*
→ *Divide both sides by 3: x > 16/3.*
→ *Open circle at 16/3, shade to the right.*

Answer: $x > \frac{16}{3}$

Systems of equations

22. Solve the system by elimination. Add the two equations to eliminate y.

$$\begin{cases} 3x - 2y = 0 \\ 3x + 2y = 12 \end{cases}$$

→ *Notice the y-terms have opposite signs. Add the equations to eliminate y.*
→ *(3+3)x = 12, so x = 12/6.*
→ *Substitute x back to find y.*
→ *Solution: x = 2, y = 3.*

Answer: $x = 2, \quad y = 3$

23. Solve the system by elimination: 1x + 3y = 8 4x + 1y = -1

$$\begin{cases} x + 3y = 8 \\ 4x + y = -1 \end{cases}$$

→ *Multiply and eliminate one variable.*
→ *x = -1, y = 3.*

Answer: $x = -1, \quad y = 3$

24. Solve the system by substitution.

$$\begin{cases} y = 0x + 0 \\ 3x + 2y = 6 \end{cases}$$

→ *The first equation gives y in terms of x directly.*
→ *Substitute into the second equation and solve for x.*
→ *Back-substitute to find y.*
→ *Solution: x = 2, y = 0.*

Answer: $x = 2, \quad y = 0$

25. Solve the system by elimination. Add the two equations to eliminate y.

$$\begin{cases} x - 3y = 4 \\ x + 2y = -1 \end{cases}$$

→ *Notice the y-terms have opposite signs. Add the equations to eliminate y.*
→ *(1+1)x = 3, so x = 3/2.*
→ *Substitute x back to find y.*
→ *Solution: x = 1, y = -1.*

Answer: $x = 1, \quad y = -1$

26. Solve the system by elimination: 2x + 2y = -4 2x + 1y = -4

$$\begin{cases} 2x + 2y = -4 \\ 2x + y = -4 \end{cases}$$

→ *Multiply and eliminate one variable.*
→ *x = -2, y = 0.*

Answer: $x = -2, \quad y = 0$

27. Solve the system by substitution.

$$\begin{cases} y = -2x - 3 \\ 4x + y = -5 \end{cases}$$

→ *The first equation gives y in terms of x directly.*
→ *Substitute into the second equation and solve for x.*
→ *Back-substitute to find y.*
→ *Solution: x = -2, y = 3.*

Answer: $x = -2, \quad y = 3$

---

28. Solve the system by elimination. Add the two equations to eliminate y.

$$\begin{cases} x - 3y = 3 \\ 4x + 2y = 12 \end{cases}$$

→ *Notice the y-terms have opposite signs. Add the equations to eliminate y.*
→ *(1+4)x = 15, so x = 15/5.*
→ *Substitute x back to find y.*
→ *Solution: x = 3, y = 0.*

Answer: $x = 3, \quad y = 0$

---

29. Solve the system by elimination: 1x + 1y = -1 4x + 4y = -4

$$\begin{cases} x + y = -1 \\ 4x + 4y = -4 \end{cases}$$

→ *Multiply and eliminate one variable.*
→ *x = 0, y = -1.*

Answer: $x = 0, \quad y = -1$

---

30. Solve the system by substitution.

$$\begin{cases} y = 2x + 3 \\ x + 2y = 0 \end{cases}$$

→ *The first equation gives y in terms of x directly.*
→ *Substitute into the second equation and solve for x.*
→ *Back-substitute to find y.*
→ *Solution: x = 0, y = 0.*

Answer: $x = 0, \quad y = 0$
