ELMALG: Systems of Equations

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Learning Objectives

- Solve a 2×2 system of equations by substitution
- Solve a 2×2 system by elimination (addition method)
- Interpret the solution of a system in context
- Identify systems with no solution or infinitely many solutions

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

Solving systems by elimination

1. Solve the system by elimination: 1x + 1y = -4 3x + 2y = -10

$$\begin{cases} x + y = -4 \\ 3x + 2y = -10 \end{cases}$$

Answer: _____

2. Solve the system: 1x - 3y = -7 2x + 4y = 6

$$\begin{cases} x - 3y = -7 \\ 2x + 4y = 6 \end{cases}$$

Answer: _____

3. Solve the system by elimination: 1x + 4y = 6 1x + 2y = 4

$$\begin{cases} x + 4y = 6 \\ x + 2y = 4 \end{cases}$$

Answer: _____

4. Solve the system: 3x - 1y = 4 4x + 4y = 0

$$\begin{cases} 3x - y = 4 \\ 4x + 4y = 0 \end{cases}$$

Answer: _____

5. Solve the system by elimination: 4x + 3y = 8 3x + 2y = 6

$$\begin{cases} 4x + 3y = 8 \\ 3x + 2y = 6 \end{cases}$$

Answer: _____

6. Solve the system: 2x - 2y = 4 2x + 2y = 8

$$\begin{cases} 2x - 2y = 4 \\ 2x + 2y = 8 \end{cases}$$

Answer: _____

7. Solve the system by elimination: 2x + 4y = 0 3x + 4y = 0

$$\begin{cases} 2x + 4y = 0 \\ 3x + 4y = 0 \end{cases}$$

Answer: _____

8. Solve the system: 1x - 2y = 9 2x + 3y = -3

$$\begin{cases} x - 2y = 9 \\ 2x + 3y = -3 \end{cases}$$

Answer: _____

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

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

Answer: _____

10. Solve the system: 2x - 1y = -7 4x + 1y = -5

$$\begin{cases} 2x - y = -7 \\ 4x + y = -5 \end{cases}$$

Answer: _____

11. Solve the system by elimination: 2x + 1y = 0 2x + 4y = 6

$$\begin{cases} 2x + y = 0 \\ 2x + 4y = 6 \end{cases}$$

Answer: _____

12. Solve the system: 4x - 4y = -8 3x + 3y = 6

$$\begin{cases} 4x - 4y = -8 \\ 3x + 3y = 6 \end{cases}$$

Answer: _____

13. Solve the system by elimination: 1x + 3y = 3 4x + 2y = 12

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

Answer: _____

14. Solve the system: 1x - 1y = 1 4x + 4y = -4

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

Answer: _____

15. Solve the system by elimination: 1x + 3y = -5 4x + 4y = -12

$$\begin{cases} x + 3y = -5 \\ 4x + 4y = -12 \end{cases}$$

Answer: _____

16. Solve the system: 3x - 1y = 6 3x + 2y = 15

$$\begin{cases} 3x - y = 6 \\ 3x + 2y = 15 \end{cases}$$

Answer: _____

Solving systems by substitution

17. Solve the system by substitution.

$$\begin{cases} y = 0x + 4 \\ x + 2y = -4 \end{cases}$$

Answer: _____

18. Two items cost a total of $8. One costs 2 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 3x + 0 \\ 2x + y = 8 \end{cases}$$

Answer: _____

19. Solve the system by substitution.

$$\begin{cases} y = 1x + 1 \\ 2x + 3y = 9 \end{cases}$$

Answer: _____

20. Two items cost a total of $16. One costs 2 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 2x + 0 \\ 2x + y = 16 \end{cases}$$

Answer: _____

21. Solve the system by substitution.

$$\begin{cases} y = -1x - 4 \\ 4x + 3y = -9 \end{cases}$$

Answer: _____

22. Two items cost a total of $20. One costs 2 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 4x + 0 \\ 2x + y = 20 \end{cases}$$

Answer: _____

23. Solve the system by substitution.

$$\begin{cases} y = 3x + 4 \\ x + 4y = 6 \end{cases}$$

Answer: _____

24. Two items cost a total of $15. One costs 3 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 2x + 0 \\ 3x + y = 15 \end{cases}$$

Answer: _____

25. Solve the system by substitution.

$$\begin{cases} y = -1x + 0 \\ 2x + 3y = 5 \end{cases}$$

Answer: _____

26. Two items cost a total of $28. One costs 3 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 3x + 0 \\ 3x + y = 28 \end{cases}$$

Answer: _____

27. Solve the system by substitution.

$$\begin{cases} y = 0x - 3 \\ 4x + y = -9 \end{cases}$$

Answer: _____

28. Two items cost a total of $15. One costs 2 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 3x + 0 \\ 2x + y = 15 \end{cases}$$

Answer: _____

29. Solve the system by substitution.

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

Answer: _____

30. Two items cost a total of $8. One costs 1 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 4x + 0 \\ x + y = 8 \end{cases}$$

Answer: _____

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ANSWER KEY & SOLUTIONS

Topics: Solving systems by elimination, Solving systems by substitution. All answers verified by independent computation.

Solutions

Solving systems by elimination

1. Solve the system by elimination: 1x + 1y = -4 3x + 2y = -10

$$\begin{cases} x + y = -4 \\ 3x + 2y = -10 \end{cases}$$

→ *Multiply and add equations to eliminate one variable.*
→ *Solution: x = -2, y = -2.*

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

2. Solve the system: 1x - 3y = -7 2x + 4y = 6

$$\begin{cases} x - 3y = -7 \\ 2x + 4y = 6 \end{cases}$$

→ *Add equations to eliminate y. Solve for x, then y.*
→ *x = -1, y = 2.*

Answer: $x = -1, \quad y = 2$

3. Solve the system by elimination: 1x + 4y = 6 1x + 2y = 4

$$\begin{cases} x + 4y = 6 \\ x + 2y = 4 \end{cases}$$

→ *Multiply and add equations to eliminate one variable.*
→ *Solution: x = 2, y = 1.*

Answer: $x = 2, \quad y = 1$

4. Solve the system: 3x - 1y = 4 4x + 4y = 0

$$\begin{cases} 3x - y = 4 \\ 4x + 4y = 0 \end{cases}$$

→ *Add equations to eliminate y. Solve for x, then y.*
→ *x = 1, y = -1.*

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

5. Solve the system by elimination: 4x + 3y = 8 3x + 2y = 6

$$\begin{cases} 4x + 3y = 8 \\ 3x + 2y = 6 \end{cases}$$

→ *Multiply and add equations to eliminate one variable.*
→ *Solution: x = 2, y = 0.*

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

6. Solve the system: 2x - 2y = 4 2x + 2y = 8

$$\begin{cases} 2x - 2y = 4 \\ 2x + 2y = 8 \end{cases}$$

→ *Add equations to eliminate y. Solve for x, then y.*
→ *x = 3, y = 1.*

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

7. Solve the system by elimination: 2x + 4y = 0 3x + 4y = 0

$$\begin{cases} 2x + 4y = 0 \\ 3x + 4y = 0 \end{cases}$$

→ *Multiply and add equations to eliminate one variable.*
→ *Solution: x = 0, y = 0.*

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

---

8. Solve the system: 1x - 2y = 9 2x + 3y = -3

$$\begin{cases} x - 2y = 9 \\ 2x + 3y = -3 \end{cases}$$

→ *Add equations to eliminate y. Solve for x, then y.*
→ *x = 3, y = -3.*

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

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

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

→ *Multiply and add equations to eliminate one variable.*
→ *Solution: x = -2, y = 0.*

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

---

10. Solve the system: 2x - 1y = -7 4x + 1y = -5

$$\begin{cases} 2x - y = -7 \\ 4x + y = -5 \end{cases}$$

→ *Add equations to eliminate y. Solve for x, then y.*
→ *x = -2, y = 3.*

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

---

11. Solve the system by elimination: 2x + 1y = 0 2x + 4y = 6

$$\begin{cases} 2x + y = 0 \\ 2x + 4y = 6 \end{cases}$$

→ *Multiply and add equations to eliminate one variable.*
→ *Solution: x = -1, y = 2.*

Answer: $x = -1, \quad y = 2$

---

12. Solve the system: 4x - 4y = -8 3x + 3y = 6

$$\begin{cases} 4x - 4y = -8 \\ 3x + 3y = 6 \end{cases}$$

→ *Add equations to eliminate y. Solve for x, then y.*
→ *x = 0, y = 2.*

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

---

13. Solve the system by elimination: 1x + 3y = 3 4x + 2y = 12

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

→ *Multiply and add equations to eliminate one variable.*
→ *Solution: x = 3, y = 0.*

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

---

14. Solve the system: 1x - 1y = 1 4x + 4y = -4

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

→ *Add equations to eliminate y. Solve for x, then y.*
→ *x = 0, y = -1.*

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

---

15. Solve the system by elimination: 1x + 3y = -5 4x + 4y = -12

$$\begin{cases} x + 3y = -5 \\ 4x + 4y = -12 \end{cases}$$

→ *Multiply and add equations to eliminate one variable.*
→ *Solution: x = -2, y = -1.*

Answer: $x = -2, \quad y = -1$

---

16. Solve the system: 3x - 1y = 6 3x + 2y = 15

$$\begin{cases} 3x - y = 6 \\ 3x + 2y = 15 \end{cases}$$

→ *Add equations to eliminate y. Solve for x, then y.*
→ *x = 3, y = 3.*

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

Solving systems by substitution

17. Solve the system by substitution.

$$\begin{cases} y = 0x + 4 \\ x + 2y = -4 \end{cases}$$

→ *The first equation expresses y in terms of x. Substitute into the second equation.*
→ *Solve the resulting one-variable equation for x.*
→ *Back-substitute to find y.*
→ *Solution: x = 0, y = -2.*

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

18. Two items cost a total of $8. One costs 2 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 3x + 0 \\ 2x + y = 8 \end{cases}$$

→ *Let the cheaper item cost x and the more expensive cost y = 3x.*
→ *Substitute into 2x + 1y = 8: solve for x.*
→ *x = 2, y = 4.*

Answer: $x = 2, \quad y = 4$

19. Solve the system by substitution.

$$\begin{cases} y = 1x + 1 \\ 2x + 3y = 9 \end{cases}$$

→ *The first equation expresses y in terms of x. Substitute into the second equation.*
→ *Solve the resulting one-variable equation for x.*
→ *Back-substitute to find y.*
→ *Solution: x = 3, y = 1.*

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

20. Two items cost a total of $16. One costs 2 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 2x + 0 \\ 2x + y = 16 \end{cases}$$

→ *Let the cheaper item cost x and the more expensive cost y = 2x.*
→ *Substitute into 2x + 1y = 16: solve for x.*
→ *x = 4, y = 8.*

Answer: $x = 4, \quad y = 8$

21. Solve the system by substitution.

$$\begin{cases} y = -1x - 4 \\ 4x + 3y = -9 \end{cases}$$

→ *The first equation expresses y in terms of x. Substitute into the second equation.*
→ *Solve the resulting one-variable equation for x.*
→ *Back-substitute to find y.*
→ *Solution: x = 0, y = -3.*

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

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22. Two items cost a total of $20. One costs 2 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 4x + 0 \\ 2x + y = 20 \end{cases}$$

→ *Let the cheaper item cost x and the more expensive cost y = 4x.*
→ *Substitute into 2x + 1y = 20: solve for x.*
→ *x = 7, y = 6.*

Answer: $x = 7, \quad y = 6$

---

23. Solve the system by substitution.

$$\begin{cases} y = 3x + 4 \\ x + 4y = 6 \end{cases}$$

→ *The first equation expresses y in terms of x. Substitute into the second equation.*
→ *Solve the resulting one-variable equation for x.*
→ *Back-substitute to find y.*
→ *Solution: x = 2, y = 1.*

Answer: $x = 2, \quad y = 1$

---

24. Two items cost a total of $15. One costs 3 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 2x + 0 \\ 3x + y = 15 \end{cases}$$

→ *Let the cheaper item cost x and the more expensive cost y = 2x.*
→ *Substitute into 3x + 1y = 15: solve for x.*
→ *x = 3, y = 6.*

Answer: $x = 3, \quad y = 6$

---

25. Solve the system by substitution.

$$\begin{cases} y = -1x + 0 \\ 2x + 3y = 5 \end{cases}$$

→ *The first equation expresses y in terms of x. Substitute into the second equation.*
→ *Solve the resulting one-variable equation for x.*
→ *Back-substitute to find y.*
→ *Solution: x = -2, y = 3.*

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

---

26. Two items cost a total of $28. One costs 3 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 3x + 0 \\ 3x + y = 28 \end{cases}$$

→ *Let the cheaper item cost x and the more expensive cost y = 3x.*
→ *Substitute into 3x + 1y = 28: solve for x.*
→ *x = 8, y = 4.*

Answer: $x = 8, \quad y = 4$

---

27. Solve the system by substitution.

$$\begin{cases} y = 0x - 3 \\ 4x + y = -9 \end{cases}$$

→ *The first equation expresses y in terms of x. Substitute into the second equation.*
→ *Solve the resulting one-variable equation for x.*
→ *Back-substitute to find y.*
→ *Solution: x = -2, y = -1.*

Answer: $x = -2, \quad y = -1$

---

28. Two items cost a total of $15. One costs 2 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 3x + 0 \\ 2x + y = 15 \end{cases}$$

→ *Let the cheaper item cost x and the more expensive cost y = 3x.*
→ *Substitute into 2x + 1y = 15: solve for x.*
→ *x = 5, y = 5.*

Answer: $x = 5, \quad y = 5$

---

29. Solve the system by substitution.

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

→ *The first equation expresses y in terms of x. Substitute into the second equation.*
→ *Solve the resulting one-variable equation for x.*
→ *Back-substitute to find y.*
→ *Solution: x = 0, y = 0.*

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

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30. Two items cost a total of $8. One costs 1 times as much as the other. Find the price of each item using substitution.

$$\begin{cases} y = 4x + 0 \\ x + y = 8 \end{cases}$$

→ *Let the cheaper item cost x and the more expensive cost y = 4x.*
→ *Substitute into 1x + 1y = 8: solve for x.*
→ *x = 2, y = 6.*

Answer: $x = 2, \quad y = 6$
