# Applications of Systems of Equations

| Name: _____ | Date: _____ | Score: _____ / 24 |
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## Quick Review

Word problems that involve two unknowns often become systems of equations. **Strategy**: **(1)** identify the two unknowns and pick variables; **(2)** write two equations — usually one for totals (sum, count) and one for value (cost, weight, money); **(3)** solve by substitution or elimination; **(4)** check the answer in the original problem context, not just the equations. Classic types: **mixture problems** (acid/water, coffee blends), **rate problems** (boat/plane with current/wind), **number problems** (digit sums, ages), **coin problems** (count + value), **break-even problems** (cost = revenue). Pick the form (substitution vs. elimination) that has less fraction-juggling.

## PRACTICE

*Set up and solve each problem with a system.*

**1.** The art club keeps money in two envelopes for supplies. Together the envelopes hold $\$30$. The larger envelope has $\$8$ more than the smaller envelope. How much money is in each envelope?

_____

**2.** Two fundraising teams sold raffle tickets after school. Together they collected $\$50$. Team B collected three times as much money as Team A. How much money did each team collect?

_____

**3.** A rectangular garden has a perimeter of $24$ feet. Its length is $2$ feet more than its width. Find the length and width of the garden.

_____

**4.** Maya has $20$ coins in a jar. The coins are only nickels and quarters, and their total value is $\$3.40$. How many nickels and how many quarters does Maya have?

_____

**5.** A community theater sold $15$ tickets for a matinee. Adult tickets cost $\$12$ each and child tickets cost $\$6$ each. If the total ticket sales were $\$132$, how many adult tickets and child tickets were sold?

_____

**6.** A boat travels $24$ miles downstream in $2$ hours. The same boat travels $24$ miles upstream in $3$ hours. Find the boat's speed in still water and the speed of the current.

_____

**7.** A small plane flies $600$ miles with the wind in $4$ hours. Flying back against the same wind, it takes $5$ hours to travel $600$ miles. Find the plane's speed in still air and the wind speed.

_____

**8.** The length and width of a rectangular patio add to $22$ feet. The patio has area $105$ square feet. What are the two dimensions?

_____

**9.** A school concert sold $100$ tickets. Student tickets cost $\$5$ and adult tickets cost $\$10$. The total revenue was $\$750$. How many student tickets and adult tickets were sold?

_____

**10.** A lab needs $100$ mL of a $50\%$ solution. The lab has a $30\%$ solution and a $60\%$ solution available. How many milliliters of each solution should be mixed?

_____

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**11.** A classroom store sold $30$ writing tools. Pencils cost $\$0.50$ each and pens cost $\$1.00$ each. If the total sales were $\$22$, how many pencils and pens were sold?

**12.** Car A starts at mile marker $0$ and drives at $60$ miles per hour. Car B starts at mile marker $90$ and drives in the same direction at $45$ miles per hour. After how many hours will Car A catch Car B?

**13.** Two siblings' ages add to $50$ years. The older sibling is $20$ years older than the younger sibling. How old is each sibling?

**14.** A father is $4$ times as old as his son. In $10$ years, the father will be twice as old as his son. How old are they now?

**15.** Phone Plan A charges a $\$30$ monthly fee plus $\$0.10$ per text. Phone Plan B charges a flat $\$50$ per month. For how many texts will the two plans cost the same?

**16.** A rectangular banner has a length that is $3$ times its width. The perimeter of the banner is $64$ inches. Find the width and length.

**17.** An investor splits $\$1000$ between two accounts. One account earns $5\%$ simple interest and the other earns $7\%$ simple interest. After one year, the total interest is $\$60$. How much was invested in each account?

**18.** Pool A starts with $200$ gallons of water and drains at $20$ gallons per hour. Pool B starts with $150$ gallons and drains at $15$ gallons per hour. After how many hours will the pools contain the same amount of water?

**19.** A quiz has $20$ yes/no questions. A correct "yes" answer earns $2$ points, and an incorrect "no" answer loses $1$ point. A student has a score of $28$ points. How many yes answers and no answers are represented?

**20.** A two-digit number has digits whose sum is $9$. When the digits are reversed, the new number is $27$ greater than the original number. What is the original number?

## Word Problems

**21.** A school sold $300$ tickets to a play. Adult tickets cost \$8 and student tickets \$5. Total revenue was \$1,920. How many of each?

**Model:** _____

**Answer:** _____

**22.** A boat travels $40$ miles downstream in $2$ hours and $40$ miles upstream in $4$ hours. Find the boat's still-water speed and the current.

**Model:** _____

**Answer:** _____

**23.** A chemist needs $50$ L of a $40\%$ acid solution. She mixes a $30\%$ and a $60\%$ solution. How many liters of each?

**Model:** _____

**Answer:** _____

**24.** At a fundraiser, $80$ items sold (cookies \$2 each, brownies \$3 each). Total raised: \$190. How many of each?

**Model:** _____

**Answer:** _____

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# Answer Keys

1. $\$19,\ \$11$
2. $\$12.50,\ \$37.50$
3. $w = 5, \ell = 7$
4. $8$ N, $12$ Q
5. $a = 7, c = 8$
6. $b = 10, c = 2$
7. $p = 135, w = 15$
8. $7, 15$
9. $50, 50$
10. $33.3, 66.7$
11. $16$ pencils, $14$ pens
12. $t = 6$
13. $35, 15$
14. $f = 20, s = 5$
15. $t = 200$
16. $w = 8, \ell = 24$
17. $\$500, \$500$
18. $t = 10$
19. $16$ yes, $4$ no
20. $36$
21. $140$ adult, $160$ student
22. $b = 15,\ c = 5$
23. $33.\overline{3}$ L 30%, $16.\overline{6}$ L 60%
24. $50$ cookies, $30$ brownies

## Step-by-Step Tutor Notes

1. Let $x$ and $y$ be the account balances. The system is $x+y = 30$ and $x-y = 8$. Adding the equations gives $2x = 38$, so $x = 19$ and $y = 11$.
2. Let Team A collect $x$ dollars, so Team B collects $3x$. Then $x + 3x = 50$, so $4x = 50$ and $x = 12.50$. Team B collected $3(12.50) = 37.50$ dollars.
3. Use the labels on the display first; they tell you which count or total belongs in the answer. $2(\ell + w) = 24$, $\ell = w + 2$. $\ell + w = 12$, $(w + 2) + w = 12 \Rightarrow w = 5, \ell = 7$. This gives $w = 5, \ell = 7$.
4. Let $n$ be nickels and $q$ be quarters. Then $n + q = 20$ and $0.05n + 0.25q = 3.40$. Substitute $n = 20 - q$: $0.05(20 - q) + 0.25q = 3.40$, so $1 + 0.20q = 3.40$. That gives $q = 12$ quarters and $n = 8$ nickels.
5. Let $a$ be adult tickets and $c$ be child tickets. Use $a + c = 15$ and $12a + 6c = 132$. Since $c = 15 - a$, $12a + 6(15 - a) = 132$, so $6a = 42$ and $a = 7$. Then $c = 8$.
6. Keep the order of operations in view, then simplify without skipping the sign check. $b + c = 12$, $b - c = 8$. Add: $b = 10$, $c = 2$ mph. After simplifying, the answer is $b = 10, c = 2$.
7. Take it one clear step at a time and keep the original question in mind. $p + w = 150$, $p - w = 120$. $p = 135$, $w = 15$ mph. So the answer is $p = 135, w = 15$.
8. Use the structure of the expression to find the important point, then check that it fits the context. $x + y = 22$, $xy = 105$. Try factor pairs: $7 \cdot 15 = 105$ and $7 + 15 = 22$. ✓. That leads to $7, 15$.
9. Use the labels on the display first; they tell you which count or total belongs in the answer. $s + a = 100$, $5s + 10a = 750 \Rightarrow s + 2a = 150$. Subtract: $a = 50$, $s = 50$. This gives $50, 50$.
10. $x + y = 100$, $0.30x + 0.60y = 50$. From first: $x = 100 - y$. Sub: $0.30(100 - y) + 0.60y = 50 \Rightarrow 30 + 0.30y = 50 \Rightarrow y \approx 66.7$, $x \approx 33.3$ mL.
11. For a table question, slow down and locate the exact row, column, or cell before calculating. $p + n = 30$, $0.50p + n = 22$. Subtract: $0.50p = 8 \Rightarrow p = 16, n = 14$. This gives $16$ pencils, $14$ pens.
12. Read the table by matching the correct row and column first, then use the count or total that fits the question. $60t = 90 + 45t \Rightarrow 15t = 90 \Rightarrow t = 6$ hours. This gives $t = 6$.
13. Start with the definition the problem is testing, then apply it directly. $x + y = 50$, $x - y = 20$. $x = 35$, $y = 15$. So the answer is $35, 15$.
14. $f = 4s$ and $f + 10 = 2(s + 10) \Rightarrow 4s + 10 = 2s + 20 \Rightarrow s = 5$, $f = 20$.
15. Use the labels on the display first; they tell you which count or total belongs in the answer. $30 + 0.10t = 50 \Rightarrow t = 200$ texts (break-even). This gives $t = 200$.
16. For a table question, slow down and locate the exact row, column, or cell before calculating. $\ell = 3w$, $2(\ell + w) = 64 \Rightarrow \ell + w = 32 \Rightarrow 3w + w = 32 \Rightarrow w = 8, \ell = 24$. This gives $w = 8, \ell = 24$.
17. $a + b = 1000$, $0.05a + 0.07b = 60$. From first: $b = 1000 - a$. $0.05a + 0.07(1000 - a) = 60 \Rightarrow 70 - 0.02a = 60 \Rightarrow a = 500, b = 500$.
18. Read the table by matching the correct row and column first, then use the count or total that fits the question. $200 - 20t = 150 - 15t \Rightarrow 50 = 5t \Rightarrow t = 10$ hours. This gives $t = 10$.
19. For a table question, slow down and locate the exact row, column, or cell before calculating. $y + n = 20$, $2y - n = 28$. Add: $3y = 48 \Rightarrow y = 16$, $n = 4$. This gives $16$ yes, $4$ no.
20. Digits $t, u$: $t + u = 9$ and $(10u + t) - (10t + u) = 27 \Rightarrow 9u - 9t = 27 \Rightarrow u - t = 3$. So $u = 6$, $t = 3$. Number is $36$.
21. $a + s = 300$, $8a + 5s = 1920$. From first: $s = 300 - a$. Sub: $8a + 5(300 - a) = 1920 \Rightarrow 3a = 420 \Rightarrow a = 140, s = 160$.
22. Down: $b + c = 20$. Up: $b - c = 10$. Add: $2b = 30$, so $b = 15$ mph; current $c = 5$ mph.
23. $x + y = 50$, $0.30x + 0.60y = 0.40(50) = 20$. Sub $x = 50 - y$: $0.30(50 - y) + 0.60y = 20 \Rightarrow 15 + 0.30y = 20 \Rightarrow y = \frac{50}{3} \approx 16.67$ L, $x \approx 33.33$ L.
24. $c + b = 80$, $2c + 3b = 190$. Sub $c = 80 - b$: $2(80 - b) + 3b = 190 \Rightarrow 160 + b = 190 \Rightarrow b = 30, c = 50$.

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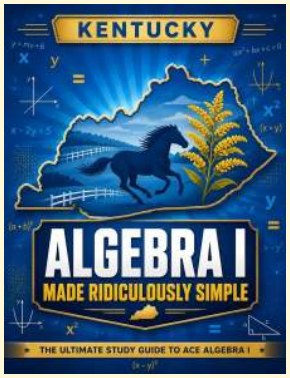


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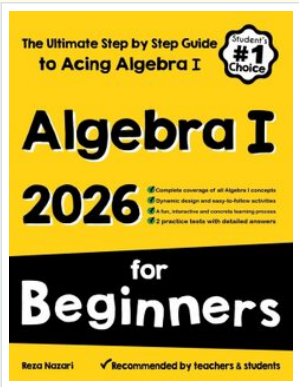


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