

Applications of Systems of Equations

Name: _____

Date: _____

Score: _____ / 24

Q 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.

- 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?

- 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?

- 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.

- 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?

- 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?

- 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.

- 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.

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

- 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?

- 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?



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◆ 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

- | | |
|---|---|
| <ol style="list-style-type: none"> 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. $t = 6$ | <ol style="list-style-type: none"> 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. 33.3 L 30%, 16.6 L 60% 24. 50 cookies, 30 brownies |
|---|---|

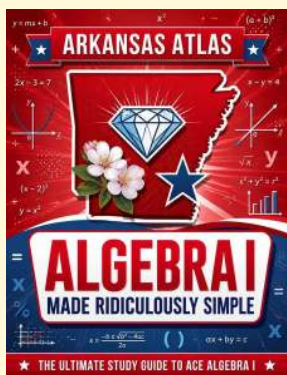
Step-by-Step Tutor Notes

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 $7 + 15 = 22$. \checkmark . 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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