Applications of Systems of Equations

Name: _____	Date: _____	Score: _____ / 24

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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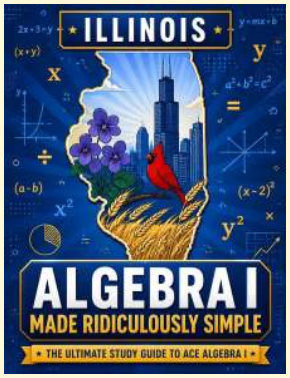

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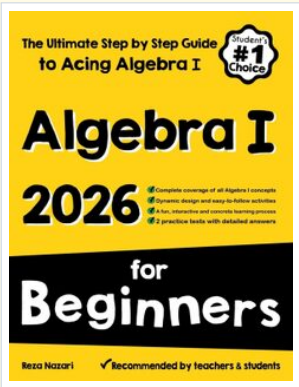

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