Solving Real Problems with Systems

Name: _____	Date: _____	Score: _____ / 24

Quick Review

Many real-world problems hide a **system of equations** inside the words. The trick is to *translate* carefully: pick two variables, then write one equation for each piece of information — often one for a **total count** and one for a **total value** or cost. Once you have the system, solve it with substitution or elimination, just like before. Finally, *answer the question in words* and check that your numbers make sense in the original story.

◇ **Example:** A box has 15 coins, all nickels and dimes, worth $\$1.05$. How many of each?

⇒ Let's name our unknowns: n is the number of nickels and d is the number of dimes. One fact is about the *count*: $n+d=15$. The other is about *value*, in cents: a nickel is 5 and a dime is 10, and the total is 105 cents, so $5n+10d=105$. From the first equation, $n=15-d$. Substitute: $5(15-d)+10d=105$, which simplifies to $75+5d=105$, so $5d=30$ and $d=6$. Then $n=15-6=9$. Nine nickels and six dimes — that's $45+60=105$ cents. It checks!

Answer: 9 nickels, 6 dimes

PRACTICE

Set up and solve a system for each problem.

1. $x+y=14,\ \ x-y=2$ _____

2. $x+y=25,\ \ x-y=5$ _____

3. $a+b=30,\ \ 2a+b=44$ _____

4. $x+y=18,\ \ 5x+10y=130$ _____

5. $p+q=20,\ \ 25p+10q=350$ _____

6. $x+y=12,\ \ 3x+5y=50$ _____

7. $a+b=40,\ \ a=3b$ _____

8. $x+y=16,\ \ x=y+4$ _____

9. $2x+3y=31,\ \ x+y=12$ _____

10. $x+y=9,\ \ 4x+2y=26$ _____

11. $3a+b=17,\ \ a+b=9$ _____

12. $x+y=50,\ \ x-y=10$ _____

13. $5x+2y=24,\ \ x+2y=12$ _____

14. $x+y=100,\ \ x=4y$ _____

15. $2x+y=13,\ \ 3x-y=12$ _____

16. $a+b=21,\ \ 2a+4b=62$ _____

17. $x+y=7,\ \ 10x+25y=130$ _____

18. $x+y=35,\ \ x-y=7$ _____

19. $3x+2y=18,\ \ x=2$ _____

20. $x+y=60,\ \ x=2y$ _____

Word Problems

21. A class of 28 students went to a museum. Tickets were $\$5$ for students who took the bus and $\$8$ for those who walked, for a total of $\$179$. How many took the bus? _____

22. A jar holds 40 marbles, red and blue. There are 8 more red marbles than blue. How many of each color are there? _____

23. A store sells small and large notebooks. A small costs $\$2$ and a large costs $\$5$. A customer bought 9 notebooks for $\$33$. How many large notebooks did they buy? _____

24. Two friends biked a total of 54 miles. One biked twice as far as the other. How far did each bike? _____

Answer Keys

1. $(8, 6)$
2. $(15, 10)$
3. $(14, 16)$
4. $(10, 8)$
5. $(10, 10)$
6. $(5, 7)$
7. $(30, 10)$
8. $(10, 6)$
9. $(5, 7)$
10. $(4, 5)$
11. $(4, 5)$
12. $(30, 20)$
13. $(3, \frac{9}{2})$
14. $(80, 20)$
15. $(5, 3)$
16. $(11, 10)$
17. $(3, 4)$
18. $(21, 14)$
19. $(2, 6)$
20. $(40, 20)$
21. 15 students took the bus
22. 24 red, 16 blue
23. 5 large notebooks
24. 36 miles and 18 miles

Step-by-Step Explanations

1. Add the equations: $2x = 16$, so $x = 8$ and $y = 6$.
2. Add: $2x = 30$, so $x = 15$ and $y = 10$.
3. Subtract the first from the second: $a = 14$, then $b = 16$.
4. From $x = 18 - y$: $5(18 - y) + 10y = 130$, so $5y = 40$, $y = 8$, $x = 10$.
5. Substitute $p = 20 - q$: $25(20 - q) + 10q = 350$, so $-15q = -150$, $q = 10$.
6. From $x = 12 - y$: $3(12 - y) + 5y = 50$, so $2y = 14$, $y = 7$, $x = 5$.
7. Substitute $a = 3b$: $3b + b = 40$, so $b = 10$ and $a = 30$.
8. Substitute: $(y + 4) + y = 16$, so $2y = 12$, $y = 6$, $x = 10$.
9. From $x = 12 - y$: $2(12 - y) + 3y = 31$, so $y = 7$, $x = 5$.
10. From $y = 9 - x$: $4x + 2(9 - x) = 26$, so $2x = 8$, $x = 4$, $y = 5$.
11. Subtract: $2a = 8$, so $a = 4$ and $b = 5$.
12. Add: $2x = 60$, so $x = 30$ and $y = 20$.
13. Subtract: $4x = 12$, so $x = 3$, then $2y = 9$, $y = \frac{9}{2}$.
14. Substitute $x = 4y$: $4y + y = 100$, so $y = 20$ and $x = 80$.
15. Add: $5x = 25$, so $x = 5$, then $y = 3$.
16. From $a = 21 - b$: $2(21 - b) + 4b = 62$, so $2b = 20$, $b = 10$, $a = 11$.
17. From $x = 7 - y$: $10(7 - y) + 25y = 130$, so $15y = 60$, $y = 4$, $x = 3$.
18. Add: $2x = 42$, so $x = 21$ and $y = 14$.
19. Substitute $x = 2$: $6 + 2y = 18$, so $2y = 12$, $y = 6$.
20. Substitute $x = 2y$: $2y + y = 60$, so $y = 20$ and $x = 40$.
21. With $b + w = 28$ and $5b + 8w = 179$, substitute $w = 28 - b$: $5b + 8(28 - b) = 179$, so $-3b = -45$ and $b = 15$.
22. With $r + b = 40$ and $r = b + 8$, substitute: $(b + 8) + b = 40$, so $2b = 32$, $b = 16$, $r = 24$.
23. With $s + l = 9$ and $2s + 5l = 33$, substitute $s = 9 - l$: $2(9 - l) + 5l = 33$, so $3l = 15$ and $l = 5$.
24. With $x + y = 54$ and $x = 2y$, substitute: $2y + y = 54$, so $y = 18$ and $x = 36$.

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