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APPLICATIONS OF LINEAR SYSTEMS Guide Notes

APPLICATIONS OF LINEAR SYSTEM OF EQUATIONS: Are represented through story problems or word problems. The point is to set up the equations and solve the system.
These applications mostly represent the following topics:

- Relation between numbers
- Mixtures
- Business
- Geometry
- Investment

STEP BY STEP: SOLVING APPLICATIONS

1) Read the problem carefully to determine the unknown quantities.

2) Choose a variable to represent the unknown.

3) Translate the problem to the language of algebra to form a system of equations.

4) Solve the system of equations and then answer the question of the original problem.

5) Verify your solution by returning to the original problem.

Set up the linear system of equations for the following word problems:

1. The sum of 2 numbers is 16 and their difference is 10.

System:

$$\begin{cases} x + y = 16 \\ x - y = 10 \end{cases}$$

2. A chemistry teacher has a 25% acid solution and another 40% acid solution. He wants to prepare 400 ml of a final solution at 30%

System:

$$\begin{cases} x + y = 400 \\ 0.25x + 0.40y = 0.30(400) \end{cases} \quad Solving: \quad \begin{cases} x + y = 400 \\ 0.25x + 0.40y = 120 \end{cases}$$

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3. The length of a rectangle is 2 cm more than three times its width and the perimeter of the rectangle is 40 cm.

System:

$$\begin{cases} x = 2 + 3y \\ 2x + 2y = 40 \end{cases}$$

SAMPLE PROBLEMS

Solve the following verbal problems involving linear systems:

- **The sum of 3 times a larger number and twice a smaller is 26. The difference of 2 times the larger and the smaller is 8. Find the numbers.**

- Identify variables

  x: Larger Number y: Smaller Number

- Set up equations

$$3x + 2y = 26 \quad \textit{and} \quad 2x - y = 8$$

- Solve linear System

We will use the elimination method, like follows:

$$\begin{cases} 3x + 2y = 26 \\ 2x - y = 8 \end{cases}$$

We interchange the "x" or "y" coefficients from equation I and equation II to eliminate one of the variables. In this case, we are going to interchange the "x" coefficients of both equations, like follows:

$$\begin{cases} 2(3x + 2y = 26) \\ -3\ (2x - y = 8) \end{cases}$$

Applying distributive property:

$$\begin{cases} 6x + 4y = 52 \\ -6x + 3y = -24 \end{cases}$$

The result would be:

$$7y = 28 \quad \rightarrow y = 4$$

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Now, we calculate the value of variable "x" by substituting the result of "y" into one of the equations

$$x = \frac{8+y}{2} = \frac{8+4}{2} = 6$$

x= 6 and y= 4

- **A roll of 30 bills contains only $5 bills and $10 bills. If the value of the roll is $250, then how many of each bill are in the roll?**

- Identify variables

  x: Number of $5 bills y: Number of $10 bills

- Set up equations

$$\boldsymbol{x + y = 30} \quad \boldsymbol{and} \quad \boldsymbol{5x + 10y = 250}$$

- Solve linear System

In this case we will use the elimination method, like follows:

$$\begin{cases} x + y = 30 \\ 5x + 10y = 250 \end{cases}$$

We interchange the "x" or "y" coefficients from equation I and equation II to eliminate one of the variables. In this case, we are going to interchange the "x" coefficients of both equations, like follows:

$$\begin{cases} 5(x + y = 30) \\ -1(5x + 10y = 250) \end{cases}$$

Applying distributive property:

$$\begin{cases} 5x + 5y = 150 \\ -5x - 10y = -250 \end{cases}$$

The result would be:

$$-5y = -100 \quad \rightarrow y = 20$$

Now, we calculate the value of variable "x" by substituting the result of "y" into one of the equations

$$x = 30 - y = 30 - 20 = 10$$

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There are 10 bills of $5 and 20 bills of $10

x= 10 and y= 20