

# 6-4: Applications of Linear Systems



**Essential Understanding** You can solve systems of linear equations using a graph, the substitution method, or the elimination method. The best method to use depends on the forms of the given equations and how precise the solution should be.



A blue arrow pointing to the right with the text "take note" written inside it in a white, sans-serif font.**Concept Summary** Choosing a Method for Solving Linear Systems

<b>Method</b>	<b>When to Use</b>
<b>Graphing</b>	When you want a visual display of the equations, or when you want to estimate a solution
<b>Substitution</b>	When one equation is already solved for one of the variables, or when it is easy to solve for one of the variables
<b>Elimination</b>	When the coefficients of one variable are the same or opposites, or when it is not convenient to use graphing or substitution

Two kinds of word problems:

- Real two variable word problems - ones that NEED two variables to be solved
- Contrived two variable word problems - ones that can be solved using one or two variables

Formulas:

- Solution:

$$\text{Solution Volume} * \% \text{ solution} = \text{pure element volume}$$

- Distance with Wind/Current:

$$\text{Rate} * \text{Time} = \text{Distance}$$

BUT

$$\text{Rate} = \text{Speed of Vessel} +/- \text{Speed of Current/Wind}$$

- Combinations:

$$\# \text{ Items} * \text{Value per Item} = \text{Total Value of Items}$$

- Digit Problems:

$$x = 10\text{'s digit}$$

$$y = 1\text{'s digit}$$

$$10x + y = \text{the number}$$

$$10y + x = \text{number with the digits reversed}$$

Set up word problems following same guidelines used in earlier chapters:

- Define **two** variables
- Use diagrams, charts, lists to organize your information
- Write **two** equations
- Solve the **system of equations**
- Check your answer for:

Accuracy - works in BOTH equations

Reasonableness - makes sense; realistic; satisfies info given

Completeness - answers question(s) asked in problem

A metal worker has some alloys that are 20% copper and some that are 60% copper. How much of each does he need to make 80 kg of a 52% copper alloy?

	Volume Alloy * % Copper = Volume Pure Copper		
Alloy 1	x	20	20x
Alloy 2	y	60	60y
Total	80	52	52(80)

$$\begin{aligned}
 & \cancel{-2}x + \cancel{y} = \cancel{80} - 160 \\
 & \cancel{20}x + \cancel{60}y = \cancel{4160} \\
 & 4y = 256 \\
 & y = 64
 \end{aligned}$$

$$x = 20\% \text{ alloy } 4160$$

$$y = 60\% \text{ alloy } -1600$$

$$\text{Eq 1: } x + y = 80$$

$$\text{Eq 2: } 20x + 60y = 52(80)$$

$$\begin{aligned}
 & (16, 64) \quad \frac{4160}{40} y = \frac{2560}{40} \\
 & \underline{\hspace{1cm}} \quad \frac{40}{40}
 \end{aligned}$$

It takes a plane flying west 6.5 hours to fly 2600 miles against a head wind. It takes another plane flying east 5.2 hours to travel the same distance, at the same speed, with the same speed tail wind. Find the speed of the plane and the speed of the wind.

	Rate $x$	Time	Distance
West Plane	$x-y$	6.5	2600
East Plane	$x+y$	5.2	2600
Total			

$x =$  plane speed

$y =$  wind speed

Eq #1:  $(x-y)6.5 = 2600$

Eq #2:  $(x+y)5.2 = 2600$

$$\begin{aligned} & [(x-y)6.5 = 2600] \div 6.5 \\ & [(x+y)5.2 = 2600] \div 5.2 \end{aligned}$$

$$\begin{aligned} & 1x - y = 400 \\ & 1x + y = 500 \end{aligned}$$

$$\begin{aligned} & 2x = 900 \\ & x = 450 \\ & y = 50 \end{aligned}$$

w/wind 500 mph  
ag/wind 400 mph

$(450, 50)$

Sample #3:

I bought 4 pens & 5 pencils for \$6.71. I bought 5 pens & 3 pencils for \$7.12. If I bought the same kinds of pens and pencils what did I spend for each?

	# Pencils * \$/Pencil + # Pens * \$/Pen = Total Cost				
1st Purchase	5	x	4	y	$5x + 4y = 6.71$
2nd Purchase	3	x	5	y	$3x + 5y = 7.12$

x = \$ pencil

y = \$ pen

Eq 1:  $5x + 4y = 6.71$

Eq 2:  $3x + 5y = 7.12$

$x = .39$        $(.39, 1.19)$   
 $y = 1.19$

The sum of the digits of a two digit number is 7.

The value of the number is two less than 12 times the ten's digit. Find the number.

$$\begin{array}{c} x \\ \hline 10's \end{array} \quad \begin{array}{c} y \\ \hline 1's \end{array}$$

$$10x + y = \#$$

$$\begin{array}{l} \rightarrow x + y = 7 \\ 10x + y = 12x - 2 \end{array}$$

$$\textcircled{25}$$

$$2 + 5 = 7$$

$$2(10) + 5 = 25$$

example

$$\begin{array}{l} x = 3 \\ y = 4 \end{array}$$

$$\# \text{ is } 34$$

You try:

One antifreeze solution is 10% alcohol. Another is 18% alcohol.  
How many liters of each solution should be used to make 20 liters of a 15% solution?

You try:

It takes you 3.2 hours to canoe 12 miles downstream. The return trip takes 4.8 hours. Find your paddling speed and the speed of the current.

The sum of the digits of a 2 digit number is 11. If the digits are reversed, the new number is 27 more than the original number. Find the number.

