Transformation
T-STEM 2013
New Directions | New Pathways | New Outcomes

Systems Activity

Overview

Systems of linear equations are a set or collection of equations that you deal with all together at once. Linear equations are simpler to solve than non-linear equations, and the simplest linear system is one in which there are two equations with two variables. **Solutions** to linear systems are the point(s) at which the lines intersect. In this VI, students will explore the simples of linear systems.

Systems of equations can be used to solve many types of problems including distance, mixture, and breakeven analysis problems. In this activity, you will use systems of equations to solve mixture problems.

Objectives

Students will:

- Analyze and solve systems of linear equations using equations and graphs.
- Interpret the reasonableness of the solutions.
- Use systems to solve mixture problems.

Standards (TEKS)

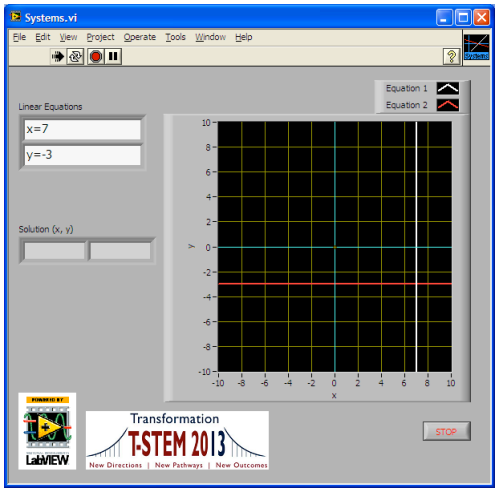
Algebra 1: A.8A, B, C
Algebra 2: 2A.3A, B, C

Activity

1) Open and run the VI.
2) The default equations are: $2x + 1y = 1$ and $x + 4y = -5$. What is the **solution**?
    a) Are there other ways that you could solve this system of equations? If so, what additional methods could be used?
    b) Create a table of values for the two default equations and describe how you can use a table of values to find the solution to the system.

x	***y***

3) Let's practice:
    a) Alter the default equations using $x = 7$ and $y = -3$.



    b) What do the two graphs look like?
    c) What is the solution?
    d) How does the solution relate to the equations?
4) More practice:
    a) Alter the equations using $y = 3x - 2$ and $y = -x - 6$. (Note: The VI accepts equations in **Standard Form**, $Ax + By = C$)
    b) What is the solution?
    c) Show how you can solve this equation using the **combinations/eliminations** method.
    d) Identify a point that lies on one line, but not the other. Which line does that point fall on?
5) Even more practice:
    a) Determine whether or not either of the points $(-1, -5)$ and $(0, -2)$ is a solution to the system of equations $3x - y = 2$ and $x + y = -6$.
    b) How could you solve the system algebraically using the **substitution** method?
    c) Demonstrate how you could check to see if either of the points is a solution using the plug-in method?

Systems of equations can be used to solve problems involving mixtures of coins with different values or liquids with different **concentrations** of a **solute**. For example, a chemist may have different solutions of acetic acid in water. In one solution, there is 25% acetic acid, while another solution is 45% acetic acid. For a particular formula, the chemist needs 300mL of 30% solution of acetic acid. The chemist can use a system of equations to find out how much of each pre-made solution to use to make the necessary 300ml.

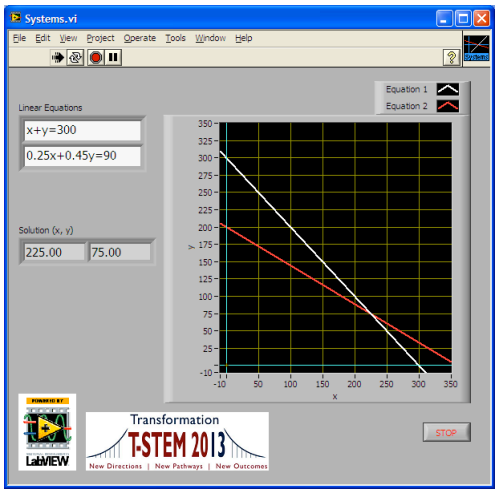
Use x for the amount of 25% acetic acid solution, and use y for the amount of 45% solution. Start by writing an equation for the total amount of liquid. Since the chemist wants to end up with 300mL, x plus y must add up to 300. That is, $x + y = 300$.

Next, write an equation for the amount of acetic acid. There is 25% of x and 45% of y, so we can use $.25x$ and $.45y$ for the amount of acetic acid from the pre-made solutions. The chemist's formula calls for 30% of the 300mL to be acetic acid, that is .3(300) = 90 is the amount of acetic acid in the resulting solution. From this, the equation to use is $.25x + .45y = 90$.

6) Enter the two equations into the Systems VI:

$$\begin{cases} x + y = 300 \\ .25x + .45y = 90 \end{cases}$$

   a) Adjust the graph window as needed to view the graphed lines.
      i. Double-click on the maximum x value and set it to 350.
      ii. Do the same for the maximum y-value.



   b) What is the solution to this system?
   c) How many mL of the 25% solution are needed? The 45% solution?

7) Solve this problem again, except this time the chemist has pre-made 10% and 40% solutions of acetic acid and needs 200mL of a 30% solution.
   a) Write your two equations.
   b) Plug the equations into the Systems VI.
   c) How many mL of the 10% solution are used?

It is clear the solution to a system of linear equations is the point where the two lines intersect. Given this phenomenon, it is possible to have systems of equations with no solutions or with infinitely many solutions.

8) Create a system of equations in two variables that has an infinite number of solutions.

9) Create a system of equations in two variables that has no solutions.