Teacher Notes

Solving Systems of Linear Equations with Linear Combinations (The Elimination Method)

Activity Overview
In this activity, students explore solving systems of linear equations with linear combinations (or the "elimination" method) from meaningful multi representational approach.

Concepts
- Solving Systems of Linear Equations
- Linear Combinations

Teacher preparation
This activity allows students explore the meaning of the "elimination" method for solving systems of linear equations. Students should have familiarity solving linear equations for one variable.

Classroom management tips
- This activity is designed to be student-centered with the teacher acting as a facilitator while students work cooperatively. The student worksheet is intended to guide students through the main ideas of the activity and provide a place to record their observations and reflections.
- Students will be asked make calculations and graph functions. Therefore, a basic working knowledge of the TI-Nspire CAS handheld is needed.
- The ideas contained in the following pages are intended to provide a framework as to how the activity will progress. Suggestions are also provided to help ensure that the objectives for this activity are met.

TI-Nspire CAS Applications
Calculator, Graphs & Geometry, Notes

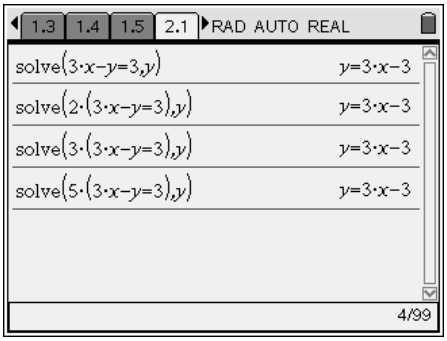
One concept defines this activity: Understanding solving systems of linear equations using linear combinations (also known as the "elimination" method).

To launch this Activity, present **Problem 1—Launch the Activity (Multiplying an Equation by a Constant)** to the class and discuss the question that follows. Students should conclude that these equations are equivalent and should be able to justify their conclusion. However, closure is not the goal of this discussion. They are not expected to "prove" their conclusions. This launch is designed to set the stage for the lesson and to assess student's prior knowledge. This concept will be developed further in **Problem 2—Multiplying an Equation by a Constant**.

Problem 2—Multiplying an Equation by a Constant

Step 1: In this problem the students are asked to use CAS to solve 3x – y = 3, 2(3x – y = 3), 3(3x – y = 3) and 5(3x – y = 3) for y. One possible solution is shown here.

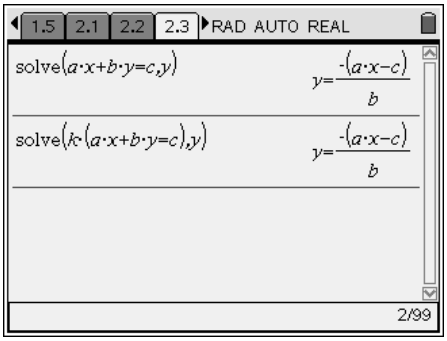
When answering question 1, the students should notice that all of these equations are equivalent and be able to explain why they know this.



Step 2: When answering question 2, the students may conjecture that these equations will also be equivalent. A possible symbolic justification may look like this.

$3x + 2y = 8$	$k\cdot(3x + 2y = 8)$
$2y = 8 – 3x$	$3kx + 2ky = 8k$
$y = (8 – 3x)/2$	$2ky = 8k - 3kx$
	$y = (8k - 3kx)/2k$
	$y = (8 – 3x)/2$

Step 3: Question 3 asks the students to generalize further. They should conclude that the equations will be equivalent. Page 2.3 shows one possible use of CAS to justify this.

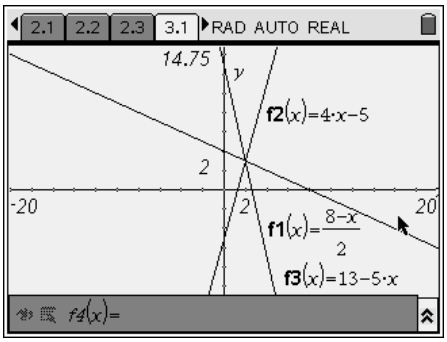


Students are asked to answer the questions on the Student Handout. The teacher should then facilitate a discussion of their findings. This can be done as a large group or small group discussion.

Problem 3—Adding Equations

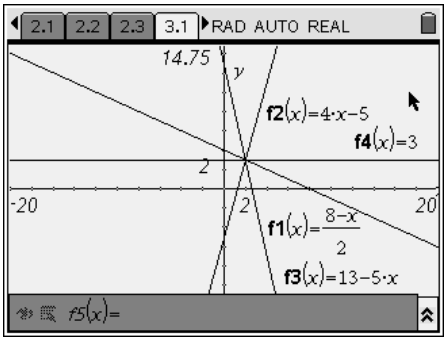
Step 1: In this problem students will explore the relationship that the sum of two linear equations has to the original equations.

In page 3.1, **f1**(x) and **f2**(x) have been added together to get **f3**(x). The students should notice that the sum (**f3**(x)) intersects the other two at the same point (i.e. all three equations coincide)



Step 2: In the second portion of this problem, the students are walked through a process of using linear combinations to eliminate one of the variables. Each step of the process is modeled and a follow up question or series of questions is asked.

The students are asked to make and check their conjecture by graphing. Here page 3.1 shows the graph of **f4**(x) = 3.



Students are asked to answer the questions on the Student Handout. The teacher should then facilitate a discussion of their findings. This can be done as a large group or small group discussion.

Assessment and evaluation
Included in the Activity is **Problem 4—The Elimination Method** that can be used as an assessment and evaluation of the students.

Problem 4—The Elimination Method
In this problem the students are asked examine a student's symbolic solution to the system $5x + 2y = 4$ and $x + 3y = -7$.

The teacher may want to get the students started on Student Handout page 5 in a more directed manner and then have the students work in small groups to finish the problem.

Note: None of this problem is intended to be done with technology.

Activities extensions

Teachers may want to use **Problem 5—A Special Case** as an extension.

Problem 5 – A Special Case

This problem is intended to be an extension of the previous problems. In this problem the students will investigate a system of linear equations that are parallel and thus have no solution.