

# Congruence

## Materials

HP39gs with Congruence HP Aplet  
Congruence Worksheets

## Introduction

Two figures are congruent when they have the same size and shape. You could pick one figure up, perhaps turn it or flip it, and then set it down on top of the other figure so that the two fit perfectly. Mathematically, you could reflect, rotate, and/or translate one figure until it coincides with the other.

This activity explores congruent figures. It requires the Congruence HP Aplet on the HP39gs. If you do not have this HP Aplet installed on your calculator, see your teacher..

## **Working with the Aplet**

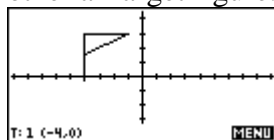
The VIEWS menu for the HP Aplet is accessible at any time by pressing the VIEWS key.



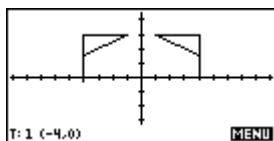
Highlight New Problem, and press the ENTER key.



You are asked to select a new problem that is Easy or Harder. Highlight your selection and press the ENTER key. You will see two figures displayed on the graph. One is an original figure, the other a Target figure. The original is always the one shown on the screen below:

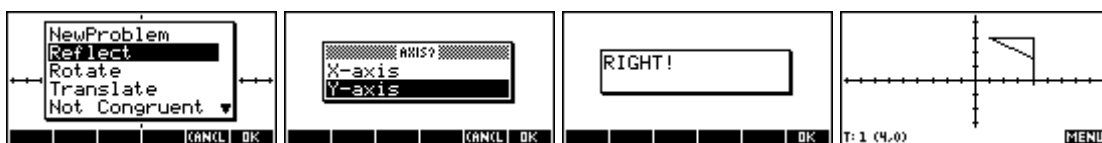


As you can see, the original figure is a pennant standing straight up and down, with its base at the point  $(-4, 0)$ . Your target figure will almost surely be positioned differently from the one shown below (the figures are selected at random). It's even possible that the two figures are not congruent.



Your objective in the HP Aplet is to determine whether or not the two figures are congruent and, if they are, to record a sequence of transformations that will take the original figure and move it to the target so that they coincide.

If you think that the figures *are* congruent, press the VIEWS key, and choose a transformation. For the example shown above, a reflection in the  $y$ -axis looks like it could work.

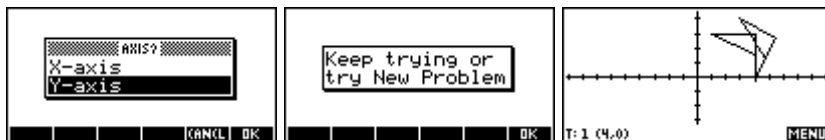


After you press OK, the two pennants are graphed one on top of the other.

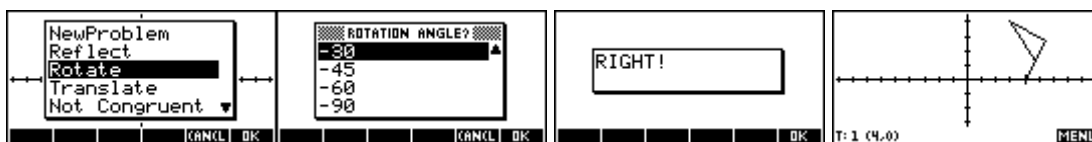
Let's try a harder one. Press the VIEWS key, select a New Problem, and choose Harder difficulty.



It seems more than one transformation is needed. Let's try to move the original to the target. Our first transformation will be a reflection in the  $y$ -axis.

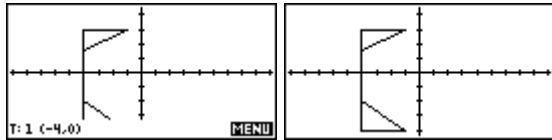


Now we need a rotation. Note that in this HP Aplet, rotations are always centered at the base of the pennant. The point at the base doesn't move as the flag turns around that point. Positive rotation angles are in the counter-clockwise direction. In this case, it appears we need a rotation of  $-30^\circ$ .

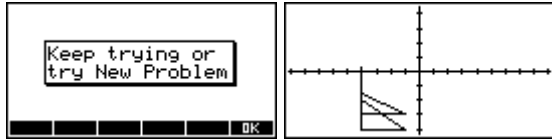


Success!

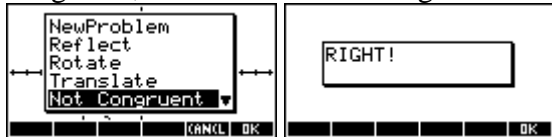
Here's a problem that shows what happens when the figures are not congruent.



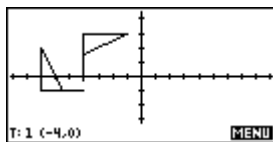
Notice that some of the new pennant appears to be off the bottom of the screen. Press the MENU menu key twice and you can see more of it, as shown above on the right. Maybe a reflection in the  $x$ -axis will work.



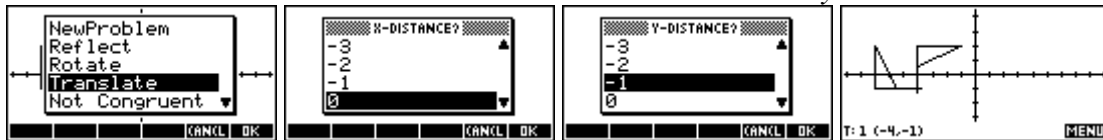
This looks hopeless. Nothing we can do will make the two pennants coincide. They are not congruent, so we chose Not Congruent from VIEWS.



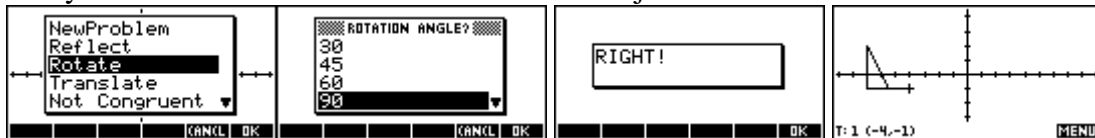
Finally, here's a harder problem that needs two transformations.



Can you see what transformations will work? Let's start with a translation. To do a translation, we specify a distance in both the horizontal or  $x$ -direction, and in the vertical or  $y$ -direction. Try a translation of 0 units in the  $x$ -direction and 1 unit down in the  $y$ -direction:



Can you see it now? A rotation should finish the job.

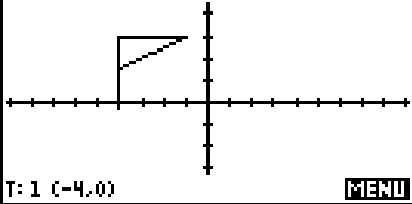
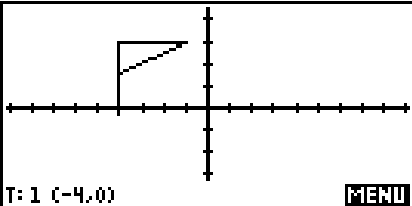
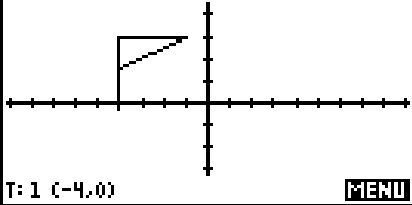


### Now Try These

Now you're ready to use the Congruence HP Aplet and do some work on your own. Use the worksheets to sketch the original target for each new problem. Then record your transformations. Answer "Not Congruent" in the transformation box when the two figures are not congruent. Otherwise, record the transformation and its effect.

# Student Worksheet for Easy Congruence Problems

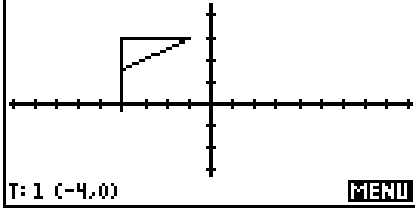
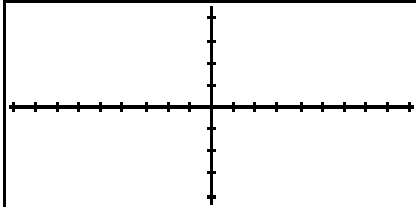
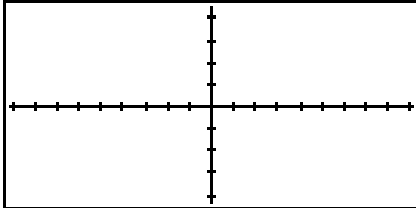
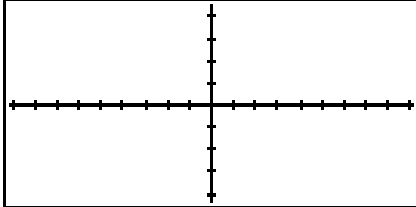
Name: \_\_\_\_\_

Original figure with target (sketch the target):	
	
Transformation	Sketch the result:
Original figure with target (sketch the target):	
	
Transformation	Sketch the result:
Original figure with target (sketch the target):	
	
Transformation	Sketch the result:

# Student Worksheet for Harder Congruence Problems

Name: \_\_\_\_\_

Each of these can be done with two transformations, though space is available for four.

Original figure with target (sketch the target): 	
Transformation	Sketch the result: 
Transformation	Sketch the result: 
Transformation	Sketch the result: 
Transformation	Sketch the result: 