

A Geometry Lab in Your Hand...



Using Cabri Jr.

on the TI-83+ and TI-84+

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The Cabri Jr. App for the TI-83+/TI-84+

The Cabri Jr. app for the TI-83+/TI-84+ is a version of the Cabri Geometry dynamic software for the TI-83+/TI-84+ family of handheld calculators. Many of the features of the computer program are available in Cabri Jr.

Using Cabri Jr., you can:

- Draw points, segments, lines, circles, triangles and quadrilaterals.
- Construct perpendicular and parallel lines; perpendicular and angle bisectors; and geometric loci.
- Transform objects through translation, reflection, rotation, and dilation.
- Compute lengths, areas, perimeters, and angle values of relevant objects.
- Display coordinates and equations of lines and circles.
- Import/export constructions to the TI-89, TI-92 Plus, or Voyage™ 200 versions of Cabri Geometry, as well to the Cabri Geometry II Plus computer software.

Important Key strokes for Cabri Jr.:

Press **[APPS]** to display a list of the applications available, and then select **Cabri Jr.** Press **[ENTER]** to continue.

Press **[◀]**, **[▲]**, **[▶]**, and **[▼]** to move the pointer around the screen. You can press and hold an arrow key to move the pointer rather than repeatedly pressing it.

Press the graphing keys **[Y=]**, **[WINDOW]**, **[ZOOM]**, **[TRACE]**, and **[GRAPH]** to access the Cabri Jr. menus.

Once a menu is displayed, use **[▲]** and **[▼]** to highlight the desired tool, then press **[ENTER]** to select the tool. Press **[▶]** to view a submenu.

Press **[CLEAR]** to close a menu or exit a tool.

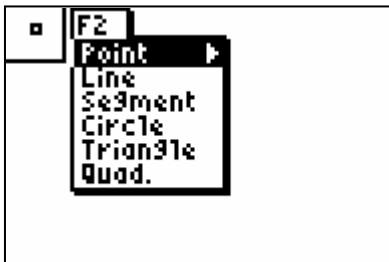
To Undo the last completed action, press **[Y=]** to open the File Tools Menu (F1 menu) and highlight Undo. Press **[ENTER]**.

Menus in Cabri Jr.:

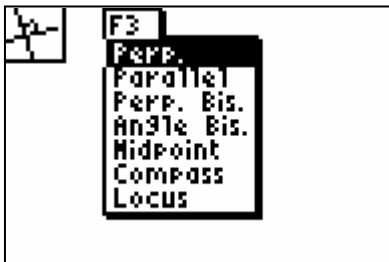


File operations and animation

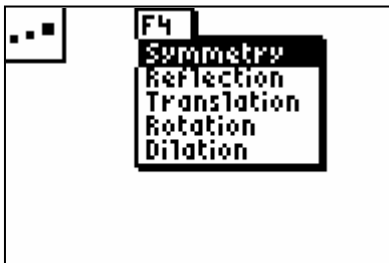
*In 2.0: Undo Explore steps through construction from start
Save As includes option to save directly to Archive*



Object tools

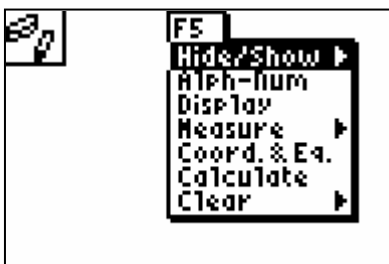


Construction tools



Transformation tools

*In 2.0: Reflection selects line of reflection first then object
Translation selects segment or 2 points first then object
Rotation can use numerical input for angle of rotation*

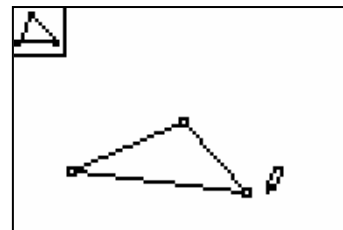


Display and measurement tools

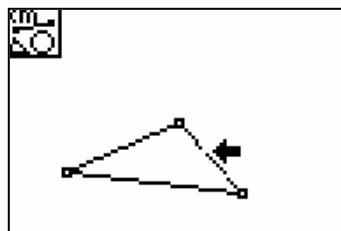
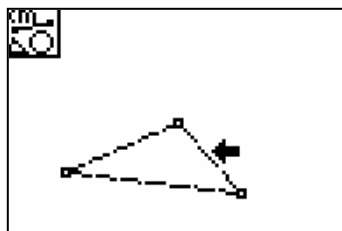
*In 2.0: Measurements to 2 decimal places
Range of values from -3276.8 to 3276.8
Calculate sum of 3 numbers*


Using Cabri Jr. Tools

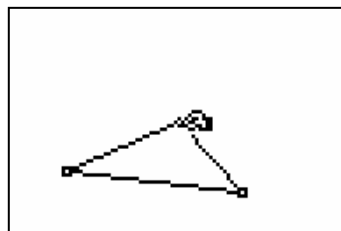
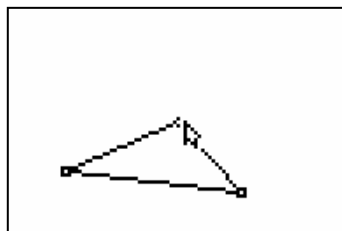
Once a tool is selected from a menu, it remains active until another tool is chosen or you press **[CLEAR]** to exit the tool. The tool icon in the upper left corner of the screen indicates which tool is active.



When certain tools are active, the pointer changes form when it gets close to an available object, and the object “blinks”. Be aware of what object is blinking before pressing **[ENTER]**, to be sure it is the object you intend to select. If more than one object is available, press **[2nd]** to toggle between the choices. For example, when using the Distance & Length Tool with a triangle, if the whole triangle is blinking, the perimeter will be measured (below left). If just one side is blinking, the side length will be measured (below right).



The Hand Tool  is not accessed through a menu. It is available when no other tool is active. When the pointer gets close to an available object, it changes to a hollow arrow and the object blinks. Press **[ALPHA]** to grab the object and use the arrow keys to move and drag the object around the screen. Press **[ENTER]** to set the object's new position.

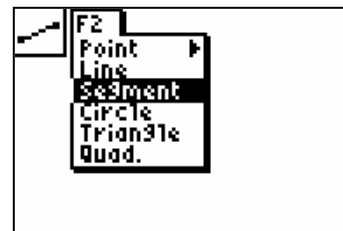


- Note that some labels and measurements “stick” to the object they relate to, and cannot be dragged too far away.

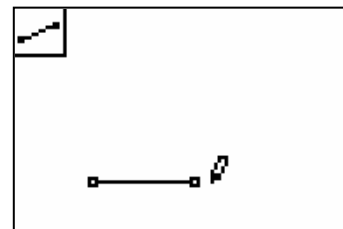
Constructing a Parallelogram

 **A** Construct a segment and label its endpoints.

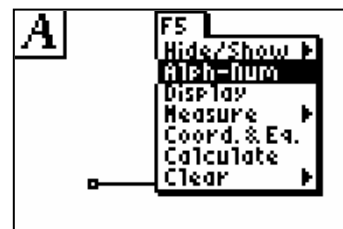
- A. Press **WINDOW** to view the **Drawing Tools Menu (F2 menu)** and highlight the **Segment Tool**. Press **ENTER** to select the tool.



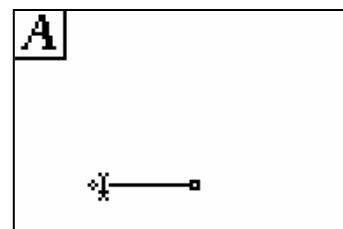
- B. Move the cursor to the lower left area of the screen and press **ENTER** to create the first endpoint of the segment there. Move the cursor to the lower middle area of the screen and press **ENTER** to create the second endpoint there.



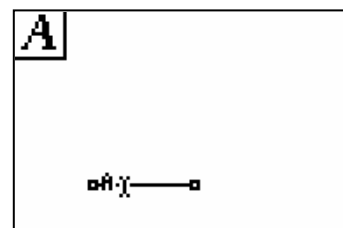
- C. Press **GRAPH** to view the **Display Tools Menu (F5 menu)** and highlight the **Alpha-Numeric Tool**. Press **ENTER** to select the tool.



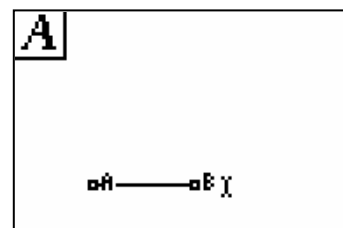
- D. Move the cursor to the left endpoint of the segment. The point blinks when the cursor is close enough to the point to select it.




- E. Press **ENTER** to create a label for this point. Enter **A** by pressing **MATH** (note that alpha lock is on) and then press **ENTER** to complete the label.

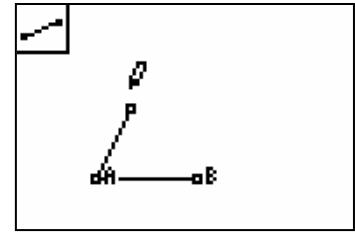


- F. Repeat this procedure to label the other endpoint as **B** (B is above the **APPS** button). When complete, press **CLEAR** to exit the **Alpha-Numeric Tool**.

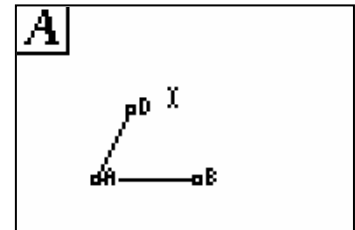


 **A** Construct a second segment with common endpoint **A**.

- G. Use the **Segment Tool** (**WINDOW** button, **F2** menu) to create a segment with one endpoint at **A**. Move the cursor to point **A**, press **ENTER**, then move the cursor up and to the right and press **ENTER** again.



- H. Use the **Alpha-Numeric Tool** (**GRAPH** button, **F5** menu) to label the new endpoint as **D** (D is above the **x-1** button). Remember to press **ENTER** once to create the label, and then again to complete the label.



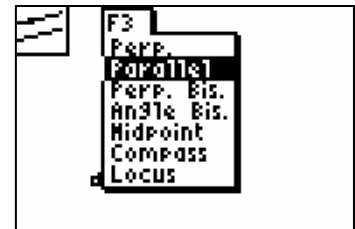
 Create a line through **D** parallel to segment **AB**.

To use the Parallel Tool, you must do the following:

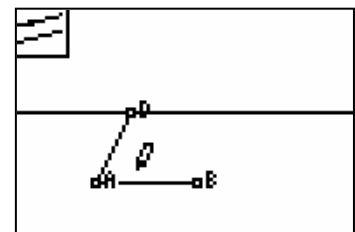
- Select the point through which the parallel line will be drawn.
- Select the line or segment to which the new line will be parallel.


The order of the selection does not matter.

- I. Press **ZOOM** to view the **Construction Tools Menu** (**F3** menu) and highlight the **Parallel Tool**. Press **ENTER** to select the tool.



- J. Move the cursor to point **D** and press **ENTER**. Move the cursor to segment **AB** and press **ENTER**. A line is drawn through **D** parallel to segment **AB**.

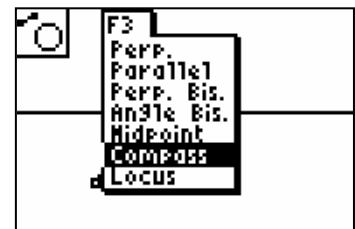


 Use the compass tool to copy the distance from **A** to **B** to the parallel line.

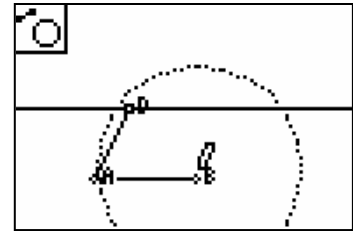
To use the Compass Tool, you must do the following:

- Select the radius to be copied, either by selecting a segment or by selecting two endpoints.
- Select the center point from which to draw the compass circle.

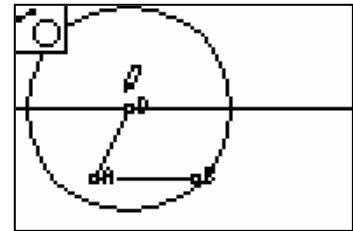
- K. Press **ZOOM** to view the **Construction Tools Menu** (**F3** menu) and highlight the **Compass Tool**. Press **ENTER** to select the tool.






- L. Move the cursor to point **A** and press **[ENTER]**. Move the cursor to point **B** and press **[ENTER]**. A compass circle will appear and move with the cursor.

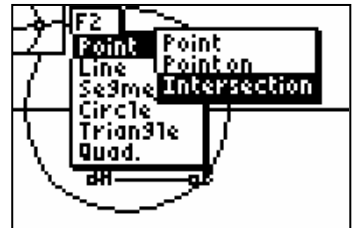


- M. Move the cursor to point **D** and press enter. The compass circle will be anchored centered at **D**.



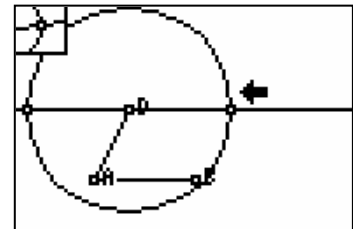
   Create and label the intersection point and complete the quadrilateral.

- N. Press **[WINDOW]** to view the **Drawing Tools Menu (F2 menu)** and highlight the **Point Menu**. Press **[↓]** to view the menu. Highlight the **Intersection Point Tool** and press **[ENTER]** to select the tool.

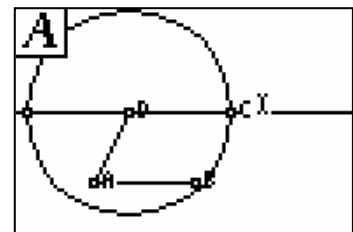


- O. Move the cursor to the intersection of the compass circle with the parallel line and press **[ENTER]** to create an intersection point there.

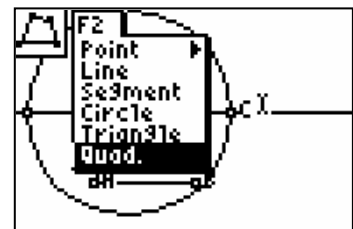
- **Note:** Both intersection points are created at the same time.



- P. Use the **Alpha-Numeric Tool (GRAPH button, F5 menu)** to label the new point as **C** (C is above the **[PRGM]** button). Remember to press **[ENTER]** once to create the label, and then again to complete the label.

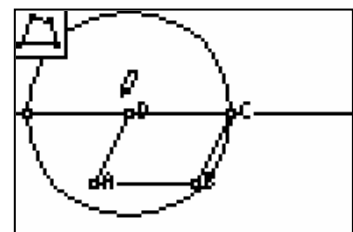



- Q. Press **[WINDOW]** to view the **Drawing Tools Menu (F2 menu)** and highlight the **Quadrilateral Tool**. Press **[ENTER]** to select the tool.



- R. Move the cursor to point **A** and press **[ENTER]**. Move the cursor to point **B** and press **[ENTER]**. Move the cursor to point **C** and press **[ENTER]**. Move the cursor to point **D** and press **[ENTER]**.

- **Note:** Be careful to select the point itself, not the label.

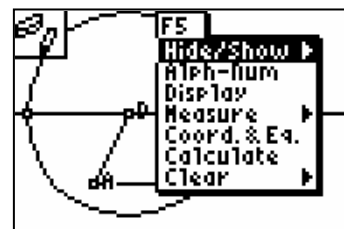


 Hide the line and circle and drag a vertex of the parallelogram.

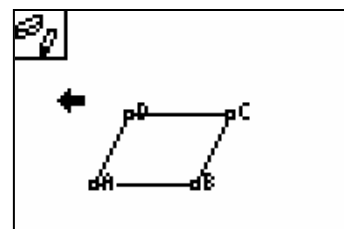
When using the Hide/Show Tool:

- The pointer changes to an eraser when it is near an available object to hide.
- After pressing **[ENTER]**, the object is displayed with dotted lines until the pointer is moved away.
- To show objects previously hidden, move the pointer to the object's location. The pointer changes to a pen when it is close enough to a hidden object. Press **[ENTER]** to show the object.

S. Press **[ENTER]** to view the **Display Tools Menu (F5 menu)** and highlight the **Hide/Show Tool**. Press **[ENTER]** to select the tool.

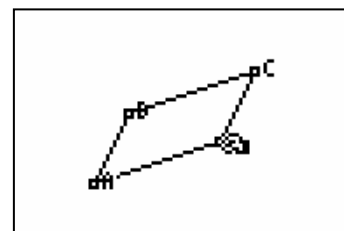


T. Use the **Hide/Show Tool** to hide the parallel line, the compass circle, and the extra intersection point. Move the cursor to the object you wish to hide and press **[ENTER]**. When complete, press **[CLEAR]** to exit the tool.



U. Move the cursor to vertex **B** of the parallelogram and press **[ALPHA]** to grab it. Drag the vertex around the screen and observe the results.

- **Note:** Be careful to grab the vertex itself, not the label.
- **Note:** The pointer changes to a hollow arrow when it is near an available object.



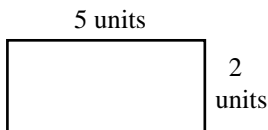
When complete, press **[CLEAR]** to exit the tool. Try to grab the other vertices and observe the results.

Questions & Conjectures

1. How is the **Compass Tool** like a real compass?
2. What happened when you tried to grab the vertices of the parallelogram in Part I? Were they all available to drag?
3. **Extension:** Use the **Slope Tool** (**[GRAPH]** button, **F5 Measure** menu) to find the slopes of the sides of the parallelogram. Drag on a vertex of the parallelogram and observe the results. Explain.
4. What other properties of a parallelogram can be confirmed by the tools in the **Measure** menu?

WARMUP:

Multiply each side length of this rectangle by a scale factor of 3, and sketch what the new rectangle would look like.

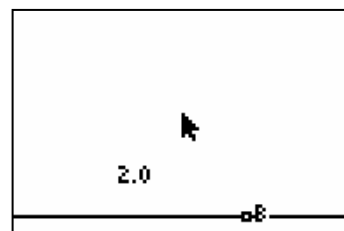


PROCEDURE & COLLECT DATA:

On the calculator, you will create a triangle and make several measurements. Then you will create a dilation image with different scale factors and make measurements on the image triangle.

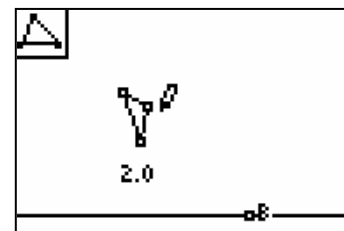
1. Download the Cabri Jr. Slider Tool file to your calculator, or follow the separate directions to construct the Slider Tool.

2. Launch the Cabri Jr. App on your calculator, and choose **Open** from the **File Tools Menu** (Y= button, F1 menu). Open the Slider Tool file.



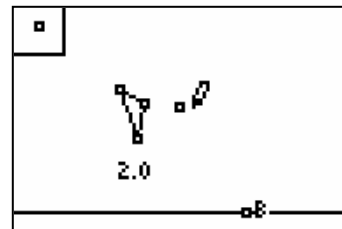
3. Move the cursor to point **B** and press [ALPHA] to grab it.
 - **Note:** Be careful to grab the point itself, not the label **B**.
 - **Note:** The pointer changes to a hollow arrow when it is near an available object.
 Use the cursor keys to drag point **B** along the line and observe the results. Press [CLEAR] to exit the **Hand Tool**.

4. Select the **Triangle Tool** from the **Drawing Tools Menu** (WINDOW button, F2 menu). Move the cursor to the left half of the screen and press [ENTER] to anchor one vertex of the triangle. Move the cursor and press [ENTER] two more times to anchor the other two vertices of the triangle.

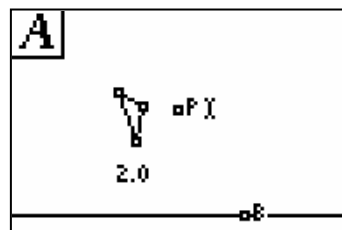


- **Note:** Make the triangle scalene to more easily view the properties of the dilation.

5. Select the **Point Tool** from the **Drawing Tools Menu** (**WINDOW** button, **F2** menu). Move the cursor to the center of the screen and press **ENTER** to anchor a point there.



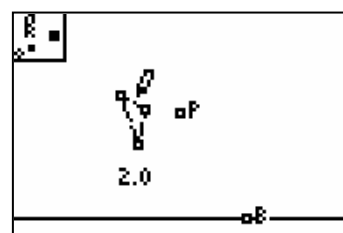
6. Use the **Alpha-Numeric Tool** (**GRAPH** button, **F5** menu) to label the newly created point as **P** (P is above the **8** button). Remember to press **ENTER** once to create the label, and then again to complete the label.



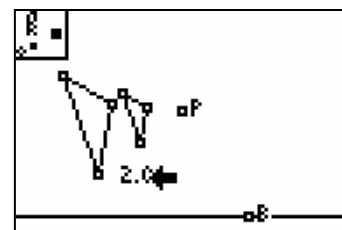
To use the Dilation Tool, you must do the following:

- Select what is to be dilated,
- Select a point to be the center of dilation,
- Select the numeric value to be used as a scale factor.

7. Select the **Dilation Tool** from the **Transformation Tools Menu** (**TRACE** button, **F4** menu). Move the cursor to the triangle and press **ENTER** to select it.
- **Note:** Be careful to select the whole triangle, not just one side. Wait for the whole triangle to blink, or press **2nd** to switch between full object and side only.



8. Move the cursor to point **P** and press **ENTER** to select it.
9. Move the cursor to the Slider value and press **ENTER** to select it. A new triangle (the image) is created. Press **CLEAR** to exit the **Dilation Tool**.
- **Note:** If the image triangle does not appear, it is probably off the screen. Use the **Hand Tool** (**ALPHA** button) to drag the original triangle closer to the center of dilation.

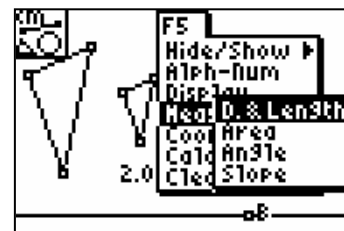


10. What do you observe on your screen? Describe the dilation in words, and make a sketch:

11. Use the **Hand Tool** (ALPHA button) to drag a vertex of the pre-image (original) triangle. What do you observe?

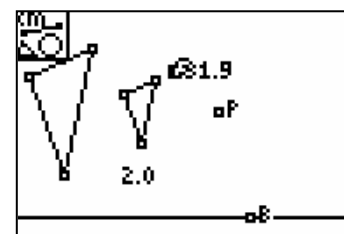
12. Use the **Hand Tool** (ALPHA button) to drag the center of dilation (Point P). What do you observe?

13. Press GRAPH to view the **Display Tools Menu** (F5 menu) and highlight the **Measure Menu**. Press RIGHT to view the menu. Highlight the **Distance & Length Tool**. Press ENTER to select the tool.



14. Move the cursor to the desired side of the triangle. Press ENTER to measure the side, move the cursor, and press ENTER to anchor the measurement on the screen. Repeat this to measure the corresponding side of the image triangle. When complete, press CLEAR to exit the tool.

- **Note:** Be careful to select the side of the triangle and not the whole triangle. Wait for only the side to blink, or press 2nd to switch between full object and side only.



Record measurements: Pre-image side length _____ Image side length _____

15. Select the **Angle Measure Tool** from the **Measure Menu** (GRAPH button, F5 menu). Angles are measured by selecting 3 points, with the vertex of the angle selected second.
- Move the cursor to one point on the side of the desired angle and press ENTER .
 - Move the cursor to the vertex of the angle and press ENTER .
 - Move the cursor to the third point on the angle and press ENTER .
 - Finally, move the measurement to a desired location and press ENTER to anchor it on the screen.

16. Repeat this to measure a corresponding angle of the image triangle. When complete, press **CLEAR** to exit the tool.

- **Note:** Cabri Jr. measures each angle to two decimal places which is very precise but it only displays each measurement to one decimal place. Therefore, the displayed measure may appear to be inaccurate.

Record measurements: Pre-image angle _____ Image angle _____

17. Select the **Area Tool** from the **Measure Menu** (**GRAPH** button, **F5** menu). Move the cursor to the desired triangle. Press **ENTER** to measure the area, and press **ENTER** again to anchor the measurement on the screen. Repeat this to measure the area of the image triangle. When complete, press **CLEAR** to exit the tool.

Record measurements: Pre-image area _____ Image area _____

18. Select the **Calculate** tool the **Display Tools Menu** (**GRAPH** button, **F5** menu) to divide each of your measurements from the image triangle by the pre-image (original) triangle's measurements. Don't type numbers.

- Move the cursor to the image triangle measurement and press **ENTER**.
- Press the \div button to indicate division.
- Move the cursor to the pre-image triangle measurement, and press **ENTER**.
- Use the cursor keys to move the calculation to a blank area of the screen and press **ENTER** a final time to anchor the calculation.

Record these ratios: length ratio _____ angle ratio _____ area ratio _____

19. What do you observe about these ratios and your original scale factor? Can you make any conjectures?

20. Use the **Hand Tool** (**ALPHA** button) to drag Point **B** on the slider tool. Change the scale factor to 3. What do you observe?

21. Record the image triangle's measurements with the new scale factor:

length _____ angle _____ area _____

Record the calculation ratios with the new scale factor:

length ratio _____ angle ratio _____ area ratio _____

22. Change your scale factor to a value between 0 and 1. Scale factor I used _____

What happens to your image triangle? _____

Record the image triangle's measurements and ratios again:

length _____ angle _____ area _____

length ratio _____ angle ratio _____ area ratio _____

Continue changing scale factors and observing measurements until you feel you can answer the following questions.

MAKE CONJECTURES:

23. What do you observe to be true about the length ratio?

24. What do you observe to be true about the angle ratio?

25. What do you observe to be true about the area ratio?

26. How are the pre-image and image triangles related?

27. Explain what happens when the dilation factor is a negative number.

28. Did the triangle change orientation with a positive or negative dilation?

APPLY THE MATH:

Two dilation figures have corresponding sides with lengths 3 and 12.

A. What is the scale factor of the dilation? _____

B. What is the ratio of their angle measures? _____


C. What is the ratio of their areas? _____

D. If the smaller triangle has another side with length = 5, what is the length of the corresponding side of the larger triangle? Show work!

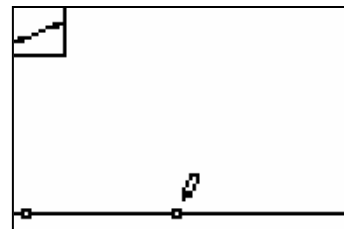
E. If the larger triangle's area is 90, what is the smaller triangle's area? Show work!

Slider Tool Construction

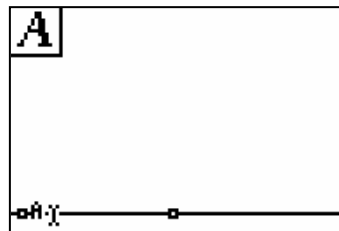
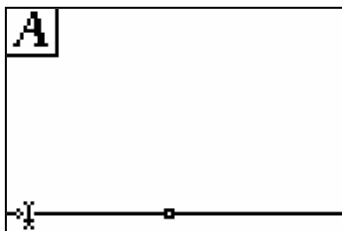
These steps create a slider tool that generates a number in the range of approximately -4.5 to 4.5 units.

 **A** Draw the line **AC** horizontally across the bottom of a new screen with point **A** near the left edge and point **C** near the middle of the screen.

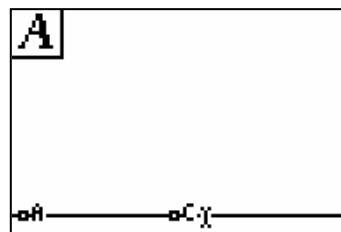
- A. Select the **Line Tool** from the **Drawing Tools Menu** (**WINDOW** button, **F2** menu). Move the cursor to the lower left corner of the screen and press **ENTER** to anchor one point of a line. Move the cursor to the lower middle of the screen and press **ENTER** to anchor the second point of the line.




- B. Select the **Alpha-Numeric Tool** from the **Display Tools Menu** (**GRAPH** button, **F5** menu). Move the cursor to the point you created in the lower left corner of the screen. The point blinks when the cursor is close enough to the point to select it. Press **ENTER** to create a label for this point. Enter **A** by pressing **MATH** (note that alpha lock is on) and then press **ENTER** to complete the label.

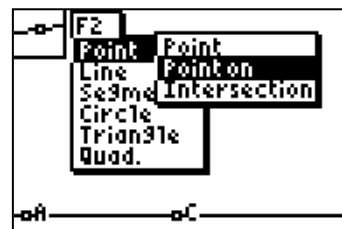


- C. Repeat this procedure to label the point in the lower middle of the screen as **C** (**C** is above the **PRGM** button). When complete, press **CLEAR** to exit the **Alpha-Numeric Tool**.

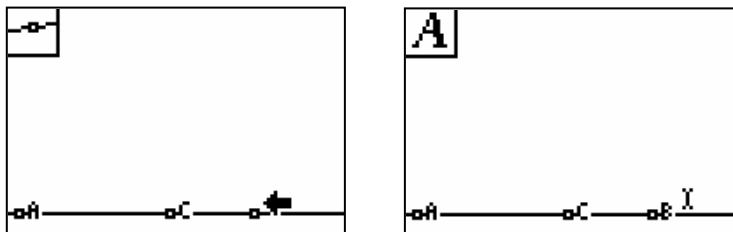


 **A** Construct point **B** on line **AC** to the right of point **C**.

- D. Press **WINDOW** to view the **Drawing Tools Menu** (**F2** menu) and highlight the **Point Menu**. Press **ENTER** to view the menu. Highlight the **Point On Object Tool** and press **ENTER** to select the tool.

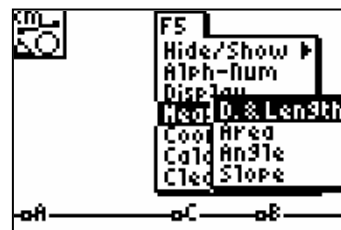


- E. Move the cursor to the right of point **C** on line **AC** and press **[ENTER]** to place a point on the line. Use the **Alpha-Numeric Tool** (**[GRAPH]** button, **F5** menu) to label the newly created point as **B** (B is above the **[APPS]** button).

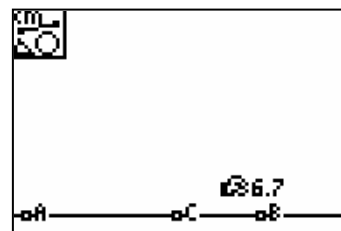


Measure the distances **AB** and **AC** and calculate the difference **AB – AC**.

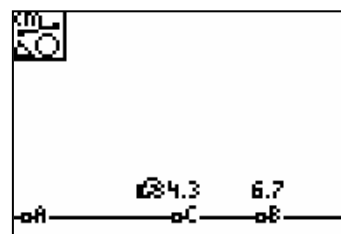
- F. Press **[GRAPH]** to view the **Display Tools Menu** (**F5** menu) and highlight the **Measure Menu**. Press **[▶]** to view the menu. Highlight the **Distance & Length Tool**. Press **[ENTER]** to select the tool.



- G. Move the cursor to point **A** and press **[ENTER]**, then move the cursor to point **B** and press **[ENTER]**. Use the cursor keys to move the measurement to a location away from the line, and press **[ENTER]** a final time to anchor the measurement.
- **Note:** Be careful that the point itself is blinking, not the entire line.

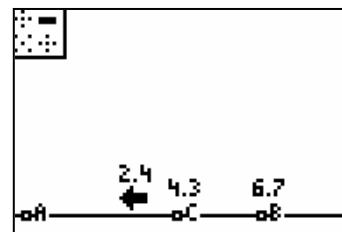


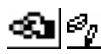
- H. Repeat step K to measure the distance **AC**. Note that the **Distance & Length** tool is still active.



- I. Select the **Calculate Tool** from the **Display Tools Menu** (**[GRAPH]** button, **F5** menu). A calculation is performed on a pair of numbers.

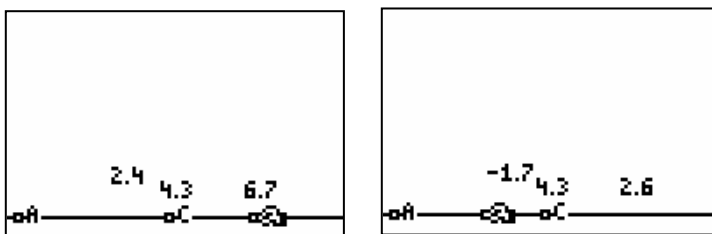
- Move the cursor to the distance **AB** (which should be the larger number) and press **[ENTER]**.
- Press the **[−]** button to indicate subtraction.
- Move the cursor to the distance **AC**, and press **[ENTER]**.
- Use the cursor keys to move the calculation to a blank area of the screen and press **[ENTER]** a final time to anchor the calculation.
- Press **[CLEAR]** to exit the **Calculate Tool**.



 Drag point **B** to change the numeric value, and hide objects no longer needed.

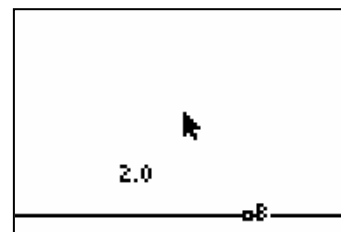
- J. Move the cursor to point **B** and press $\boxed{\text{ALPHA}}$ to grab it.
- **Note:** Be careful to grab the point itself, not the label **B**.
 - **Note:** The pointer changes to a hollow arrow when it is near an available object.

Use the cursor keys to drag point **B** along the line and observe the difference $\mathbf{AB} - \mathbf{AC}$ as it changes. When point **B** is to the right of point **C**, the difference is positive. When point **B** is between points **A** and **C**, the difference is negative.



Move point **B** so that the difference is 2. Press $\boxed{\text{CLEAR}}$ to exit the **Hand Tool**.

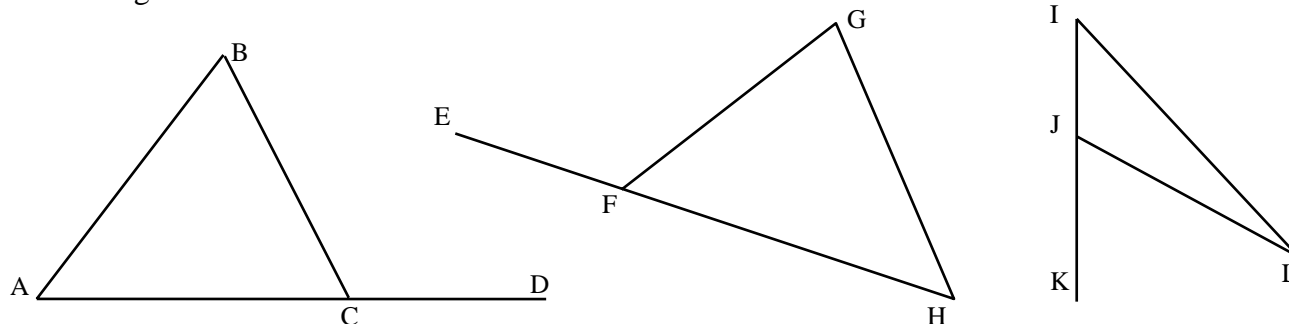
- K. Select the **Hide/Show Tool** from the **Display Tools Menu** ($\boxed{\text{GRAPH}}$ button, **F5** menu). Move the cursor to point **A** on the line, and press $\boxed{\text{ENTER}}$ to hide point **A**. Repeat this to hide all objects and numbers except the line, point **B** and the calculated difference $\mathbf{AB} - \mathbf{AC}$. Press $\boxed{\text{CLEAR}}$ to exit the **Hide/Show Tool**.



- L. To save the slider tool as a file that can be shared with students, select **Save** from the **File Tools Menu** ($\boxed{\text{Y=}}$ button, **F1** menu) and save the file on the TI-83+ with a name such as “slider”. Then the teacher can use a linking cable and the Link menu ($\boxed{\text{X,T,}\theta,\eta}$ button) to send the file to the students’ devices so they have the ready-made tool to begin the activity. This can also be accomplished by uploading the file to a computer via TI-Connect and downloading it to the students’ devices.

WARMUP:

On each figure below, label the exterior angle, the 2 remote interior angles, and the adjacent interior angle.



PROCEDURE:

On the calculator, you will create an acute triangle with its bottom edge on a line, like the figure above on the left. Then you will measure the four angles and collect data

1. Choose the **Line** tool ([F2] menu, [WINDOW] button) and draw a line on your screen by pressing [ENTER] in two places.
2. Choose the **Triangle** tool ([F2] menu, [WINDOW] button), and create a triangle whose bottom edge is on the line. Make sure the line is blinking before pressing [ENTER].
3. Use the **Alph-Num** tool ([F5] menu, [GRAPH] button) to label the triangle's vertices A, B, and C. (Remember to press [ENTER] first to start the label, then again to finish the label.)
4. Choose the **Point** tool ([F2] menu, [WINDOW] button) and create a new point on the line to the right of your triangle. Label it point D.
5. Choose the **Angle measure** tool ([F5] menu, [GRAPH] button) and measure the 3 interior angles of the triangle and the exterior angle. To measure an angle, press [ENTER] on 3 points, with the vertex of the angle 2nd. Record this data in the first row of the chart on the next page.
6. Use the **Hand** tool ([ALPHA] button) to pull on the vertex of your triangle that is not on the line. Make your triangle into an obtuse triangle. Then record the new angle measures in the chart.
7. Create two more triangles by pulling on a vertex of your triangle. Record your data in the chart, and classify each triangle as acute, obtuse or right.

COLLECT DATA:

Fill in the symbols for each of your angles in the top row. Complete the chart with your angle measurements and triangle classifications.

Type of Triangle ↓	Measure of Exterior Angle <	Measure of Remote Interior <	Measure of Remote Interior <	Measure of Adjacent Interior <
Acute				
Obtuse				

MAKE CONJECTURES:

8. Use the **Calculate** tool ([F5] menu, [GRAPH] button) and find the sum of the 3 angles of the triangle. Don't type numbers. Choose three angle measurements that are on the screen, and then press [+] to find their sum.

Sum of the 3 interior angles of the triangle: _____

What happens to this result when you make changes to the shape of your triangle?

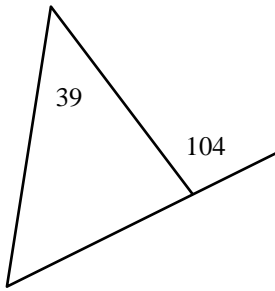
What theorem justifies your answer above?

9. Make some observations about the information in your chart. Do you notice any relationships between the exterior angles and either type of interior angle?

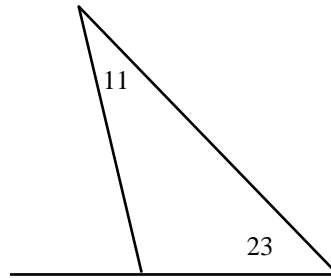
APPLY THE MATH:

Find the missing angle measures in the triangles below. Show work!

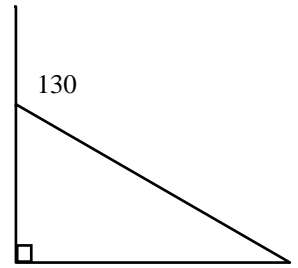
1.



2.



3.



4. Create your own problem like #1–3 above with a diagram and fill in the angle measures.

EXTENSION:

Create a new triangle that has one exterior angle at each vertex using this procedure:

1. Clear your screen ([F5] menu, [GRAPH] button) and create a new line ([F2] menu, [WINDOW] button). Choose the **Segment** tool ([F2] menu, [WINDOW] button) and create a segment with one endpoint on the line. Then create a second segment with one endpoint on the segment and the other endpoint on the line.

2. Make some measurements, and make a labeled sketch below.

3. What do you observe to be true about these three exterior angles?
