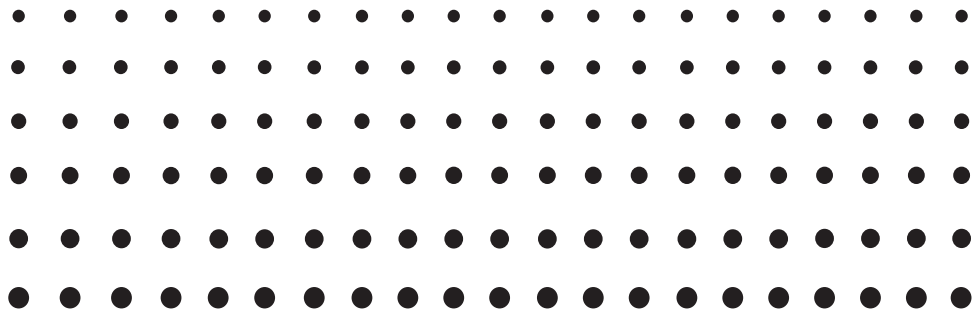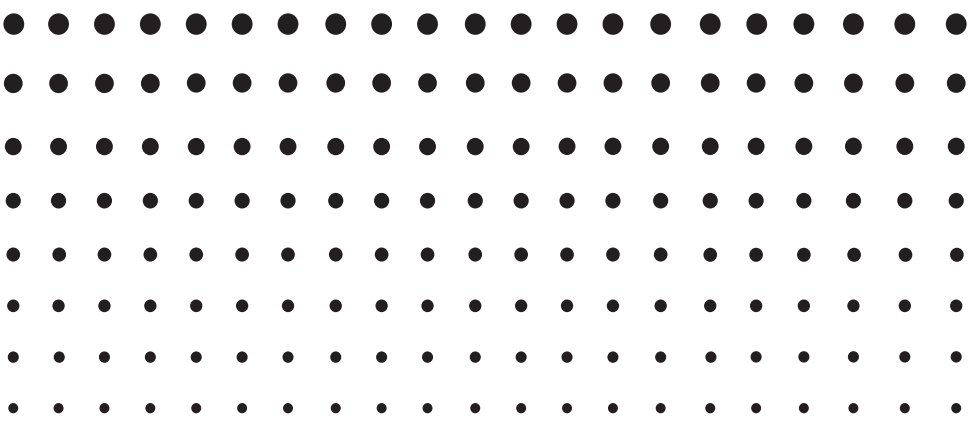E

For fx-9860G Series/
GRAPH 95/75+/75/85 Series/
fx-9860GIII/fx-9750GIII/GRAPH35+ E II

Geometry Application

User's Guide

CASIO Worldwide Education Website

https://edu.casio.com

CASIO ®

Contents

1. Geometry Mode Overview

The Geometry Mode allows you to draw and analyze geometric objects. You can draw a triangle and specify values to change the size of its sides so they are 3:4:5, and then check the measurement of each of its angles. You can also lock the coordinates of a point or the length of a line segment, and you can draw a circle and then draw a line that is tangent to a particular point on the circle. The Geometry Mode also includes an animation feature that lets you watch how an object changes in accordance with conditions you define.

Geometry Mode Menus

Unlike other modes, the Geometry Mode does not have function menus along the bottom of the screen. Instead, it uses menus named [F1] through [F6] and [OPT], like the ones shown below.
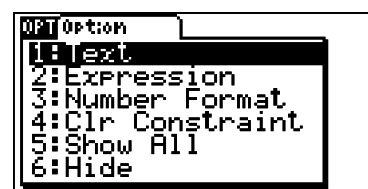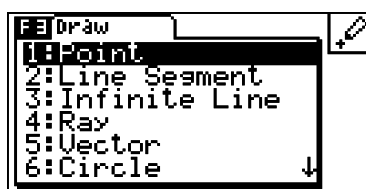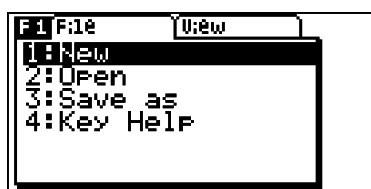
The following is a general explanation of Geometry Mode menus.

- Pressing a key that corresponds to a menu ([F1] through [F6] or [OPT]) will display the menu for that tab.

- After displaying a menu, use ⏵ and ⏴ to move between menu screens.

- To close a menu without selecting anything, press [EXIT].

■ Menu Operations in This Manual

This manual shows menu operations using the following form: [F3] (Draw) – 5:Vector. When you see this, it means you can perform either of the following two operations.

- Press [F3] to display the Draw menu, use ⏷ and ⏶ to highlight "5:Vector", and then press [EXE].

- Press [F3] to display the Draw menu and then press [5].

Menu Reference

The following tables describe the menu items that appear on each of the Geometry Mode menus.

■ [F1] (File)

To do this:	Select this menu item:
Create a new file	1:New
Open a file	2:Open
Save a file under a new name	3:Save as
Display a list of functions assigned to each key	4:Key Help

■ F1 ▶ **(View)**

To do this:	Select this menu item:
Start a box zoom operation	1:Zoom Box
Enter the pan mode (page 3-3)	2:Pan
Enter the scroll mode (page 3-4)	3:Scroll
Enlarge the display image	4:Zoom In
Reduce the size of the display image	5:Zoom Out
Adjust the size of the display image so it fills the display	6:Zoom to Fit

■ F2 **(Edit)**

To do this:	Select this menu item:
Undo or redo the last operation	1:Undo/Redo
Select all objects on the screen	2:Select All
Deselect all objects on the screen	3:Deselect All
Select an entire polygon (page 2-8)	4:Select Figure
Delete the currently selected object	5:Delete
Clear the screen	6:Clear All

■ F3 **(Draw)**

To do this:	Select this menu item:
Plot a point	1:Point
Draw a line segment	2:Line Segment
Draw a straight line	3:Infinite Line
Draw a ray	4:Ray
Draw a vector	5:Vector
Draw a circle	6:Circle
Draw an arc	7:Arc
Draw a triangle	8:Triangle
Draw an isosceles triangle	9:Isosc Triangle
Draw a rectangle	A:Rectangle
Draw a square	B:Square
Draw a polygon	C:Polygon
Draw a regular n-gon	D:Regular n-gon

■ F4 (Construct)

To construct this:	Select this menu item:
A perpendicular bisector	1:Perp Bisector
A perpendicular	2:Perpendicular
A midpoint	3:Midpoint
An intersection	4:Intersection
An angle bisector	5:Angle Bisector
A parallel	6:Parallel
A tangent	7:Tangent

■ F5 (Transform)

To do this:	Select this menu item:
Reflect an object	1:Reflection
Translate an object by specified values	2:Translation
Translate an object using an existing vector	3:Trans(Sel Vec)
Rotate an object	4:Rotation
Dilate an object	5:Dilation

■ F6 (Animate)

To do this:	Select this menu item:
Add animation to two selected objects	1:Add Animation
Replace the current animation assigned to two selected objects	2:Replace Anima
Turn on trace for a point and trace the movement of the point while animation is being executed	3:Trace
Display the animation editing screen	4:Edit Animation
Perform an animation sequence once	5:Go (once)
Perform an animation sequence repeatedly	6:Go (repeat)
Add one or more values to the animation table (page 6-7)	7:Add Table
Display the animation table	8:Display Table

■ OPTN (Option)

To do this:	Select this menu item:
Input text	1:Text
Input an expression	2:Expression
Specify the number format Geometry Mode measurements	3:Number Format
Unlock all measurements	4:Clr Constraint
Display all objects	5:Show All
Hide the currently selected object	6:Hide

Using the Pointer

You can use the following operations to move the on-screen pointer (▶) around the display when drawing objects, editing objects, etc.

• To move the pointer

Use the cursor keys to move the pointer around the display. Holding down a cursor key moves the pointer at high speed.

• To make the pointer jump to a particular location

Pressing a number key (1 to 9) will cause the pointer to jump to the corresponding section of the screen as shown below.

7	8	9
4	5	6
1	2	3

Using Key Help

Pressing [F1](File) – 4:Key Help or the [0] key will display Key Help, which provides information the function of each key in the Geometry Mode.

```
Key Help
 [ALPHA]:Select/EXE
 [tan]  :Select/EXE
 [x²]   :Sel Figure
 [X,θ,T]:Grasp
 [AC]   :Desel All
 [VARS] :Measurement
 [0]    :Key Help   ↓
```
```
Key Help
 [OPTN] :Option      ↑
 [x]    :Undo/Redo
 [1]-[9]:Move Cursor
 [.]    :Scroll
 [+]    :Zoom In
 [-]    :Zoom Out
 [(-)]  :Zoom to Fit↓
```
```
Key Help
 List   :Add Table  ↑
 ([SHIFT][1])
```

Use the ⊙ and ⊛ keys to navigate between the three Key Help screens.

To exit the Key Help screens, press [EXIT].

Note

The key operations shown on the Key Help screens apply to the drawing screen only.

Managing Geometry Mode Files

This section explains how to save Geometry Mode data to files, and how to manage your files.

Note

Whenever you save a file in the Geometry Mode, it is stored in main memory in a folder named "<@GEOM>". You can use the calculator's MEMORY mode to view the data in main memory. For more information, see the manual that comes with your calculator.

• To create a new file

1. Perform the following operation: [F1](File) – 1:New.

   • The following dialog box will appear if you have a drawing on the screen.

```
Clear
    current image?

    Yes:[F1]
    No :[F6]
```
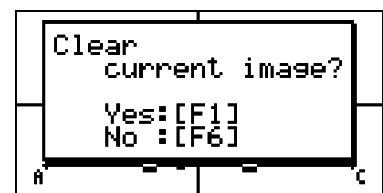
2. To clear the current drawing and create a new file, press [F1](Yes).

   • This will create a new file and display a blank drawing screen.

• **To open an existing file**

1. Perform the following operation: F1 (File) – 2:Open.

   • This displays a menu of existing files.

```
Geometry File List
ANIM1     :  1416
ANIM2     :  2156
IMAGE     :   152
OCTA      :  1404
PARABOLA  :  2176
TRI3      :   720
DEL
```

2. Use ⊙ and ⊙ to move the highlighting to the file you want to open and then press EXE.

   • The following dialog box will appear if you have a drawing on the screen.

```
G
Clear
   current image?

Yes:[F1]
No :[F6]
DEL
```
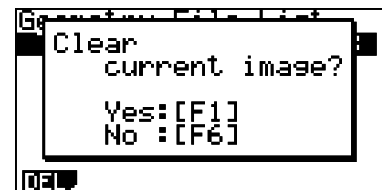
3. To clear the current drawing, press F1 (Yes).

   • This will open the file you selected in step 2.

• **To delete a file**

1. Perform the following operation: F1 (File) – 2:Open.

   • This displays a menu of existing files.

2. Use ⊙ and ⊙ to move the highlighting to the file you want to delete and then press F1 (DEL).

   • This causes a confirmation dialog box to appear.

```
G
Delete
   Geometry File?
Yes:[F1]
No :[F6]
TRI3      :   720
DEL
```
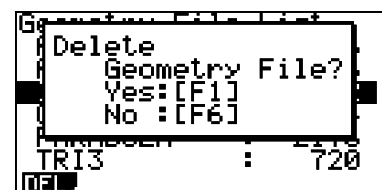
3. Press F1 (Yes) to delete the selected file or F6 (No) to cancel the delete operation.

4. To exit the file menu, press EXIT.

• To save a file under a different name

1. While the file you want to save is open, perform the following operation: F1 (File) – 3:Save as.

    • This will display the file name input screen and automatically switch the calculator's keys to Alpha Lock.

The cursor changes to 🄰 when the keyboard is in Alpha Lock.

```
Geometry File Name
[A        ]
```

2. Input up to 8 characters for the file name and then press EXE .

    • You can use the following characters in a file name.

      - Uppercase alphabetic characters A through Z
      - Lower-case *r* and Greek letter θ
      - Numerals 0 through 9
      - Period (.), blank space, quotes ("), plus sign (+), minus sign (–), multiplication sign (×), division sign (÷), brackets ([ ]), braces ({ })

    • After inputting the name you want, press EXE to save the file and return to its drawing screen.

Key Functions

The figure below shows the keys that are used for Geometry Mode drawing screen operations.

Displays menus.
(Page 1-1)

Selects, deselects, executes.

Selects an object to move it. (Page 2-20)

Selects an entire polygon. (Valid for polygons only.) (Page 2-8)

[SHIFT] [1] Adds an animation table. (Page 6-7)

Causes the pointer to jump to a particular position. (Page 1-4)

Displays Key Help. (Page 1-5)

Enters the Scroll mode. (Page 3-4)

Zooms the screen image to fit the window area. (Page 3-5)

Displays the measurement box. (Page 5-1)

Moves the pointer.

Cancels an operation, or returns to the previous menu or screen.

Selects, deselects, executes.

Deletes the currently selected object. (Page 2-21)

Deselects all, cancels an operation, deletes all (when pressed twice).

Undoes/Redoes an operation. (Page 2-19)

Zooms in/out. (Page 3-5)

Selects, deselects, executes.

2. Drawing and Editing Objects

This section explains how to perform the following operations.

• Plot points, draw line segments, polygons, etc. ([F3](Draw) menu)

• Select and deselect objects ([F2](Edit) menu)

• For a drawn object, construct a perpendicular bisector, perpendicular, etc. ([F4](Construct) menu)

• For a drawn object, perform various transform operations ([F5](Transform) menu)

• Undo an operation, move an object, delete an object and other editing operations ([F2](Edit) menu)

Using the Draw Menu

Press F3 (Draw) to display the Draw menu. You can use the Draw menu to plot points, and draw line segments, triangles, polygons, and other objects.

• To plot a point

1. Perform the following operation: F3 (Draw) – 1:Point.

2. Move the pointer to the location on the screen where you want to plot a point and then press EXE.

   • This will plot a point at the pointer location.
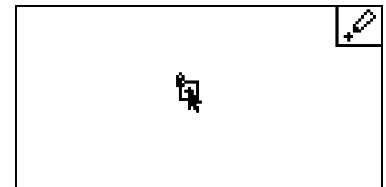
   • The ✎ icon will remain on the display, which means you repeat step 2 to plot more points, if you want.

3. After you are finished plotting all the points you want, press AC/ON or EXIT to deselect the Point tool.

Note

Some drawing tools remain after you draw something, like the Point tool. To deselect such a tool, press AC/ON or EXIT.

● To add a labeled point to an existing line

Note

You can use the following procedure to add a labeled point to an existing line, to a side of a polygon, to the periphery of a circle, etc.

1. Perform the following operation: F3 (Draw) – 1:Point.

2. Move the pointer on the screen towards the line where you want to add the labeled point.
   - This selects the line, which is indicated by "☐".
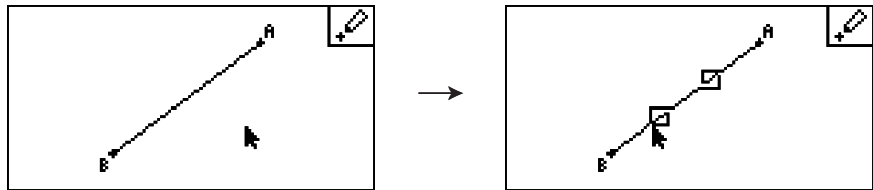
3. Press EXE.
   - This will add a point on the line at the pointer location.
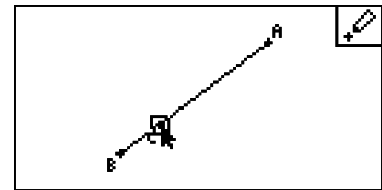
● To draw a line segment

1. Perform the following operation: F3 (Draw) – 2:Line Segment.

2. Move the pointer to the location on the display from where you want to draw the line segment and then press EXE.

3. Move the pointer to the location on the display to where you want to draw the line segment and then press EXE.
   - This will draw a line segment between the two points.
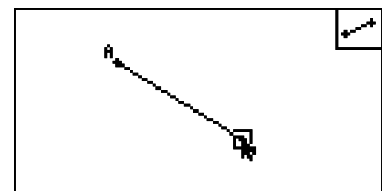
Note

In steps 2 and 3 of the above procedure, you can move the pointer to an existing point on the screen and press EXE. This will make the existing point one of the ends of the line segment.

• To draw an infinite line

1. Perform the following operation: [F3] (Draw) – 3:Infinite Line.
2. Move the pointer to any location on the display and then press [EXE].
3. Move the pointer to another location on the display and then press [EXE].
   • This will draw a line that passes between the two points.
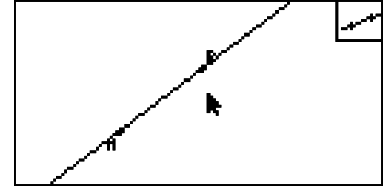
• To drew a ray

1. Perform the following operation: [F3] (Draw) – 4:Ray.
2. Move the pointer to any location on the display and then press [EXE].
3. Move the pointer to another location on the display and then press [EXE].
   • This will draw a ray that starts from the first point you selected and that passes through the second point.
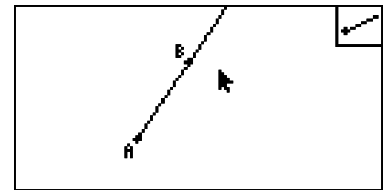
• To draw a vector

1. Perform the following operation: [F3] (Draw) – 5:Vector.
2. Move the pointer to the location on the display from where you want to draw the vector and then press [EXE].
3. Move the pointer to the location on the display to where you want to draw the vector and then press [EXE].
   • This draws the vector.
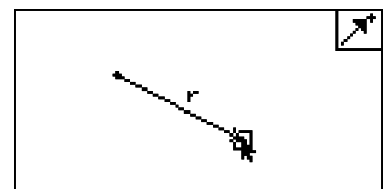
• To draw a circle

1. Perform the following operation: F3 (Draw) – 6:Circle.

2. Move the pointer to the location on the display where you want the center point of the circle to be and then press EXE.

3. Move the pointer to the location on the display where you want the circumference of the circle to be and then press EXE.

   • This draws a circle whose center point is the point you specified in step 2 and whose circumference runs through the point you specified in step 3. In other words, the distance between the two points you specify is the radius of the circle.

Note

In steps 2 and 3 of the above procedure, you can move the pointer to an existing point on the screen and press EXE. This will make the existing point either the center point or the circumference point.

• To draw an arc

1. Perform the following operation: F3 (Draw) – 7:Arc.

2. Move the pointer to the location on the display where you want the center point of the arc to be and then press EXE.

3. Move the pointer to the location on the display where you want the start point of the arc to be and then press EXE.

4. Move the pointer to the location where you want the end point of the arc to be.
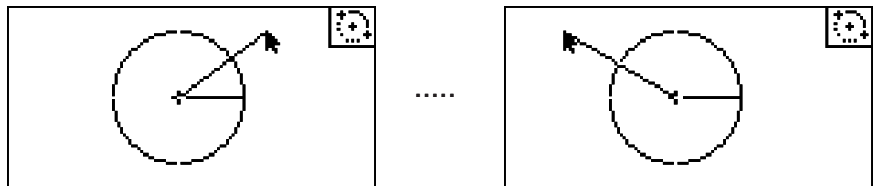
5. Move the pointer and the line segment to the location on the display where you want the end point of the arc to be and then press EXE.

   • An arc will be drawn from the start point to the end point, in a counterclockwise direction.
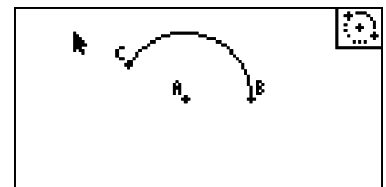
• To draw a triangle

1. Perform the following operation: F3 (Draw) – 8:Triangle.

2. Move the pointer to any location on the display and then press EXE.

3. Move the pointer to another location.

   • This causes a selection boundary to appear, indicating the size of the triangle that will be drawn.
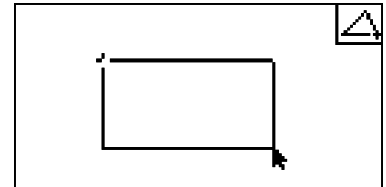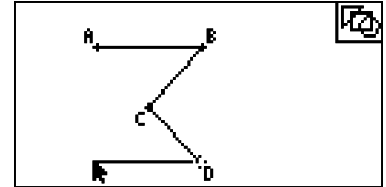
4. Press EXE.

   • This draws a triangle.
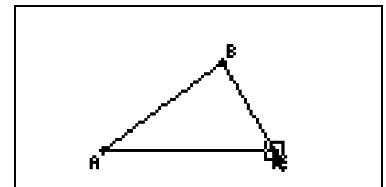
   • If the location of the pointer when you press EXE is very close to the point you specified in step 2, the triangle that is drawn will be the maximum size that fits in the screen.

Note

The same type of two-point selection boundary in the above procedure is also used when drawing an isosceles triangle, rectangle, square, or regular n-gon.

In each case, the resulting object will be the maximum size that fits in the screen if the second point specified is too close to or at the same location of the first point.

Example: When drawing a triangle

→
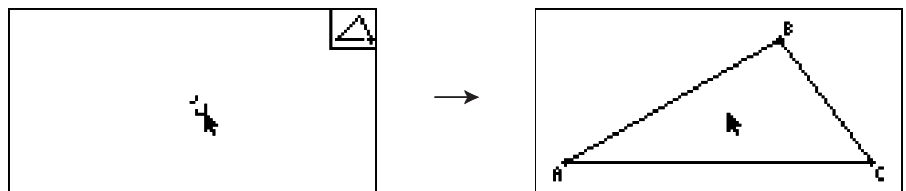
• To draw an isosceles triangle

1. Perform the following operation: F3 (Draw) – 9:Isosc Triangle.
2. Perform steps 2 through 4 under "To draw a triangle" (page 2-5).
   - This draws an isosceles triangle.
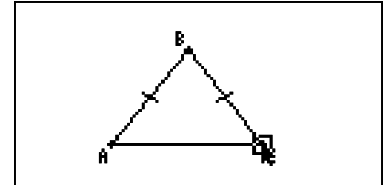
• To draw a rectangle or a square

1. Perform either of the following operations: F3 (Draw) – A:Rectangle or F3 (Draw) – B:Square.
2. Move the pointer to any location on the display and then press EXE.
   - This causes a cross (✚) to appear at the pointer location.
3. Move the pointer to another location.
   - This causes a selection boundary to appear, indicating the size of the rectangle (or square) that will be drawn.
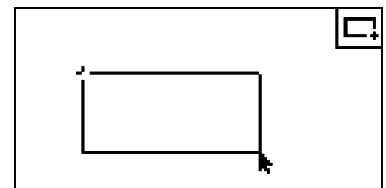
4. Press EXE.
   - This draws a rectangle or square.
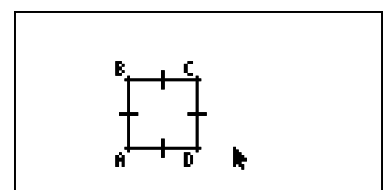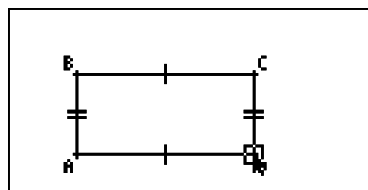
   - If the location of the pointer when you press EXE is very close to the point you specified in step 2, the object that is drawn will be the maximum size that fits in the screen.

Note

In the case of a square, each side will be the length of the shorter side of the rectangle you specify with the selection boundary in step 3.

• To draw a polygon

1. Perform the following operation: F3 (Draw) – C:Polygon.

2. Move the pointer to the location on the display where you want a vertex of the polygon to be and then press EXE.

    • Repeat this step as many times as required to specify the other vertices of the polygon.

3. To complete the polygon, move the pointer to the location of the first vertex and then press EXE.
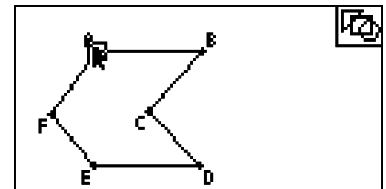
Note

If you press EXIT in place of step 3, the figure will be finalized as-is, resulting in an unclosed non-polygon.

• To draw a regular n-gon

1. Perform the following operation: F3 (Draw) – D:Regular n-gon.

    • This displays a dialog box prompting you to specify the number of sides.
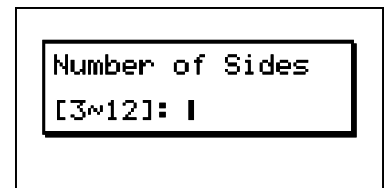
2. Input a value from 3 to 12 and then press EXE.

3. Perform steps 2 through 4 under "To draw a triangle" (page 2-5).

    • This will draw a regular n-gon using the number of sides you specified in step 2.
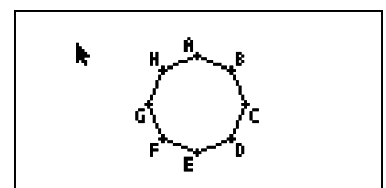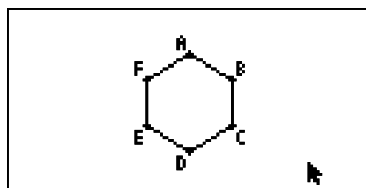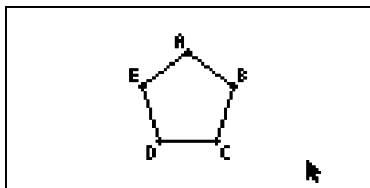
Selecting and Deselecting Objects

Before you can edit (move or delete) an object or create a figure using an object, you first need to select part of it or all of it. This section explains how to select and deselect objects.

• To select a particular object

1. If any tool icon is in the upper right corner of the screen, press [EXIT] or [AC/ON] to deselect the tool.

2. Move the pointer close to the object you want to select.

   • This will cause one or more □ marks to appear on the object.

(Line Segment)

(Point)

(Circle)
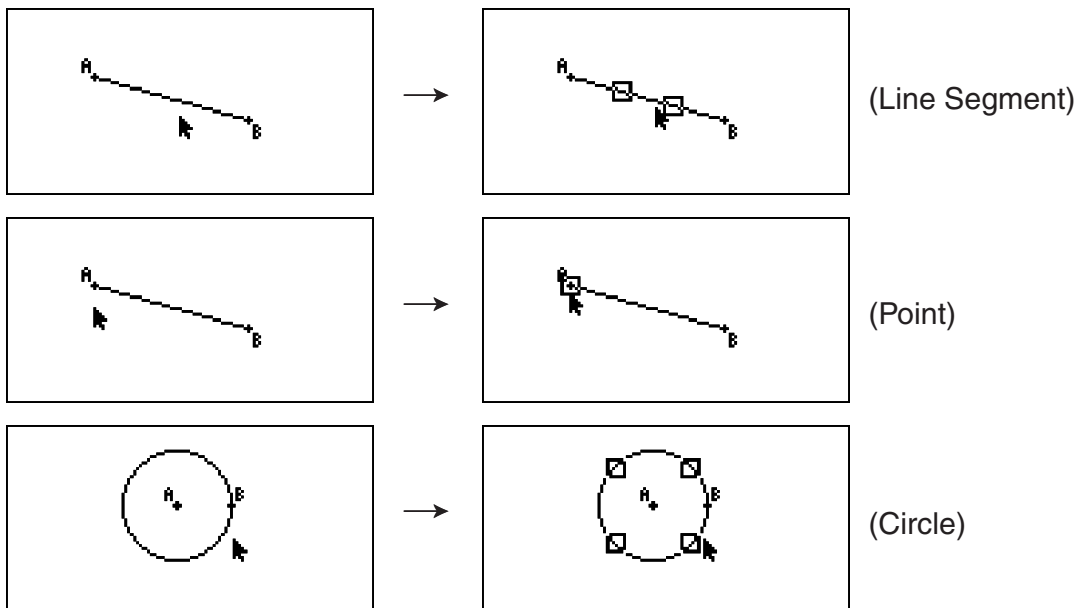
3. Press [EXE].

   • This will cause the □ to change to ■, which indicates that the object is selected.
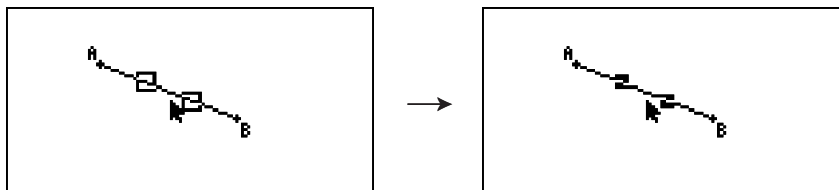
   • Now you can repeat steps 2 and 3 to select other objects, if you want.

• To select an entire polygon

1. If any tool icon is in the upper right corner of the screen, press [EXIT] or [AC/ON] to deselect the tool.

2. Move the pointer close to the object you want to select.

   • This will cause □ marks to appear on some part (vertex, side, etc.) of the object.
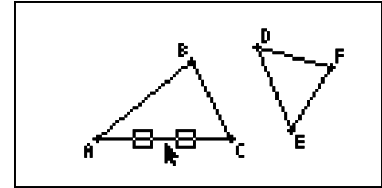
3. Press x^2 or perform the following operation: F2 (Edit) – 4:Select Figure.

   • This selects the entire object.
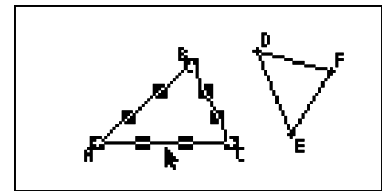
• To deselect a particular object

1. If any tool icon is in the upper right corner of the screen, press EXIT or AC/ON to deselect the tool.

2. Move the pointer close to the object you want to deselect.

   • This will cause the ■ mark(s) to become highlighted.

3. Press EXE.
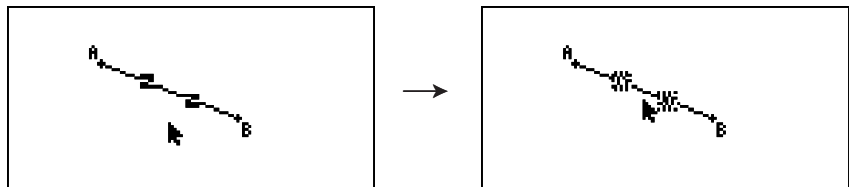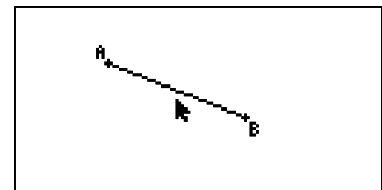
   • This will deselect the object, which causes the ■ mark(s) to disappear.

• To select all objects on the screen

Perform the following operation: F2 (Edit) – 2:Select All.

• To deselect all objects on the screen

Press AC/ON or perform the following operation: F2 (Edit) – 3:Deselect All.

Using the Construct Menu

Press [F4] (Construct) to display the Construct menu. You can use the Construct menu to construct various types of geometric objects, such as a perpendicular bisector, parallel, angle bisector, etc.

• To construct a perpendicular bisector

1. Draw a line segment and select it.
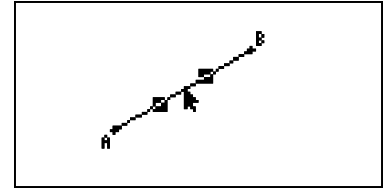
2. Perform the following operation: [F4] (Construct) – 1:Perp Bisector.
   • This will draw the perpendicular bisector of the line segment you selected.
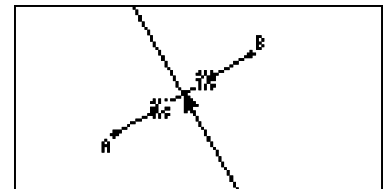
Note

You can perform a perpendicular bisector construct operation while a single line segment, one side of a polygon, or two points are selected on the screen.

## • To construct a perpendicular

1. Draw a line segment, plot a point, and select the line and point.
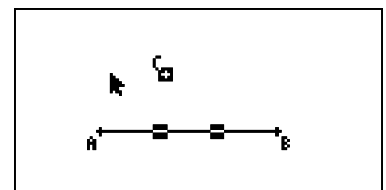
2. Perform the following operation: [F4] (Construct) – 2:Perpendicular.
   • This will draw a perpendicular to the selected line segment and passes through the selected point.
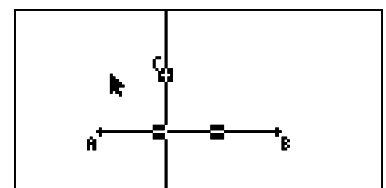
Note

You can perform a perpendicular construct operation while a single line segment and single point, a single line and single point, a single ray and a single point, a single vector and a single point, or one side of a polygon and a single point are selected on the screen.

● **To construct a midpoint**

1. Draw a line segment and select it.
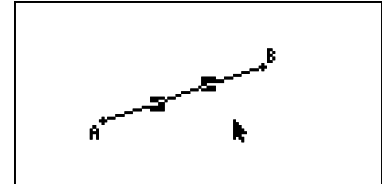
2. Perform the following operation: [F4] (Construct) – 3:Midpoint.
    • This will plot the midpoint of the line segment you selected.
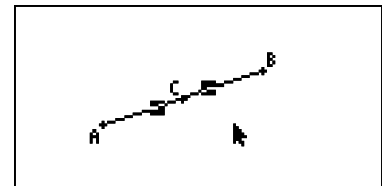
Note

You can perform a midpoint construct operation while a single line segment, one side of a polygon, or two points are selected on the screen.

● **To construct the point of intersection of two lines**

1. Draw to intersecting line segments and select them.
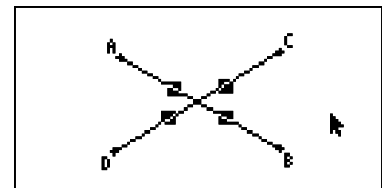
2. Perform the following operation: [F4] (Construct) – 4:Intersection.
    • This plots the point where the two line segments intersect.
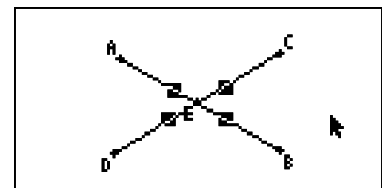
Note

You can construct the point of intersection of two lines while two of any of the following objects (two of the same object or two different objects) are selected on the screen: line segment, line, rays, vector, side of a polygon, circle, or arc.

• To construct an angle bisector

1. Draw a triangle and select two of its sides.
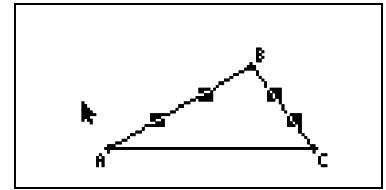
2. Perform the following operation: [F4] (Construct) – 5:Angle Bisector.
   • This draws the bisector of the angle formed by the two sides of the triangle that you selected.
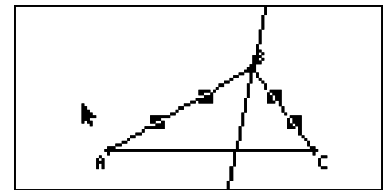
Note

• You can perform an angle bisector construct operation while two of any of the following objects (two of the same object or two different objects) are selected on the screen: line segment, line, ray, vector, or one side of a polygon.
• If the two objects you select are intersecting, the angle bisector construct operation will construct two angle bisectors.
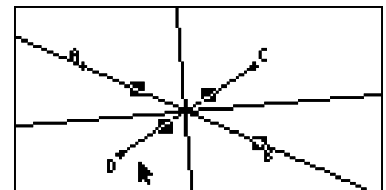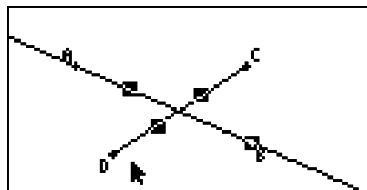
• To construct a parallel

1. Draw a line segment, plot a point, and select the line and point.
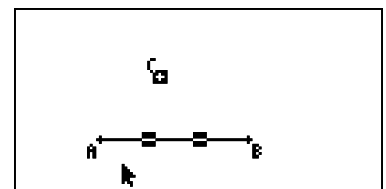
2. Perform the following operation: F4 (Construct) – 6:Parallel.

   • This will draw a parallel to the selected line segment that passes through the selected point.
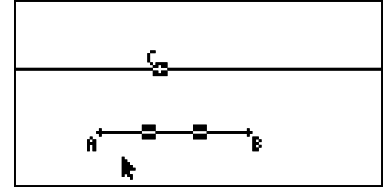
Note

You can perform a parallel construct operation while any of the following combination objects is selected.

• A single line segment and a single point, a single line and a single point, a single ray and a single vector and a single point

• One side of a polygon and a single point

• To construct a tangent

1. Draw a circle.
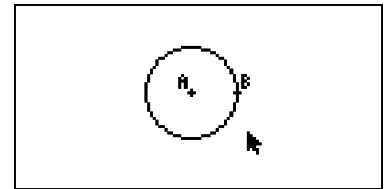
2. Perform the following operation: F4 (Construct) – 7:Tangent.

   • This will cause the message "Select Curve" to appear.

3. Move the pointer close to the location on the circle where you want to construct the tangent.

   • Move the pointer towards the circle until □ marks appear on it.
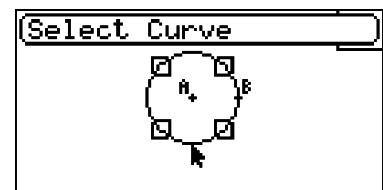
4. Press EXE.

   • This will draw a line that is tangent to the circle at the location you selected with the pointer.
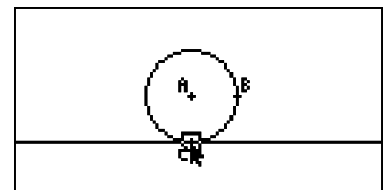
Note

You can perform the tangent construct operation while a circle or arc is selected.

Using the Transform Menu

Press F5 (Transform) to display the Transform menu. You can use the Transform menu to perform various transform operations, such as object reflection, object rotation, etc.

• To reflect an object

1. Draw the object you want to reflect. Here, we will use a triangle.
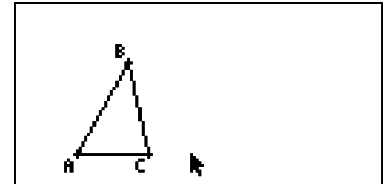
2. Draw a line segment that represents the axis of the reflection.
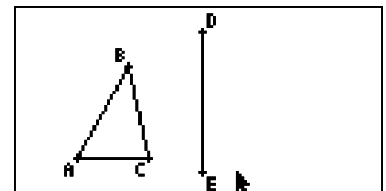
3. Perform the following operation: F5 (Transform) – 1:Reflection.

    • This will cause the message "Select Axis" to appear.

4. Move the pointer close to the line segment that you want to use as the axis of the reflection

    • Move the pointer towards the line segment until □ marks appears on it.
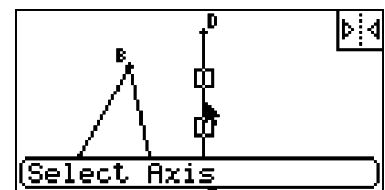
5. Press EXE.

    • This reflects the object using the line segment as the axis.
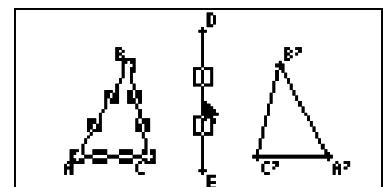
Note

• You can specify a line segment, line, ray, or one side of a polygon as the axis of reflection.
• If you select only part of an object before performing step 3 of the above procedure, only the selected part will be reflected. If you selected side BC of the triangle in step 2, perform the rest of the steps starting from step 3 would reflect side BC only as shown below.
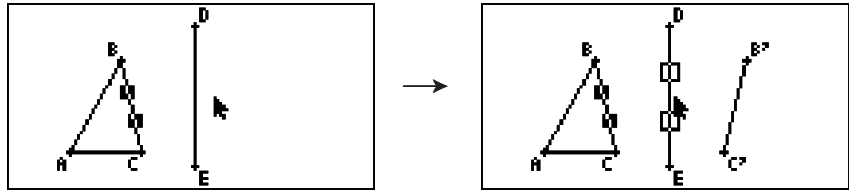
• **To translate an object by specified values**

1. Draw the object you want to translate. Here, we will use a triangle.
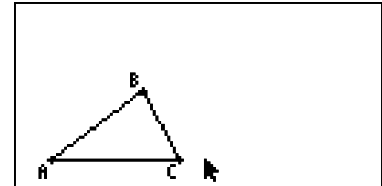
2. Perform the following operation: [F5] (Transform) – 2:Translation.

  • This displays the Translation screen.

3. Input vector format values to specify the distance of parallel translation.

  • The value in line 1 is the translation distance along the X-axis, while the value in line 2 is the distance along the Y-axis.

4. After the values are the way you want, press ⌷.

   • This performs parallel translation of the object by the distance specified by the values you input in step 3.
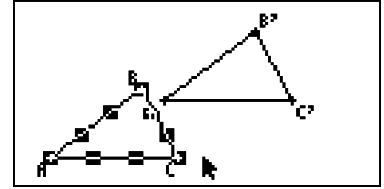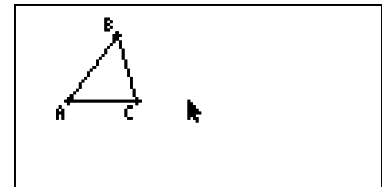

Note

If you select only part of an object before performing step 2 of the above procedure, only the selected part will be translated.

• To translate an object using an existing vector

1. Draw the object you want to translate. Here, we will use a triangle. Next, draw the vector you want to use for parallel translation.
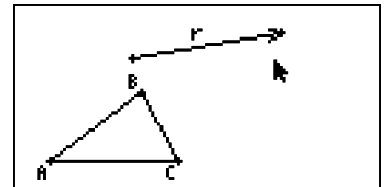
2. Perform the following operation: ⌷ (Transform) – 3:Trans(Sel Vec).

   • This will cause the message "Select Vector" to appear.
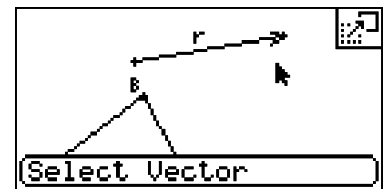
3. Move the pointer close to the vector you want to use for the parallel translation.

   • Move the pointer towards the vector until □ marks appears on it.
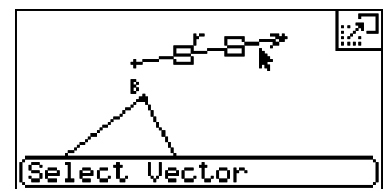
4. Press ⌷EXE⌷.

   • This will perform parallel translation of the original object in the direction of the vector you selected.
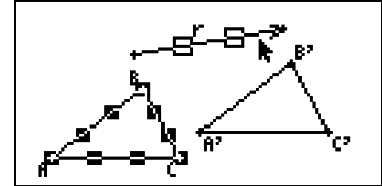
Note

If you select only part of an object before performing step 2 of the above procedure, only the selected part will be translated.

• **To rotate an object**

1. Draw the object you want to rotate. Here, we will use a triangle.

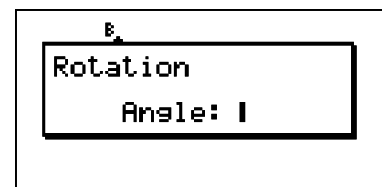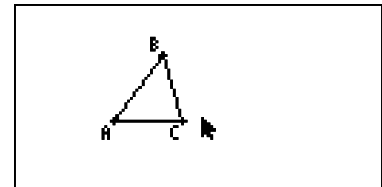2. Perform the following operation: ⌷F5⌷ (Transform) – 4:Rotation.

   • This will cause the message "Sel Rotation Center" to appear.

3. Move the pointer to the location you want to specify as the center of rotation.
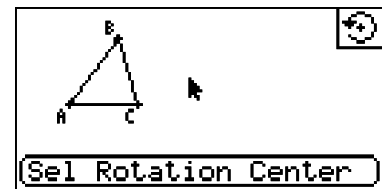
4. Press ⌷EXE⌷.

   • This displays a dialog box for specifying the angle of rotation.

5. Input the angle of rotation (counterclockwise) in degrees and then press [EXE].

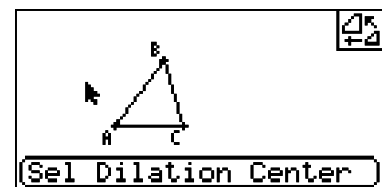   • This will draw the original object, rotated the specified amount.
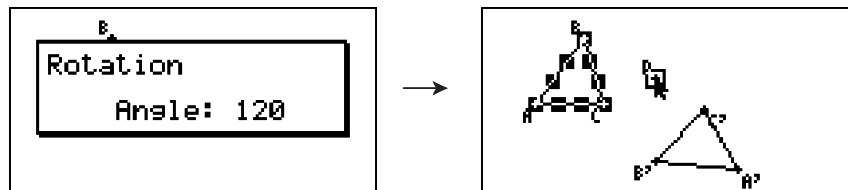
Note

If you select only part of an object before performing step 2 of the above procedure, only the selected part will be rotated.
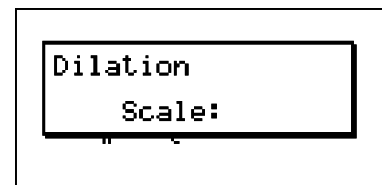
• **To dilate an object**

1. Draw the object you want to dilate. Here, we will use a triangle.

2. Perform the following operation: [F5] (Transform) – 5:Dilation.

    • This will cause the message "Sel Dilation Center" to appear.

    • See the figure in the notes below for details about meanings of the terms used during the dilation operation.

3. Move the pointer to the location you want to specify as the center of dilation.

4. Press [EXE].

   • This displays a dialog box for specifying the dilation scale.

5. Input a scale value in the range of $0.1 \leqq |x| \leqq 10$ and then press $\boxed{\text{EXE}}$.

   • This will draw a resized version of the original object.
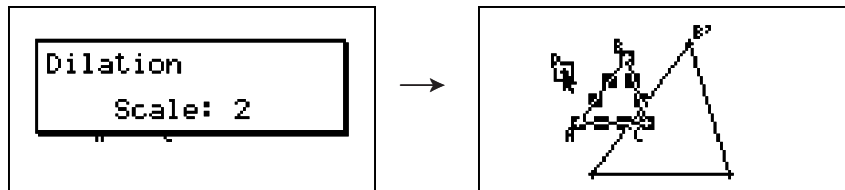
Note

• If you select only part of an object before performing step 2 of the above procedure, only the selected part will be dilated.

• The following figure illustrates the meanings of the terms used in the above procedure.
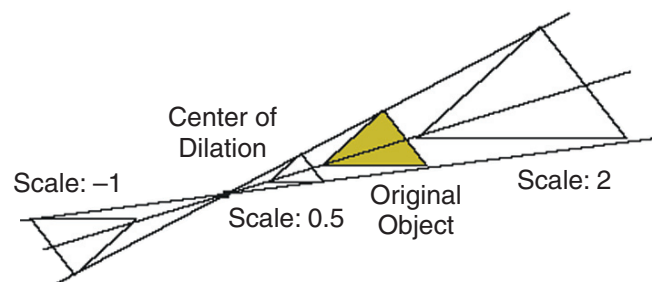
Undoing and Redoing an Operation

The Undo command lets you undo the last operation you performed, while Redo lets you restore an operation you have undone.

• To undo the last operation you performed

Immediately after performing the operation you want to undo, press $\boxed{\text{X}}$ or perform the following operation: $\boxed{\text{F2}}$ (Edit) – 1:Undo/Redo

Important!

Note that the following operations cannot be undone.

• Clear all objects operation: $\boxed{\text{F2}}$ (Edit) – 6:Clear All (page 2-21)
• View Window setting configuration (page 3-3)
• Zoom operation (page 3-4)
• Scroll operation (page 3-4)
• Pan operation (page 3-3)
• Setup change (page 3-1)

• To redo an operation

Immediately after undoing the operation, press $\boxed{\text{X}}$ or perform the following operation: $\boxed{\text{F2}}$ (Edit) – 1:Undo/Redo

Moving and Deleting an Object

Before you can move or delete an object, you first need to select it. For details, see "Selecting and Deselecting Objects" (page 2-8).

• To move an object

Note

Sometimes you may find that an object will not move the way you want it to. If this happens, try locking the part(s) of the object that you do not want to move (page 5-10), or temporarily unlock all objects (Clr Constraint, page 5-11).

1. Select the object you want to move.

   • If you want to move only one of the vertices of a triangle for example, select the vertex. To move only one side of the triangle, select the side.
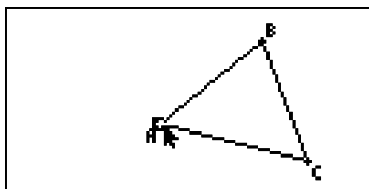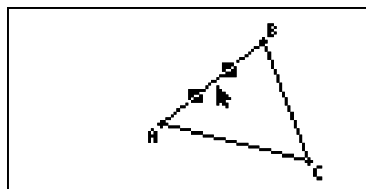
| One vertex selected | One side selected | Three sides selected |

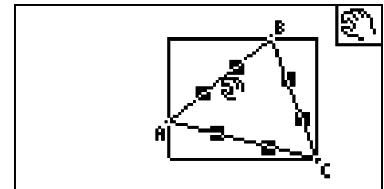2. Press $\boxed{\text{X,}\theta\text{,T}}$.

   • This causes the ✍ icon to appear in the upper right corner of the screen and the pointer to change from ▸ to ✍. Also, a rectangle will enclose the object that you selected in step 1.
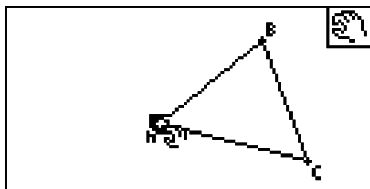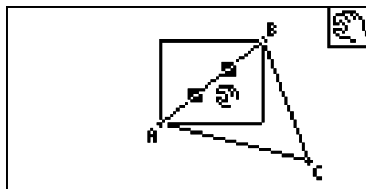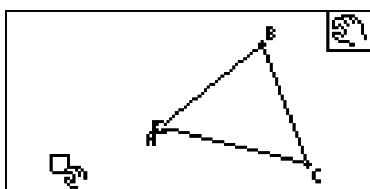

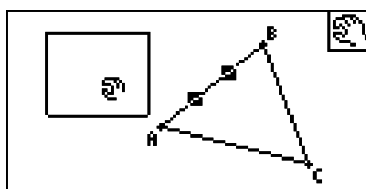| One vertex selected | One side selected | Three sides selected |

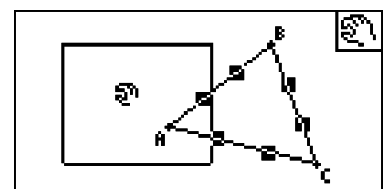3. Use the cursor keys to move the object in the direction you want.

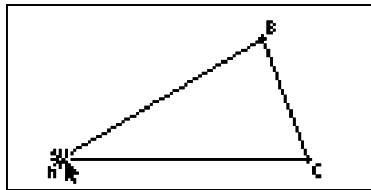   • The rectangle will move in corresponding direction.
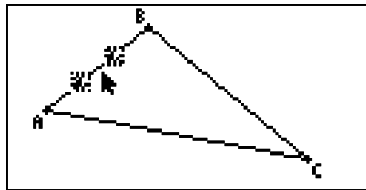

| One vertex selected | One side selected | Three sides selected |

4. To move the object to the current location of the rectangle, press [EXE].
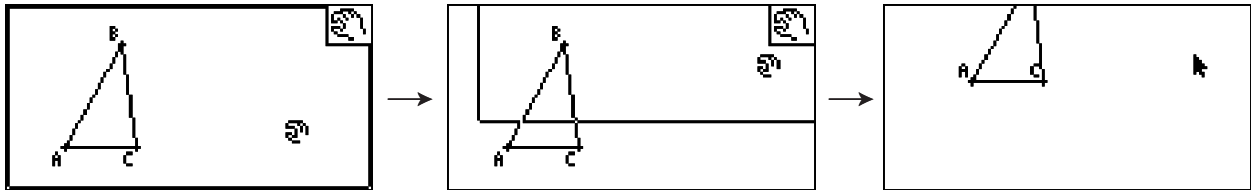
| One vertex selected | One side selected | Three sides selected |

Note

If you press [X,θ,T] when nothing is selected on the screen, the pointer will change to a 🖑, which you can use to pan (shift) the entire screen.
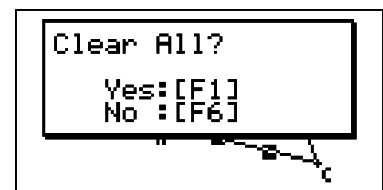
• **To delete an object**

1. Select the object you want to delete.

   • If you want to delete only one of the vertices of a triangle for example, select the vertex. To delete only one side of the triangle, select the side.

2. Press [DEL] or perform the following operation: [F2] (Edit) – 5:Delete.

   • This deletes the selected object.

• **To delete all objects on the screen**

1. Perform the following operation: [F2] (Edit) – 6:Clear All.

   • This causes a confirmation dialog box to appear.

```
Clear All?
   Yes:[F1]
   No :[F6]
```

   Important!

   Pressing [F1] (Yes) in the following step will delete all the objects currently on the screen. This operation cannot be undone.

2. Press [F1] (Yes) to delete all the objects on the screen or [F6] (No) to cancel the delete operation.

Note

You can also delete all objects by pressing [AC/ON] twice while nothing is selected on the screen.

Hiding and Showing Objects

Use the following operations to hide specific objects and to show all currently hidden objects.

• To hide an object

1. Select the object you want to hide.

2. Perform the following operation: [OPTN] (Option) – 6:Hide.

   • This hides the selected objects.

• To show all hidden objects

Perform the following operation: [OPTN] (Option) – 5:Show All. This shows all currently hidden objects.

3. Controlling the Appearance of the Geometry Window

This section provides information about how to control the appearance of the screen by scrolling or zooming, and by showing or hiding axes and the grid.
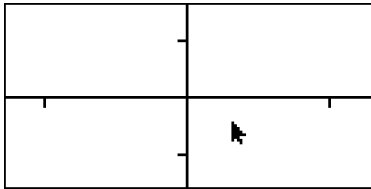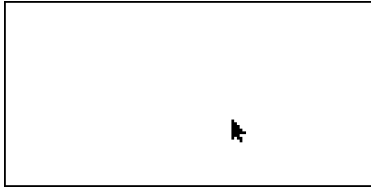
Displaying Axes and the Grid

Use the following procedures to turn display of the axes and grid on or off.

• To specify the axis setting

1. Press [SHIFT] [MENU] (SET UP) to display the Setup screen.

```
Axes         :Off
Integer Grid :Off




On  Off SCALE
```

2. Use the following key operations to select the setting you want.

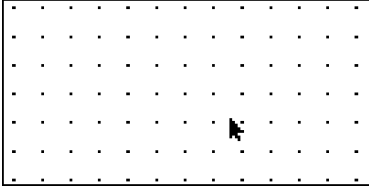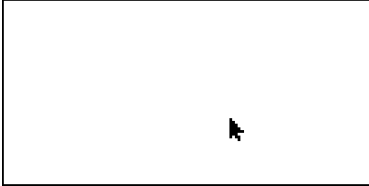| To select this setting:		Press this key:
Axes on		[F1] (On)
Axes off		[F2] (Off)
Axes with scale values on		[F3] (SCALE)

3. After the setting is the way you want, press [EXIT].

Note

The scale values that are displayed after you select [F3] (SCALE) in the above procedure will be the outermost scale on each of the axes (x and y). Note, however that scale values will not be displayed if the outermost values are outside of the display range.

• **To toggle integer grid display on and off**

1. Press [SHIFT] [MENU] (SET UP) to display the Setup screen.

2. Use ⊙ to move the highlighting to "Integer Grid".

3. Use the following key operations to select the setting you want.

| To select this setting:		Press this key:
Integer grid on		[F1] (On)
Integer grid off		[F2] (Off)

4. After the setting is the way you want, press [EXIT].

Note

When you plot or move a point while the integer grid is turned on, the point will snap to the nearest grid location. Turn on integer grid when you want all of the points on a graph to be located at integer value coordinates.

Configuring View Window Settings

You can configure View Window settings to specify the coordinates of the screen's left edge (Xmin) and right edges (Xmax). The length of the y-axis is configured automatically using a ratio of 1:2 (y-axis:x-axis), but you can specify what part of the y-axis is in the middle of the screen (Ymid).
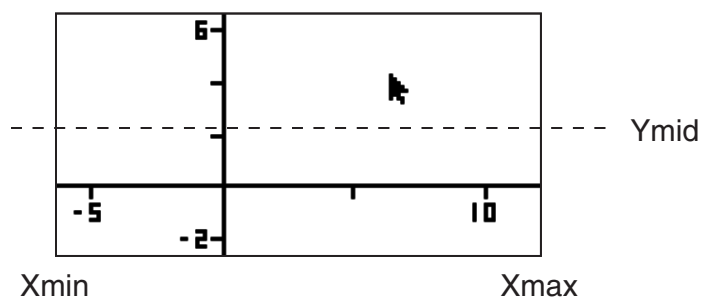
Ymid

Xmin   Xmax

• To configure View Window settings

1. Perform the following operation to display the View Window screen: [SHIFT] [F3] (V-WIN).

```
View Window

Xmin :-6.3
 max :6.4
Ymid :0.05

INIT
```
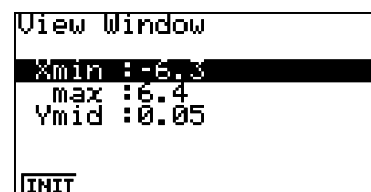
2. Input values for Xmin, Xmax, and Ymid.
   • If you want to return these settings to their initial defaults, press [F1] (INIT).
3. After all the settings are the way you want, press [EXIT].

# Using Pan and Scroll to Shift the Display Image

There are two methods available for shifting the contents of the screen. In addition to scrolling, you can also use pan, which lets you grab a specific point on the screen and shift it to the position you want.
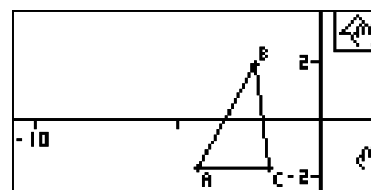
• To pan the screen

1. Perform the following operation: [F1] ▶ (View) – 2:Pan.
   • This enters the Pan mode, which is indicated by the 🖑 icon in the upper right corner of the screen.
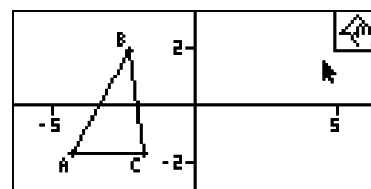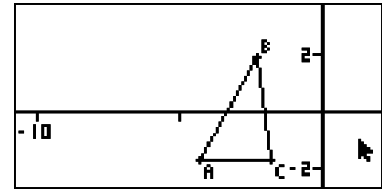
2. Move the pointer to the location on the screen you want to grab and then press [EXE].
   • This causes the pointer to change from ▸ to 🖑.
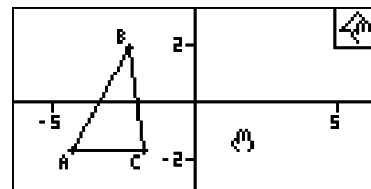
3. Use the cursor keys to shift the screen in the direction you want.

4. To exit the Pan mode, press EXIT .

Note

In the Pan mode, each press of EXE toggles the shape of the pointer between ▸ and 🖐. While the ▸ pointer is displayed, you can use the cursor keys to move it to another location on the screen. Pressing the cursor keys while the 🖐 pointer is displayed will shift (pan) the screen contents.

• **To scroll the screen**

1. Press ⊡ or perform the following operation: F1 ▶(View) – 3:Scroll.
    • This enters the Scroll mode, which is indicated by the ✛ icon in the upper right corner of the screen. The pointer disappears from the screen at this time.

2. Use the cursor keys to scroll the screen in the direction you want.

3. To exit the Scroll mode, press EXIT .

Zooming

The Geometry Mode provides you with a selection of zoom commands that you can use to enlarge or reduce an entire screen image or a specific area of an object.

• **To zoom using the zoom box**

1. Perform the following operation: F1 ▶(View) – 1:Zoom Box.
    • This causes the 🔍 icon to appear in the upper right corner of the screen.
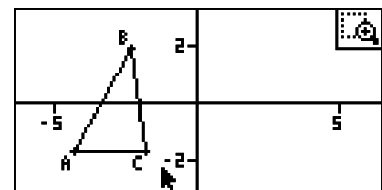
2. Move the pointer to the location on the display on one edge of the area you want to select as the zoom box area and then press EXE .
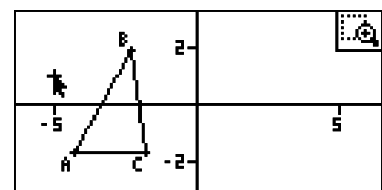
3. Move the pointer in the direction of the opposite edges of the zoom box area.

   • As you do, the calculator will display a selection boundary that will expand as you move the pointer.

4. After selecting the zoom box area you want, press [EXE].

   • The area within the zoom box area expands to fill the entire screen.
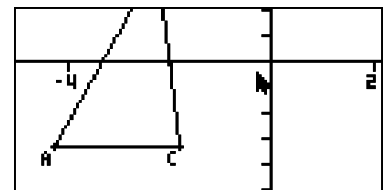
• **To zoom in and out**

To double the size of the displayed image, press [+] or perform the following operation: [F1] [▶](View) – 4:Zoom In.
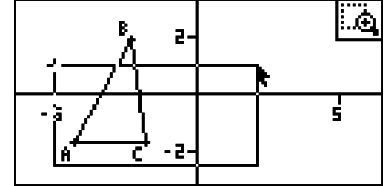
To halve the size of the displayed image, press [–] or perform the following operation: [F1] [▶](View) – 5:Zoom Out.

• **To zoom the screen image to fit the window area**

Press [–] or perform the following operation: [F1] [▶](View) – 6:Zoom to Fit.

• This will enlarge or reduce the currently display image so it fills the screen.
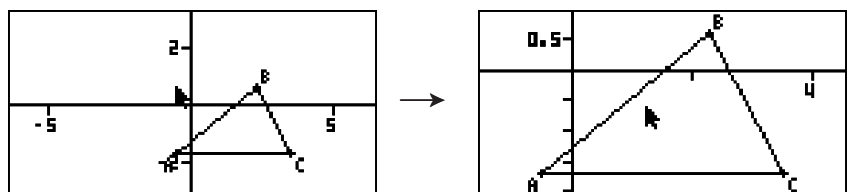
4. Using Text and Labels in a Screen Image

You can use the procedures in this section to insert text into a screen image. You can also edit the labels that the calculator inserts automatically for objects, and add labels to objects.

Inserting Text into Screen Images

You can use the following procedure to insert text into a screen image and to edit existing text.

• To insert text into a screen image

1. Move the pointer to the location on the screen where you want to insert the text.
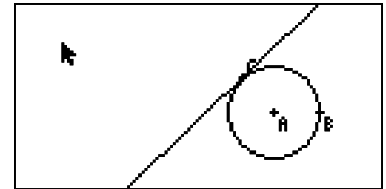
2. Perform the following operation: [OPTN] (Option) – 1:Text.
   • This will display a text input dialog box and automatically switch the calculator's keys to Alpha Lock.

3. Input up to 31 characters of text and then press [EXE].
   • The text you input is inserted into the screen image at the location of the pointer.
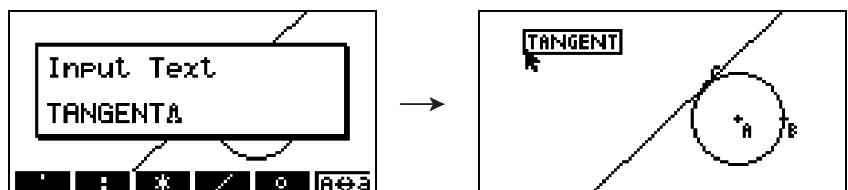
4. Now you can move the text to another location on the screen, if you want.
   • For details, see "To move an object" (page 2-20).

● **To edit screen text**

1. Select the text you want to edit.
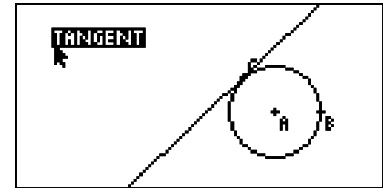
2. Press [VARS].

   • This displays the measurement box at the bottom of the screen.
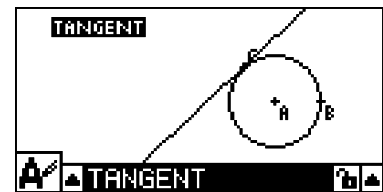
3. Press [EXE].

   • This displays the text input dialog box.

4. Edit the text and then press [EXE].

   • This causes the newly edited text to appear on the screen.
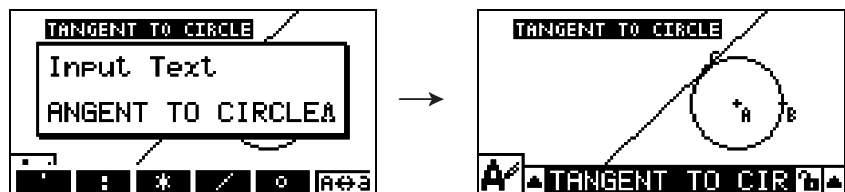
5. To close the measurement box, press [EXIT] twice.

Adding or Modifying a Label

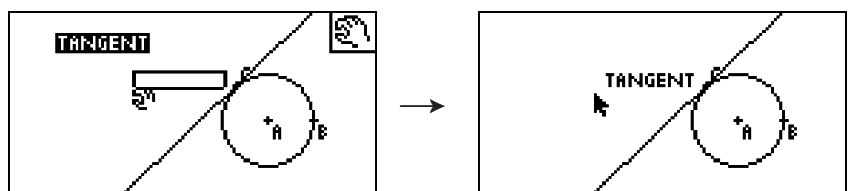Label operations are explained in this section using a triangle. In the first example we modify an existing label, while in the second example we add a label to one side of the triangle.

● **To modify an existing label**

1. On the triangle, select the vertex whose label you want to change. In this example we will select point A.
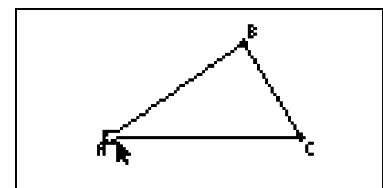
2. Press [VARS].

   • This displays the measurement box at the bottom of the screen.

3. Press ◀ to highlight the up arrow button on the left side of the measurement box and then press [EXE].

   • This displays an icon palette.

4. Use the cursor keys to move the highlighting to the 🅰 icon on the icon palette and then press [EXE].

5. Press ▶ to move the highlighting back to the measurement box and then press [EXE].

   • This will display a label editing dialog box and automatically switch the calculator's keys to Alpha Lock.

↔

The Alpha Lock cursor (🅰) and the current label text ("A" in this example) will alternately flash on the dialog box.

6. Input up to 14 characters for the label text and then press [EXE].

   • This will modify the label.

→

7. To close the measurement box, press [EXIT] twice.

• **To add a new label**

1. Select the side of the triangle to which you want to add the label.
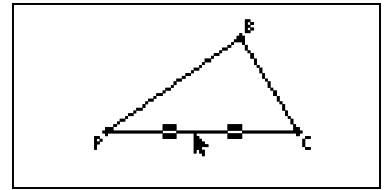
2. Press [VARS] to display the measurement box.

3. Press ◀ to highlight the up arrow button on the left side of the measurement box and then press [EXE].

    • This displays an icon palette.

4. Use the cursor keys to move the highlighting to the [A✐] icon on the icon palette and then press [EXE].

5. Press ▶ to move the highlighting back to the measurement box and then press [EXE].
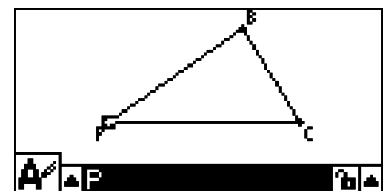
    • This will display the label edit dialog box.

6. Input up to 14 characters for the new label text and then press [EXE].

    • This will add the label.
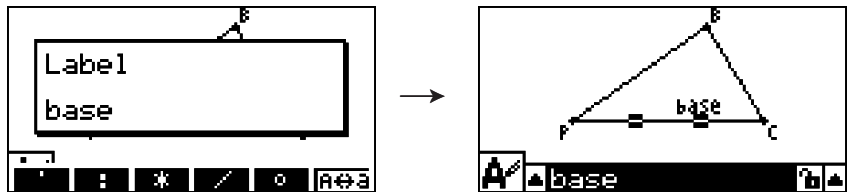
7. To close the measurement box, press [EXIT] twice.

5. Using the Measurement Box

Pressing [VARS] displays a measurement box at the bottom of the screen as shown below.
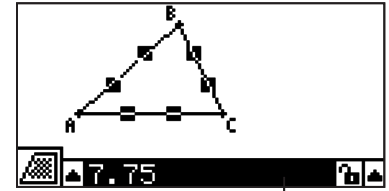
Measurement Box

You can use the measurement box to perform the following operations.

View the measurements of an object

Displaying the measurement box and selecting an object displays combinations of the following measurements, depending on the type of object you select: coordinates, distance/length, slope, equation, vector, radius, circumference, perimeter, area, angle, supplementary angle, tangency, congruence, incidence, or point on curve.

Specify the measurement of part of an object

After you display the measurement box, you can select part of an object and then change numeric values for the applicable measurement. You can specify the coordinates of a point, the length of a line segment (distance between endpoints), the angle formed by two lines, etc.

Lock the measurement of part of an object

After you display the measurement box, you can select part of an object and then lock the applicable measurement. You can lock the coordinates of a point, the length of a line segment, the angle formed by two lines, etc.

Viewing the Measurements of an Object

The type of information that appears in the measurement box depends on the object that is currently selected on the display. If a line segment is selected, for example, the measurement box shows the distance, slope, or the equation for that line. You can specify the type of information you want to view by highlighting the up arrow button to the left of the measurement box, pressing the [EXE] (or ⬆) key, and then using the cursor keys to highlight the appropriate icon on the icon palette that appears.
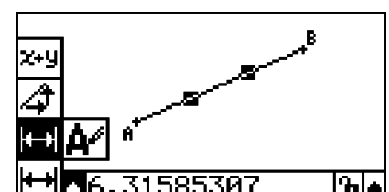
The following table describes the information that appears when you highlight each icon, and explains when each icon is available for selection.

Icon	Icon Name	This icon appears when this is selected:	Highlighting this icon displays:	Lockable
x,y	Coordinates	A single point	Coordinates of the point	Yes
↦	Distance/ length	Two points on one object or two different objects, or a single line segment or a vector	Distance between two points, length of a line segment or vector	Yes
◢	Slope	Single line, ray, line segment, or vector	Slope of the line, ray, line segment or vector	Yes
x÷y	Equation	Any single line or line segment, ray, circle, or arc	Function of the object (using rectangular coordinates)	No
x÷y	Expression	A single expression ("EXPR=" object)	Calculation formula	No
x÷y	Vector	A single vector	Vector components	Yes
⌒	Radius	A single circle or arc	Radius of circle or arc	Yes
2πr	Circumference	A single circle or arc	Length of the circumference	No[3]
2πr	Perimeter	A single polygon	Sum of the lengths of the sides	No
▨	Area	Any three points, a single circle, arc, or polygon	Area	No[3]
△	Angle[1]	Two lines, line segments, rays, or vectors[2] in any combination	Angle and its supplement formed by the two objects	Yes
↕	Supplementary Angle[1]			
↘	Tangency	Two circles or arcs, line and circle, or a line and arc	Whether the two items are tangent	Yes
△	Congruence	Two line segments	Whether the line segments are the same length	Yes
⊠	Incidence	Point and a line, arc, circle or a vector	Whether the point is on the line/curve	Yes

[1] The angle and supplementary angle is always displayed as degrees.

[2] When two vectors are selected, the angle that is no the angle formed mathematically by the two vectors. It merely indicates the simple angle that would be formed if the vectors were two lines.

[3] The circle itself can be locked.

Icon	Icon Name	This icon appears when this is selected:	Highlighting this icon displays:	Lockable
⟳	Rotation angle	Two points created by the [F5] – 4:Rotation command	Angle of rotation	No
⤢	Scale of dilation	Two points created by the [F5] – 5:Dilation command	Scale of dilation	No
A⁄	Label/Text	A point that has a label or an object that can be named	Label text	No

You can use the measurement box to determine certain measurements.

The first example below shows how to view the measurements of a line segment. In the second example, three points are selected on the screen and the measurement box shows the area of the triangle formed by them.
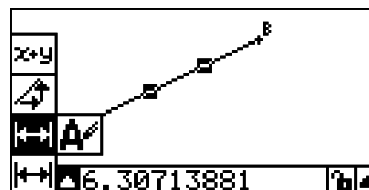
● **To view the measurements of a line segment**

1. Draw a line segment and select it.
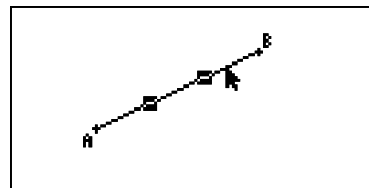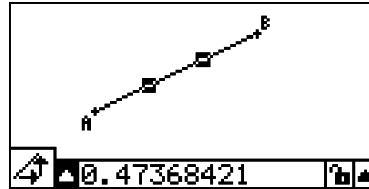

2. Press [VARS] to display the measurement box.
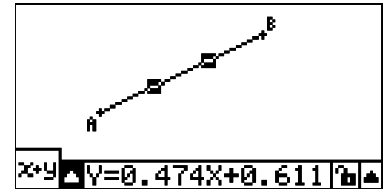   • This displays the length of the line segment.
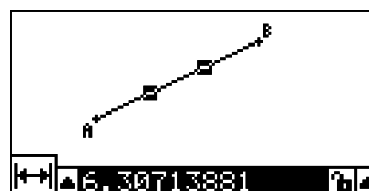
3. Press ◀ to highlight the up arrow button on the left side of the measurement box and then press [EXE].
   • This displays an icon palette.

4. Select the icons on the icon palette to display other measurements.

    •In the case of the line segment, for example, you can view its length, slope, and equation.

Slope   Equation

5. To close the measurement box, press [EXIT] twice.

• To display the area of a rectangular area

You can use the measurement box to display the area of a triangle formed by any three points you select on the display.

Example: To use the rectangle ABCD to determine the areas of the triangles formed by points A, D, and B, and points A, D, and C

1. Draw the rectangle.
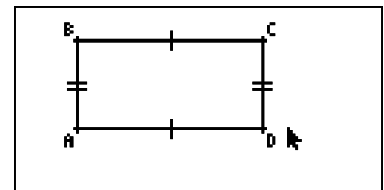
2. Select points A, D, and B.

3. Press [VARS].

    •This causes the area of the triangle ADB to appear in the measurement box.

4. To make the drawing screen active, press EXIT.

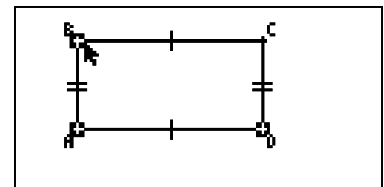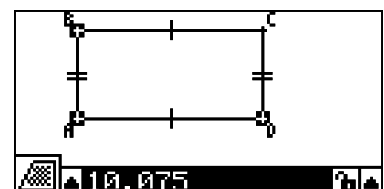   • This causes the measurement box to become unhighlighted and the pointer to reappear on the drawing screen.
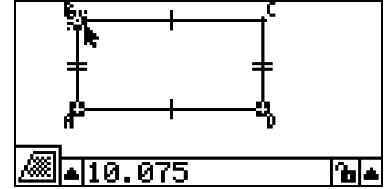
5. Press AC/ON to deselect the current points and then select points A, D, and C.

    • This causes the area of the triangle ADC to appear in the measurement box. The above procedure shows that the areas of the two triangles are the same.
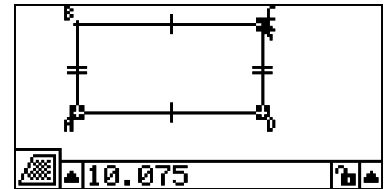
6. To close the measurement box, press EXIT.

Note

A value that shows the area of an object whose lines intersect is indicated by double asterisks (✽✽) to the left of the value. This indicates that the value may not indicate the correct area.

Specifying a Measurement of an Object

In the following examples, we specify the angle of a triangle and the length of one side of a triangle.

• **To specify the angle of a triangle**

1. Draw a triangle.

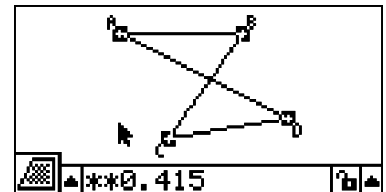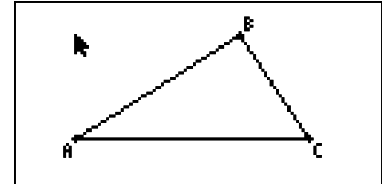2. Select side AC and then select side BC.

3. Press [VARS] to display the measurement box.

    • This displays the size of ∠ACB (in degrees) in the measurement box.
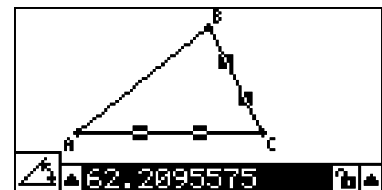
4. Input the value you want to specify for ∠ACB (in degrees) into the measurement box and then press [EXE].

    • In this example we input 90, which makes ∠ACB 90 degrees.
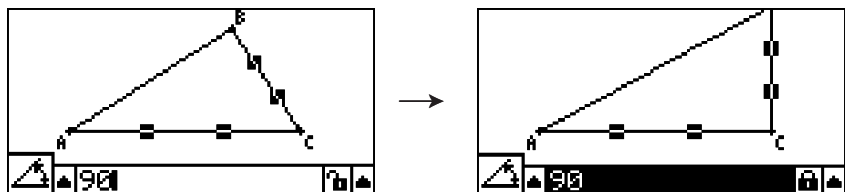
5. To close the measurement box, press [EXIT] twice.
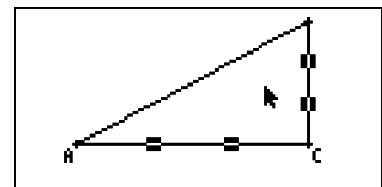
Note

• Performing step 5 in the above procedure not only changes the measurement value, it also locks the measurement. For details about locking and unlocking measurements, see "Locking or Unlocking the Measurements of an Object" (page 5-9).

• Specifying a value can change an object in a way that is unexpected. If this happens, try locking part(s) of the object (page 5-10) or temporarily unlock all objects (Clr Constraint, page 5-11).

• To specify the length of one side of a triangle

Note

• Specifying any one of the following measurements for the first time in the file you are editing (or immediately after an all clear operation: [F2](Edit) – 6:Clear All) will cause the resulting object to be resized so it fits within the display area.

　- Length of one side of a triangle
　- Length of a line segment or vector
　- Length of one side of a rectangle, square, polygon, or regular n-gon
　- Circumference of a circle or length of an arc

View Window settings will be reconfigured automatically so the size of the object on the display may not appear to change very much.

The following example shows what happens when the length of the base of a triangle drawn with default View Window settings (with a screen width of 10.7) is changed to 120.
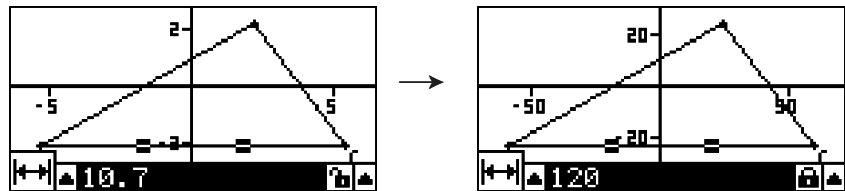
View Window settings are reconfigured in order to ensure that specifying a measurement of an object does not make it too bit to fit on the screen or too small to see. Note that all other objects currently on the screen also will be resized by the same amount at the object whose measurement you are specifying.

• Once you specify one measurement of an object, it will not be resized further if you specify another of its measurements.

• In the following example, the length of the same side of a triangle will be specified twice. Note the difference between what happens when you specify the first measurement and when you specify the second measurement.

1. Perform the following operation to clear the screen: [F2](Edit) – 6:Clear All.

2. Perform the following operation to display the View Window screen: [SHIFT] [F3] (V-WIN).

3. Press [F1](INIT) to initialize View Window settings.

4. Press [EXIT] to exit the View Window screen.

5. Press [SHIFT] [MENU] (SET UP) to display the Setup screen.

```
Axes         :Off
Integer Grid :Off



 On  Off SCALE
```
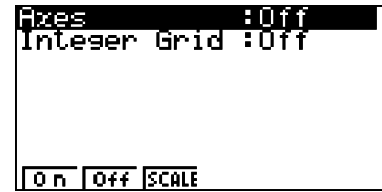
6. Press [F3] (SCALE).

7. Press [EXIT] to close the Setup screen.
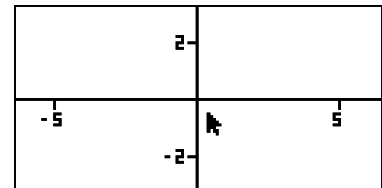
8. Draw a triangle.
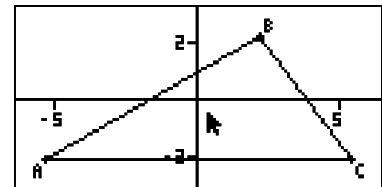
9. Select side AC.
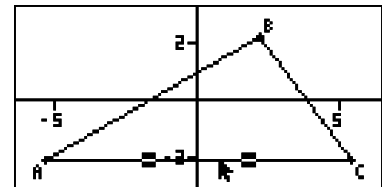
10. Press [VARS] to display the measurement box.

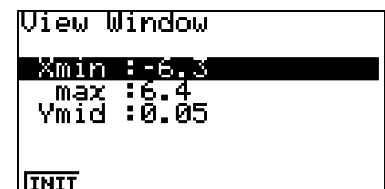   • This displays the length of side AC in the measurement box.
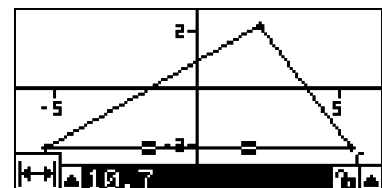
11. Input the value you want to specify for side AC into the measurement box.

   • Here, we will input 120.
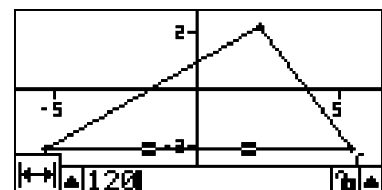
12. Press [EXE].

•This changes the length of size AC to 120 and resizes the entire triangle accordingly.
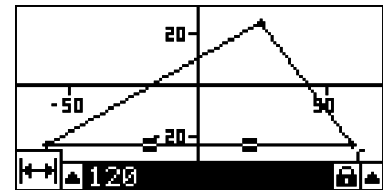
•View Window settings are update automatically so the resized triangle can fit on the screen. Note that the scale values on the axes also change.

13. Now input 90 as the length of side AC and then press [EXE].

•Using A as the point of reference, side AC is resized to 90. In this case, the length of side AC is shortened, without altering the overall size of the triangle.
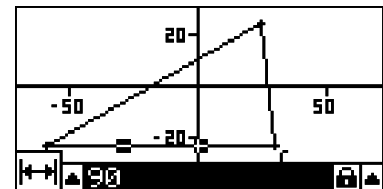
## Locking or Unlocking a Measurements of an Object

By "locking a measurement" we mean that the corresponding object cannot be moved. For example, if we lock a point to a circle and move the circle, the point will also move.

• To lock or unlock a measurement

The icon to the right of the measurement box indicates whether a measurement is locked or unlocked.

🔓   Measurement is unlocked.

🔒   Measurement is locked.

• To lock a particular measurement

You can lock a particular measurement by performing any one of the following operations.

• Perform the procedure under "Specifying a Measurement of an Object" (page 5-6) to specify the measurement. This will cause the specified measurement to become locked automatically.
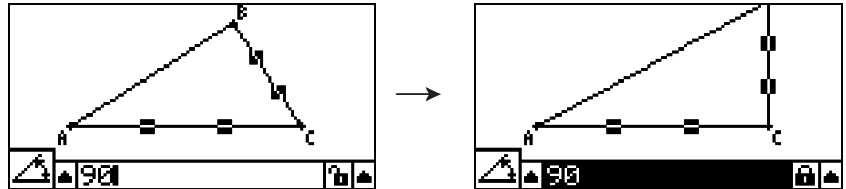
 →

• If the icon to the right of the measurement box is ▣, move the highlighting to the icon and press [EXE].

 →

• Move the highlighting to the up arrow button to the right of the ▣ icon and press [EXE]. On the menu that appears, select [Lock] and then press [EXE].

 →

Note

• Some measurements cannot be locked. For details, see the "Lockable" column in the table under "Viewing the Measurements of an Object" (page 5-1).

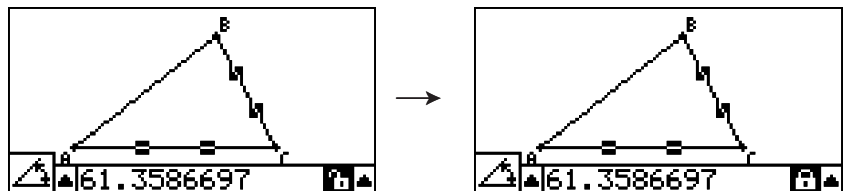### • To unlock a particular measurement

You can unlock a particular measurement by performing any one of the following operations.

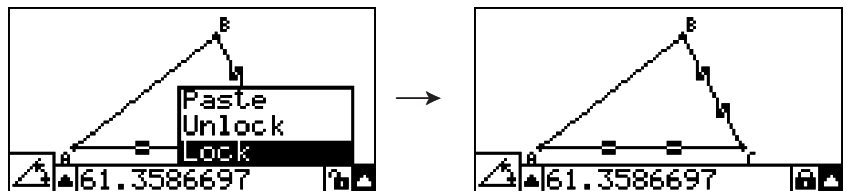• If the icon to the right of the measurement box is ▣, move the highlighting to the icon and press [EXE].

• Move the highlighting to the up arrow button to the right of the ▣ icon and press [EXE]. On the menu that appears, select [Unlock] and then press [EXE].

• To unlock all objects on the screen

Perform the following operation: [OPTN] (Option) – 4:Clr Constraint.

This unlocks all locked settings.

Note

The above operation unlocks both measurements you locked manually, as well as objects that are locked automatically whenever they are drawn. For example, the above operation unlocks all of the following lock conditions.

• The lock that is applied when you draw a rectangle that keeps its opposing sides equal (opposing side congruence lock)

• The lock that is applied when you draw an isosceles triangle (ABC) that keeps side AB and side BC equal (side AB and side BC congruence lock)

• The lock that is applied when you draw an infinite line that keeps the line passing through two points (point A and point B) (infinite line and point A, B incidence lock)

• The relationship between the line segment and perpendicular bisector that is formed when you select a line segment and perform the following operation: [F4] (Construct) – 1:Perp Bisector

• The (locked) similarities of objects when you select the objects and perform the following operation: [F5] (Transform) – 5:Dilation

Pasting Measurements into a Screen Image

You can use the procedures in this section to paste object measurements into the image on the screen. The measurements change dynamically as you manipulate the object.

The following types of measurements can be pasted into a screen image: coordinates, distance/length, slope, equation, vector components, radius, circumference, perimeter, area, angle, supplementary angle.

• To paste a measurement into a screen image

Example: To paste an internal angle measurement into a screen image

1. Draw a triangle and select two of its sides.
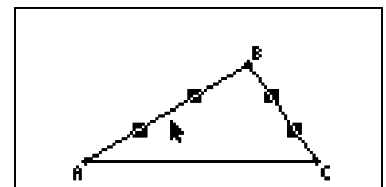
2. Press [VARS] to display the measurement box.
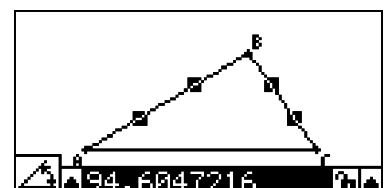
3. Press ▶ to highlight the up arrow button on the right side of the measurement box and then press EXE.

   • This will display a menu.
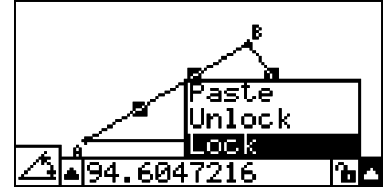
4. Use ▲ to move the highlighting to [Paste] and then press EXE.

   • This will cause the measurement in the measurement box to be pasted into the screen image. At this time, the pasted measurement text is selected.
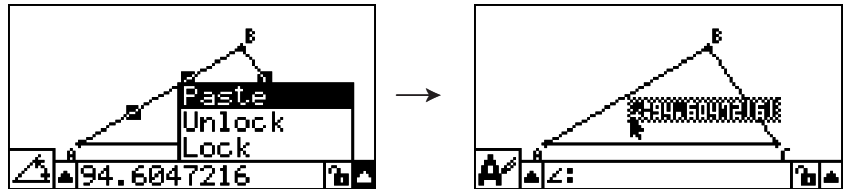
5. Move the text to another location on the screen, if you want.

   • Press X,θ,T and then use the cursor keys to move the pasted measurement around the screen. For details, see "To move an object" (page 2-20).
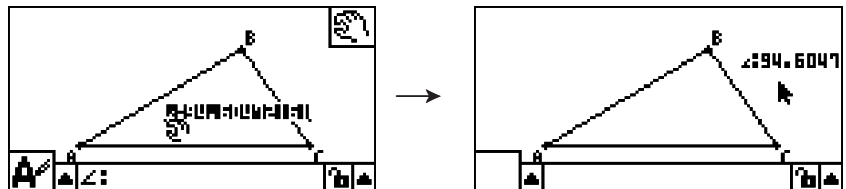
Note

You can also paste the measurement that is currently in the measurement box into the screen image by pressing SHIFT 9 (PASTE) while the measurement box is highlighted in step 2 of the above procedure.

Editing a Measurement Type Tag

When you paste a measurement into a screen image using the "To paste a measurement into a screen image" procedure on page 5-11, a measurement type tag (text or a symbol) is appended in front of the measurement value to indicate the measurement type.

Examples:	Length	Length:2.70
	Angle (Internal)	∠:94.60
	Angle (Supplementary)	∠:149.05

You can edit or delete the measurement type tag as required.

• To edit a measurement type tag

1. Select the measurement whose type tag you want to edit and then press [VARS].

   • This will display the measurement box and display the type tag of the selected measurement inside it.
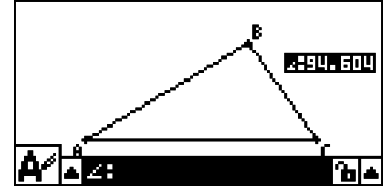
2. Press [EXE].

   • This will display the label edit dialog box.

3. Input up to 14 characters for the label type tag.

   • To delete the label type tag, press [AC/ON].

4. Press [EXE].

   • This changes the measurement, which is highlighted on the display.
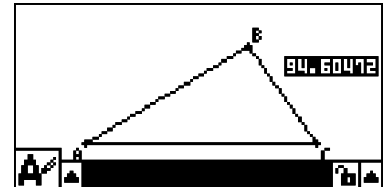
5. To close the measurement box, press [EXIT] twice.

Displaying the Result of a Calculation that Uses On-screen Measurement Values

You can use the procedure in this section to perform calculations using the angle value, line length, and other measurement values attached to an object, and display the result on the screen.

• **To display the result of a calculation that uses on-screen measurement values**

Example: With line segment AB and line segment CD (point C being on AB) drawn on the display as shown here, calculate the sum of ∠ACD and ∠DCB, and display the result on the screen. (54.72 + 125.28 = 180.00)

　　　• For information about displaying measurement values of ∠ACD and ∠DCB, see "Pasting Measurements into a Screen Image" (page 5-11).
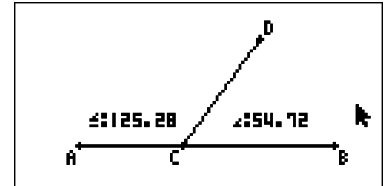
1. Perform the following operation: OPTN (Option) – 2:Expression.

　• This will display "EXPR=" at the pointer location and display the measurement box.

　• The above will also display labels for each measurement currently on the screen.
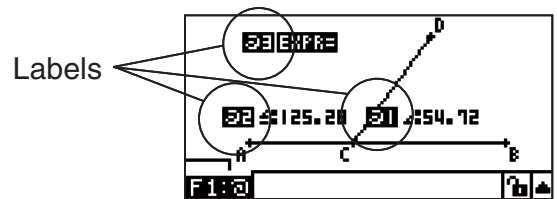
Labels

2. Now you can use the labels to specify measurement values in the calculation you input in the measurement box.

　• To input a measurement value in the measurement box, input the at sign (@) followed by the numeric label of the value: @1, @2, etc. Since we want to calculate the sum of angles DCB (@1) and ACD (@2) here, you would input the following: @1+@2.

　• You can input "@" by pressing F1.

3. After inputting the calculation expression, press EXE.

　• The calculation result is displayed to the right of "EXPR=".
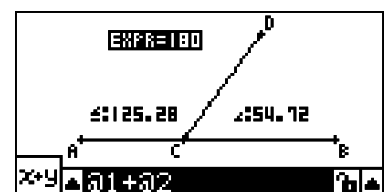
Note

When a measurement is a coordinate or vector component, the label format becomes, "@1X", "@1Y", etc. "@1X" indicates the *x*-value of a coordinate or the *x*-component value of a vector, while "@1Y" indicates the *y*-value of a coordinate or the *y*-component value of a vector.
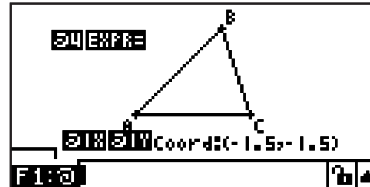
Specifying the Number Format of a Measurement

You can specify the number format for each measurement on the screen.

Note

The initial default number format is "Norm 1". For details about number formats, see "2-3 Specifying the Angle Unit and Display Format" in the manual that comes with the calculator.

• To specify the number format of a measurement

Example: To specify two decimal places for measurement values

1. Select the measurement whose number format you want to change.
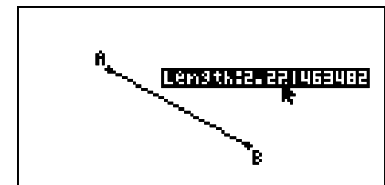
2. Perform the following operation: [OPTN] (Option) – 3:Number Format.

    • This displays the Number Format dialog box.

3. Move the highlighting to the number format you want. Since we want to specify two decimal places, we will select "Fix2" here.

4. Press [EXE].
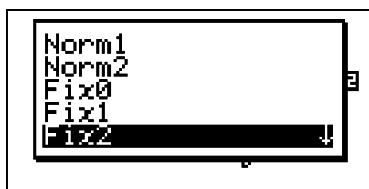
6. Working with Animations

An animation consists of one or more point/curve pairs, in which the curve can be a line segment, circle, or arc. You build an animation by selecting a point/curve pair and then adding it to an animation.

Creating and Running an Animation

• To add an animation and run it

Example: To animate a point around a circle

1. Plot a point and draw a circle, and select them.
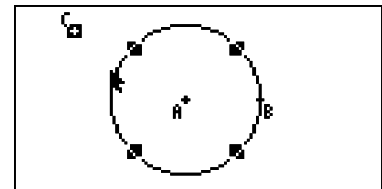
2. Perform the following operation: F6 (Animate) – 1:Add Animation.
   • This will add an animation effect that causes a point to move along the circumference of the circle.
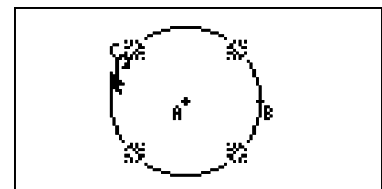
3. Perform either of the following operations: F6 (Animate) – 5:Go (once) or F6 (Animate) – 6:Go (repeat).
   • This cause the point to move along the circumference of the circle.
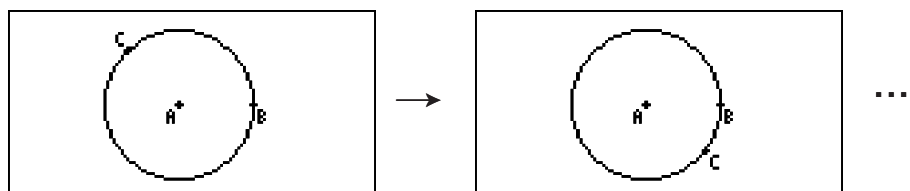
4. To stop the animation, press EXIT or AC/ON .

Note

• You can repeat the above procedure to create multiple points that move simultaneously.

Try this:

- Draw a line segment and plot another point.
- Select the line segment and the point.
- Repeat steps 2 and 3 above.

Notice that both animations go at the same time!

• To start a new animation, perform the procedure under "To replace the current animation with a new one" below.

• **To replace the current animation with a new one**

1. Select the point and curve for the new animation.

2. Perform the following operation: F6 (Animate) – 2:Replace Anima.

   • This discards the current animations and sets up an animation for a new point and curve set.

3. To execute the new animation, perform either of the following operations:
   F6 (Animate) – 5:Go (once) or F6 (Animate) – 6:Go (repeat)

4. To stop the animation, press EXIT or AC/ON .

• **To trace a locus of points**

Note

Using trace leaves a trail of points when the animation is run.

Example: To use the Trace command to draw a parabola

A parabola is the locus of points equidistant from a point (the focus) and a line (the directrix). Use the Trace command to draw a parabola using a line segment (AB) as the directrix and a point (C) as the focus.

1. Draw a line segment AB and plot point C, which is not on line segment AB.

2. Plot point D, which should also not be on line segment AB, but should be on the same side of the line segment as point C.

3. Draw a line segment that connects point D with point C.

4. Draw another line segment that connects point D with line segment AB. This is line segment DE.
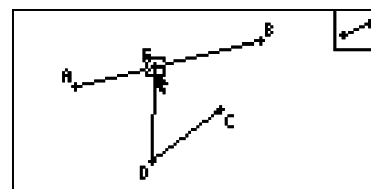
5. Select line segments AB and DE, and then press VARS .

   • This displays the measurement box, which shows the angle between line segments AB and DE.

6. Input 90 into the measurement box by pressing ⑨ ⓪ [EXE].

   • This makes the angle between line segments AB and DE 90 degrees, and locks it.
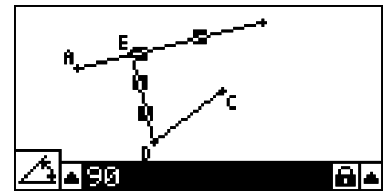
7. Press [EXIT] [AC/ON] to deselect all objects on the screen.

8. Select line segments DE and DC, and then press [VARS].
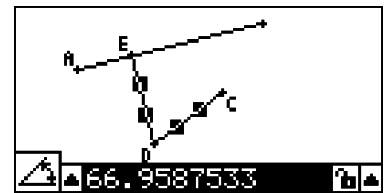
9. Press ◀ [EXE] to display the icon palette, move the highlighting to the ⚠ icon, and then press [EXE].
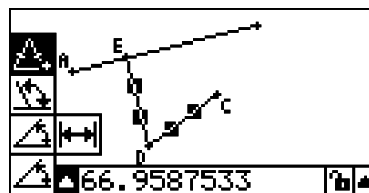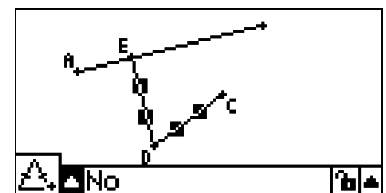
10. Use ▶ to move the highlighting to the 🔓 icon and then press [EXE].

    • This changes the icon to 🔒.

    • This makes line segments DE and DC congruent in length.
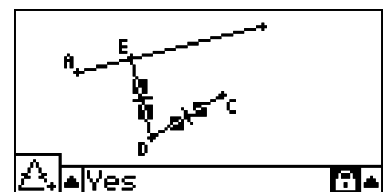
11. Press [EXIT] [EXIT] [AC/ON] and then select point E and line segment AB.

12. Perform the following operation: [F6](Animate) – 1:Add Animation.

13. Press [AC/ON] and then select point D.
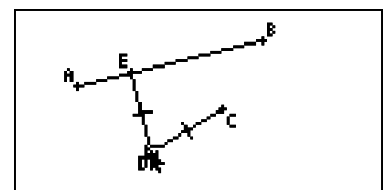
14. Perform the following operation: F6(Animate) – 3:Trace.

   • This specifies point D (the one you selected in step 13) as the "trace point".

15. Perform the following operation: F6(Animate) – 5:Go (once).

   • This should cause a parabola to be traced on the display. Note that line segment AB is the directrix and point C is the focus of the parabola.
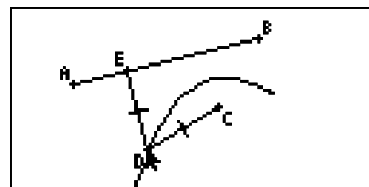
Note
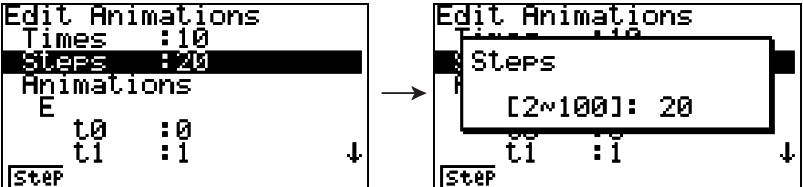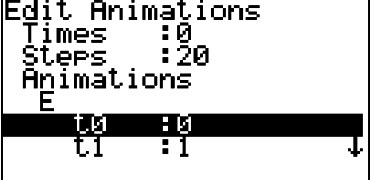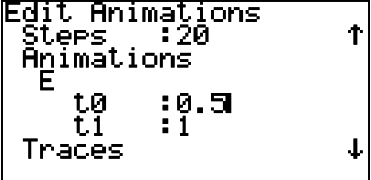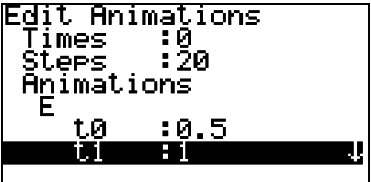
• All of the points that are currently selected on the screen become trace points when you perform the following operation: F6(Animate) – 3:Trace. This operation also cancels Trace for any point that is currently configured as a trace point.

• The calculator's auto power off feature will turn off power if an animation is being performed. If calculator power is turned off (either by auto power off or manually) while an animation is being performed, the animation will be stopped.
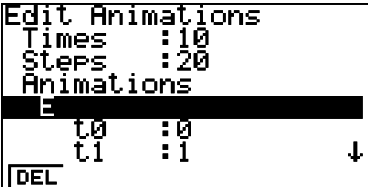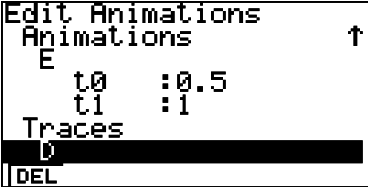
• **To edit an animation**

Example: While the animation screen created with the procedure under "To trace a locus of points", use the Edit Animations screen to edit the animation

1. While the animation screen you want to edit is on the display, perform the following operation: F6(Animate) – 4:Edit Animation.

   • This will display the Edit Animations screen.

2. Edit the animation using one of the procedures below.

When you want to do this:	Perform this procedure:
Specify how many times the animation should be executed when you perform the operation: F6(Animate) – 6:Go (repeat)	1. Use ▼ and ▲ to move the highlighting on the Edit Animations screen to "Times" and then press F1(Time). 2. On the dialog box that appears, input the number of repeats you want to specify and then press EXE. • Inputting 0 here will cause the animation to repeat until you press EXIT or AC/ON stop it.

When you want to do this:	Perform this procedure:
Specify the number of steps to be used as point E travels along line segment AB	1. Use ▼ and ▲ to move the highlighting on the Edit Animations screen to "Steps" and then press [F1](Step). 2. On the dialog box that appears, input an integer from 2 through 100 and then press [EXE].
Specify the start point and the end point of the movement of point E along line segment AB	1. Use ▼ and ▲ to move the highlighting on the Edit Animations screen to "t0", which is located just under the "E" of "Animations". 2. Input a number from 0 to 1. • t0 specifies the start point for point E movement along line segment AB. Inputting a value of 0 specifies point A as the start point, while a value of 1 specifies point B. Specifying 0.5 specifies the center of line segment AB. A value smaller than 0.5 shifts the start point towards point A, while a larger values shift towards point B. 3. After specifying a value for t0, press [EXE]. • This will highlight "t1". 4. Input a value from 0 to 1 and then press [EXE]. • t1 specifies the end point for point E movement along line segment AB. Inputting a value of 1 specifies point B as the end point, while a value of 0 specifies point A.

When you want to do this:	Perform this procedure:

Delete the animation assigned to point E	1. Use ▼ and ▲ to move the highlighting on the Edit Animations screen to "E", which is located under "Animations".
	
	``
	Edit Animations
	Times :10
	Steps :20
	Animations
	  E
	    t0 :0
	    t1 :1 ↓
	DEL
	``
	
	2. Press F1 (DEL).
	
	• This deletes the animation assigned to point E and causes "E" (along with the "t0" and "t1" values under it) to disappear from under "Animations" screen.
	
	Note
	
	Selecting "Animations" in step 1 and then pressing F1 (DEL) will delete the animations assigned to all points.

Turn off trace for point D	1. Use ▼ and ▲ to move the highlighting on the Edit Animations screen to "D" under "Traces".
	
	``
	Edit Animations
	Animations ↑
	  E
	    t0 :0.5
	    t1 :1
	Traces
	  D
	DEL
	``
	
	2. Press F1 (DEL).
	
	• This turns off trace for point D and causes "D" to disappear from under "Traces".
	
	Note
	
	Selecting "Traces" in step 1 and then pressing F1 (DEL) will turn off trace for all points.

3. After all the settings are the way you want, press EXIT.

• This will close the Edit Animations screen.

Generating an Animation Table

Under default settings, an animation causes a specified point to move along a specified line segment, circle, or arc in 20 steps. You can configure the calculator to generate a table, called an "animation table", which records the coordinates of each step, the length of the line segment, the area of the object, etc.

Any of the following data can be added to the animation table: coordinates (x, y), distance/ length, slope, radius, circumference, perimeter, area, angle, supplementary angle, vector segments (x, y), and expression.

• To add columns to the animation table

Example: Draw the triangle CDE with a base parallel to and a vertex (point D) located on horizontal line AB. Next, generate an animation table that includes the length of line segment CD and the area of the triangle as point D moves along line segment AB.
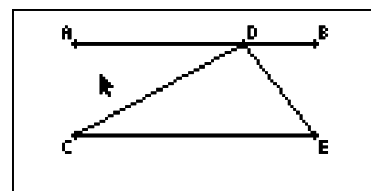
1. Draw line segment AB and triangle CDE.
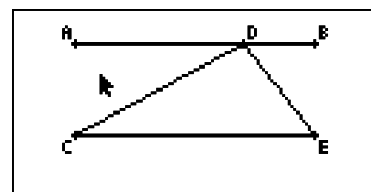
2. Select line segment AB and point D, and then perform the following operation:
   [F6] (Animate) – 1:Add Animation.

   • This will add an animation effect that causes point D to move along line segment AB.

3. Here we will generate an animation table for the length of line segment CD, so first select line segment CD.

4. Press [VARS] to display the measurement box.
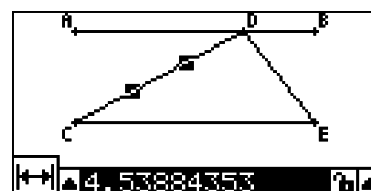
• If the ⊬ icon does not appear on the left edge of the screen, highlight the up arrow to the left of the measurement box and then press [EXE]. On the icon palette that appears, select the ⊬ icon.

5. Press ▷ to highlight the up arrow button on the right side of the measurement box and then press EXE.

   • This will display a menu.

6. Use ▲ to move the highlighting to [Add Table] and then press EXE.

   • This will display an animation table that shows the length of line segment CD at each step of the animation in a column labeled "Length".

7. Press EXIT to close the animation table screen.
8. Press EXIT again to make the drawing screen active.
9. Select sides CD, DE, and CE of the triangle.
10. Press VARS to display the measurement box.
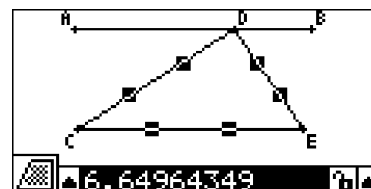
   • If the ▨ icon does not appear on the left edge of the screen, highlight the up arrow to the left of the measurement box and then press EXE. On the icon palette that appears, select the ▨ icon.

11. Perform steps 5 through 6 above.

   • Now when the animation table appears, it will include the "Length" column we created in step 6, long with a new "Area" column, which contains the area of triangle CDE at each step of the animation.

   • As can be seen here, the area of triangle CDE does not change as point D moves along line segment AB, which is parallel to the base (CE) of the triangle.

12. To exit the animation table screen, press [EXIT].

13. To close the measurement box, press [EXIT] twice.

Note

• You can add up to 26 columns to the animation table.

• In place of steps 4 through 6 in the above procedure, you can use either of the following operations to add a column to the animation table: [F6](Animate) – 7:Add Table or [SHIFT] [1].

• To display the animation table

To display the animation table you generated with the procedure under "To add columns to an animation table", perform the following operation: [F6](Animate) – 8:Display Table.

• To save an animation table column to a list

1. Display the animation table.

2. Use ◀ and ▶ to move the highlighting to the column you want to save as list data.

3. Press [F1](STO)[F1](LIST).

   • This displays a dialog box for specifying the number of the list where you want to save the column.

4. Input the list number as an integer from 1 to 26 and then press [EXE].

   • For details about list data, see "Chapter 3 List Function" in the manual that comes with the calculator.

• To save an entire animation table as spreadsheet data

1. Display the animation table.

2. Press [F1](STO)[F2](S-SHT).

   • This displays a dialog box for inputting the spreadsheet file name.
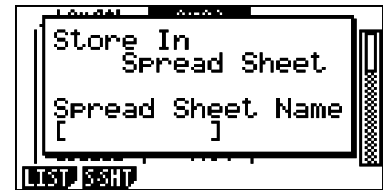
3. Input up to 8 characters for the file name and then press [EXE].

   • For details about spreadsheet data, see "Chapter 9 Spreadsheet" in the manual that comes with the calculator.

• To delete a particular column from an animation table

1. Display the animation table.
2. Use ◀ and ▶ to move the highlighting to the column you want to delete.
3. Press [F2](DEL)[F1](DEL).

• To delete all of the columns from an animation table

1. Display the animation table.
2. Press [F2](DEL)[F2](DEL-A).

   • This causes a confirmation dialog box to appear.
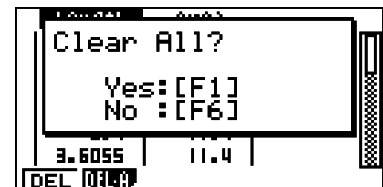
3. Press [F1](Yes) to delete the selected file or [F6](No) to cancel the delete operation.

7. Error Messages

Attempting to perform some inappropriate operation in the Geometry Mode will cause one of the error messages described below to appear. Use this table as a reference to find out what you need to do when an error message appears.

When you see this message:	It means this:	So you need to do this:
First select a segment.	You are attempting to construct a perpendicular bisector without first selecting a line segment.	Select the required object(s) and then try again.
First select a line and point.	You are attempting to construct a perpendicular or parallel without first selecting a line segment and point.	
First select 2 points or a segment.	You are trying to construct a midpoint without first selecting two points or a line segment.	
First select the applicable figure.	• You are trying to construct a point of intersection without first selecting two lines. • You are trying to execute an Add Animation or Replace Animation command without first selecting the required object. • You are trying to execute an Add Table command without first selecting the required object.	
First select 2 segments.	You are trying to construct an angle bisector without first selecting two line segments.	
Too Many Objects! Work memory cleared.	Work memory became full.	Delete objects you no longer need or open a new file.
Invalid Measurement	You are attempting to use the Expression command to input an expression that contains a measurement that does not exist.	Check to make sure that the expression you are inputting contains only measurements that are currently on the screen.

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When you see this message:	It means this:	So you need to do this:
Range ERROR	View Window settings are wrong.	Configure proper settings or initialize View Window settings by pressing [F1](INIT)[EXIT].
	The Edit Animations screen is configured with the setting t0=t1.	Configure the Edit Animations screen so t0 and t1 are assigned different values for the same animation.
Too Many Animations	You are trying to add more than 10 animations.	Use the Edit Animations screen to delete animations you no longer need, or create a new file and add new animations.
First select point(s).	You are trying to execute the Trace command without first specifying a trace point.	Specify the trace point and try again.
Too Many Trace Points	You are trying to specify more than 10 trace points.	Select only up to 10 trace points.
Too Many Rows	You are trying to add more than 26 columns to an animation table.	Delete columns from the animation table that you do not need and try again.
First configure animation settings.	• You are trying to run an animation without first configuring its settings. • You are trying to execute an Add Table command without first configuring animation settings.	Configure animation settings and try again.
Cannot Add Animation	• The point you selected for an Add Animation or Replace Animation command operation cannot be used in an animation because it is locked, etc. • The point you selected for an Add Animation or Replace Animation command operation cannot be used in an animation because it is already being used in the animation you are configuring or in another animation.	Select a point to which animation can be added and try again.

When you see this message:	It means this:	So you need to do this:
Select the applicable measurement icon.	You are trying to execute the Add Table command without first selecting the appropriate measurement icon.	Select the icon of a measurement that can be added to an animation table.
First configure animation settings and create a table.	You tried to execute the Display Table command without generating an animation table.	Generate an animation table first.

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