Review of Technical Skills

PART 1 USING THE TI-83 PLUS/TI-84 PLUS GRAPHING CALCULATOR

B–1 Evaluating Powers and Roots

1. **Evaluate the power $(5.3)^2$.**
   Press `5` `.` `3` `x²` `ENTER`.

2. **Evaluate the power $(7.5)^5$.**
   Press `7` `.` `5` `^` `5` `ENTER`.

3. **Evaluate the power $8^{\frac{-2}{3}}$.**
   Press `8` `^` `(` `(-)` `2` `÷` `3` `)` `ENTER`.

4. **Evaluate the square root of 46.1.**
   Press `2nd` `x²` `4` `6` `.` `1` `)` `ENTER`.

5. **Evaluate $\sqrt[4]{256}$.**
   Press `4` `MATH` `5` `2` `5` `6` `ENTER`.
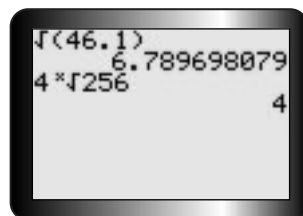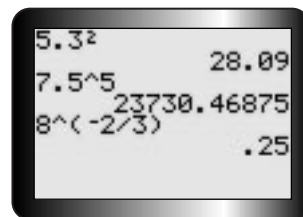
B–2 Preparing the Calculator for Graphing

Before you graph any function, be sure to clear any information left on the calculator from the last time it was used. You should always do the following:

1. **Clear all data in the lists.**
   Press `2nd` `+` `4` `ENTER`.

2. **Turn off all stat plots.**
   Press `2nd` `Y=` `4` `ENTER`.

3. **Clear all equations in the equation editor.**
   Press `Y=`, then press `CLEAR` for each equation.
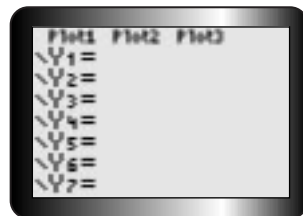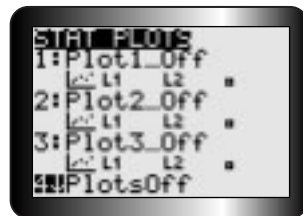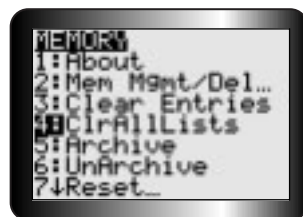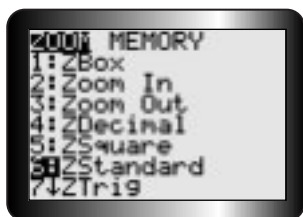
4. Set the window so that the axes range from -10 to 10.
Press ZOOM 6 . Press WINDOW to verify.

Note: It is possible to completely reset the calculator's memory and settings. This procedure removes all data and programs stored in the calculator, so be cautious.
Press 2nd + 7 1 2 .

B–3 Entering and Graphing Relations

Enter the equation of the function into the equation editor. The calculator will display the graph.
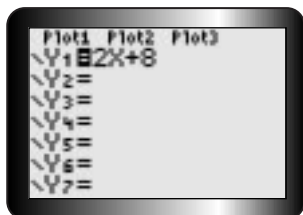
1. Enter an equation.
To enter $y = 2x + 8$, press Y= 2 X,T,θ,n + 8 . The equation will be displayed as shown.

2. Enter all linear equations in the form $y = mx + b$.
For example, enter $-2x + y = 8$ in the form $y = 2x + 8$, as shown. If m or b is a fraction, enter it between brackets.
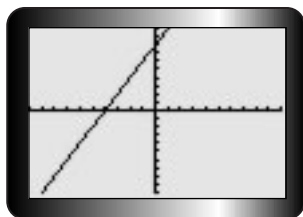
3. Press GRAPH to view the graph.

4. Resize the window using ZoomFit.
If the graph does not fit the window or is not visible in the window, the **ZoomFit** operation will automatically resize the window to show the graph.
Press ZOOM 0 .
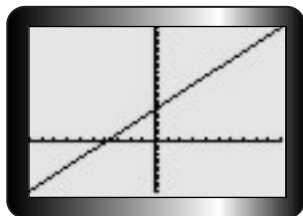
B–4 Evaluating a Relation

Sometimes you want the calculator to determine the value of a relation for a given value of the x-variable. For example, suppose you want it to determine the value of y in the relation $y = 2x + 8$ when $x = -1$.

1. **Enter the relation into the equation editor.**
   To enter $y = 2x + 8$, press [Y=] [2] [X,T,θ,n] [+] [8]. The equation will be displayed as shown.
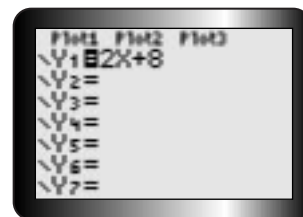
2. **Press the [TRACE] key.**
   [TRACE] shows you the coordinates of points on the graph of the relation. Use the left and right arrow keys to move the point along the graph.
   [TRACE] can only provide an approximate value based on the scale of the graph.
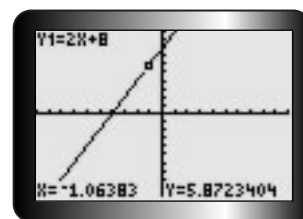
3. **Obtain exact values using the value operation.**
   Press [2nd] [TRACE] [1].
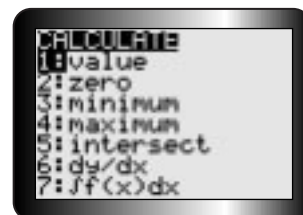
   Then press [(-)] [1].
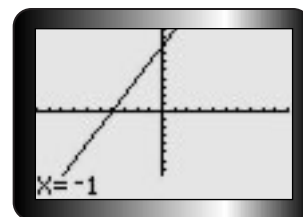
   Press [ENTER]. The calculator displays the graph with the value of y that corresponds to $x = -1$.
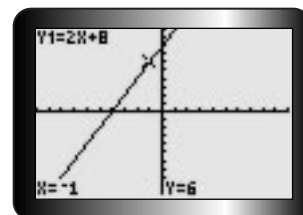
B–5 Changing Window Settings

The window settings can be changed to show a graph for a given range of values for x and y.
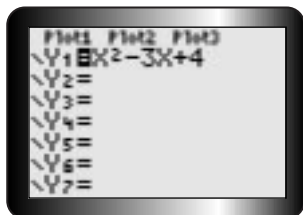
1. **Enter the relation $y = x^2 - 3x + 4$ in the equation editor.**

   To enter $y = x^2 - 3x + 4$, press [Y=] [X,T,θ,n] [x²] [−] [3] [X,T,θ,n] [+] [4].
   The equation will be displayed as shown.
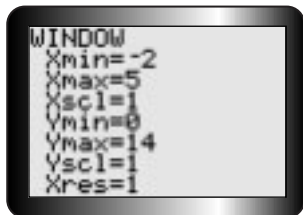
2. **Use the [WINDOW] function to set the graph window limits for x and y.**

   To display the graph for x between -2 and 5 and y between 0 and 14, press
   [WINDOW] [(-)] [2] [ENTER], then [5] [ENTER] [ENTER], then [0] [ENTER], then [1] [4] [ENTER].
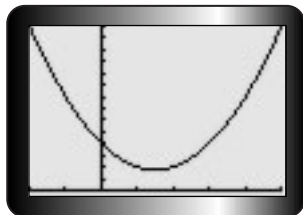
3. **Press [GRAPH] to show the relation with these settings.**

B–6 Showing a Table of Values for a Relation

The calculator can display a table of values for a relation such as $y = 2x + 8$.
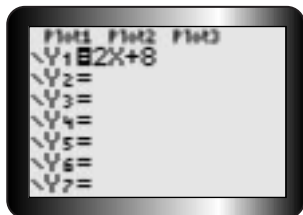
1. **Enter the relation into the equation editor.**

2. **Set the start point and step size for the table.**

   Press [2nd] [WINDOW]. The cursor is at **TblStart=**. To start at $x = -5$, press [(-)]
   [5] [ENTER]. The cursor is now at **ΔTbl=** (Δ, the Greek capital letter delta,
   stands for "change in"). To increase the x-value in steps of 1, Press [1] [ENTER].

3. **To view the table, press** 2nd GRAPH **.**

Use ▲ and ▼ to move up and down the table. Notice that you can look at higher or lower *x*-values than the original range.

B–7   Making a Difference Table for a Relation

To create a table with the first and second differences for a relation, use the STAT lists.

1. **Press** STAT 1 **and enter the *x*-values into L1.**

   For the relation $y = 2x + 8$, use *x*-values from -5 to 5. Enter -5 by pressing (-) 5 ENTER. Then enter $-4, -3, -2, \dots, 4, 5$ in the same way.

2. **Enter the relation.**

   Scroll right and up to select **L2**. Enter the relation using **L1** to represent the variable *x*.
   Press 2 × 2nd 1 + 8 .

3. **Press** ENTER **to display the values of the relation in L2.**

4. **Find the first differences.**

   Scroll right and up to select **L3**. Then press 2nd STAT. Scroll right to **OPS** and press 7 to choose **ΔList(**.

   Enter **L2** by pressing 2nd 2) .
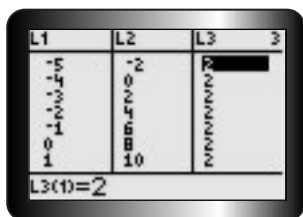
Press **ENTER** to see the first differences displayed in **L3**.

B–8 Determining the Points of Intersection of Two Relations
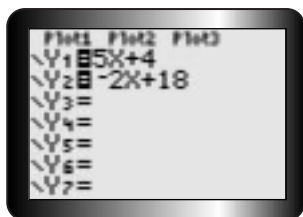
1. **Enter two relations into the equation editor.**
   This example uses $y = 5x + 4$ and $y = -2x + 18$.
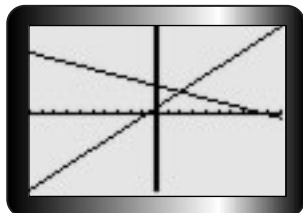
2. **Graph both relations.**
   Press **GRAPH**. Adjust the window settings until the point(s) of intersection are displayed.
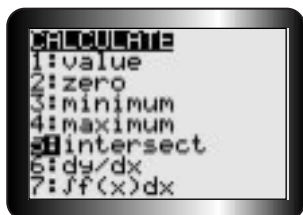
3. **Use the intersect operation.**
   Press **2nd** **TRACE** **5**.
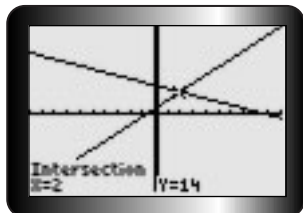
4. **Determine a point of intersection.**
   You will be asked to verify the two curves and enter an optional estimate for the intersection point. Press **ENTER** after each screen appears.
   The point of intersection is exactly (2, 14).

B–9   Creating a Scatter Plot from Data

This table gives the height of a baseball above ground level, from the time it was hit to the time it touched the ground.

Time (s)	0	1	2	3	4	5	6
Height (m)	2	27	42	48	43	29	5

Create a scatter plot of the data.

1. **Enter the data into STAT lists.**
   To start, press STAT ENTER. Move the cursor to the first position in **L1** and enter the time values. Press ENTER after each value. Repeat this for the heights in **L2**.

2. **Create a scatter plot.**
   Press 2nd Y= and 1. Turn on **Plot 1** by making sure that the cursor is over **On**, the **Type** is set to the scatter plot graph type, and **L1** and **L2** appear after **Xlist** and **Ylist**, respectively.

3. **Display the graph.**
   Press ZOOM 9 to activate **ZoomStat**.
   This displays the scatter plot.
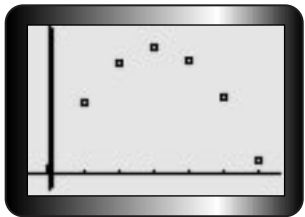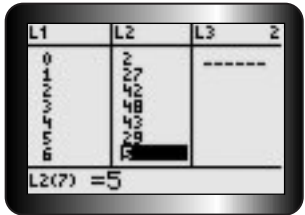
PART 2 USING THE GEOMETER'S SKETCHPAD

B–10 Defining the Tool Buttons and Sketchpad Terminology

Sketches and Dynamic Geometry

Your ability to change objects dynamically is the most important feature of *The Geometer's Sketchpad*. Once you have created an object, you can move it, rotate it, dilate it, reflect it, hide it, and change its label, colour, shade, or line thickness. No matter what changes you make, *The Geometer's Sketchpad* maintains the mathematical relationships between the object and the other objects to which it is related. This is the principle of dynamic geometry. It is the basis of the power and usefulness of *The Geometer's Sketchpad*.
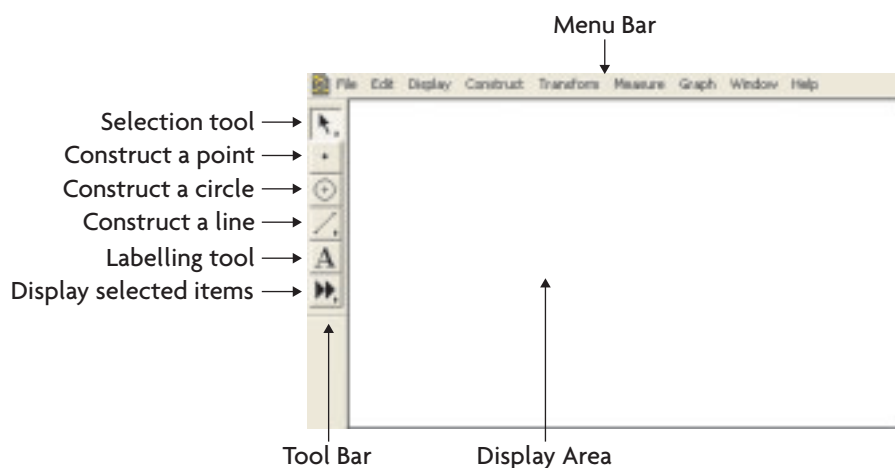
Sketchpad Terminology

Selecting means to move the mouse pointer to the desired location and click the mouse button (left-click for Windows users).

Deselecting means to select the selection tool and click anywhere in the display area away from any figures you have drawn.

Dragging means to move the mouse pointer to the point or figure you would like to move. Click on the point or figure and, while holding down the mouse button, move it to a new location. Release the mouse button when the point or figure is in the desired position.

B–11 Selections on the Construct Menu

| Command	What it constructs:	What you must select:
Point On Object	A point on the selected object(s)	One or more segments, rays, lines, or circles
Point At Intersection	A point where two objects intersect	Two straight objects, two circles, or a straight object and a circle
Point At Midpoint	The midpoint of the segment(s)	One or more segments
Segment/Ray/Line	The segment(s), ray(s), or line(s) defined by the points	Two or more points
Perpendicular Line	The line(s) through the selected point(s) and perpendicular to the selected straight object(s)	One point and one or more straight objects, or one straight object and one or more points
Parallel Line	The line(s) through the selected point(s) and parallel to the selected straight object(s)	One point and one or more straight objects, or one straight object and one or more points
Angle Bisector	The ray that bisects the angle defined by three points	Three points (select the vertex second)
Circle By Centre And Point	The circle with the given centre and passing through the given point	Two points (select the centre first)
Circle By Centre And Radius	The circle with the given centre and with a radius equal to the length of the given segment	A point and a segment
Arc By Three Points	The arc passing through the three given points	Three points
Arc On Circle	The arc on a circle extending counterclockwise from the first point to the second	A circle and two points on the circle's circumference
Polygon Interior	The polygon interior defined by using the given points as its vertices	Three or more points
Circle Interior	The interior of a circle	One or more circles
Sector Interior	The interior of an arc sector	One or more arcs
Arc Segment Interior	The interior of an arc segment	One or more arcs
Locus	The locus of an object	One geometric object and one point constructed to lie on a path

B–12 Graphing a Relation on a Cartesian Coordinate System
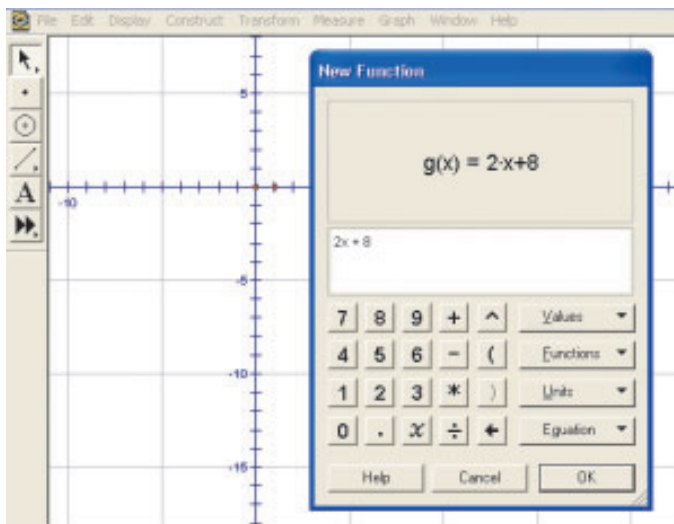
You can graph relations on a Cartesian coordinate system in *The Geometer's Sketchpad*. For example, use the following steps to graph the relation $y = 2x + 8$.

1. **Turn on the grid.**
   From the **Graph** menu, choose **Show Grid**.

2. **Enter the relation.**
   From the **Graph** menu, choose **Plot New Function**. The **New Function** calculator should appear. Use either the calculator keypad or the keyboard to enter "2 * x + 8".
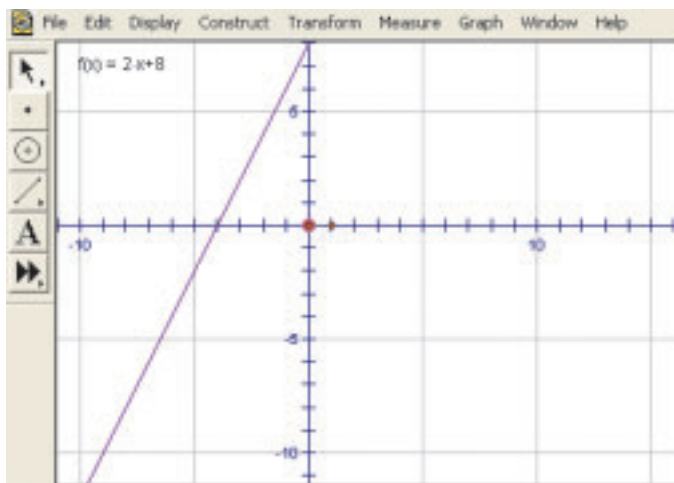
3. **Graph the relation $y = 2x + 8$.**
   Press **OK** on the calculator keypad. The graph of $y = 2x + 8$ should appear on the grid.

4. Adjust the origin and/or scale.
To adjust the origin, click on the point at the origin to select it. Then click and drag the origin as desired. To adjust the scale, click in blank space to deselect, then click on the point at (1, 0) to select it. Click and drag this point to change the scale.
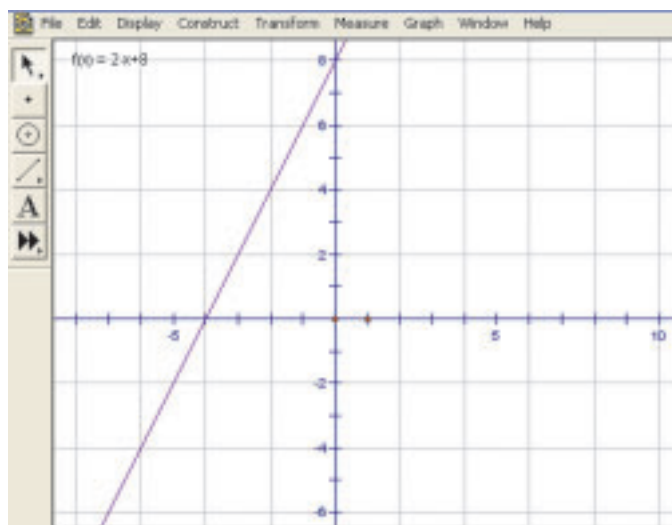
B–13 Placing Points on a Cartesian Coordinate System: Plot Points

Sometimes, you want to plot points without graphing a relation. For example, suppose you want to plot (2, 1), (3, 5), and (–2, 0).

1. Turn on the grid.

2. Enter the coordinates of a point.
From the **Graph** menu, select **Plot Points …**. For each point you want to plot, enter the *x*-coordinate followed by the *y*-coordinate. Use the Tab key to move from one coordinate entry space to the next. Press the Enter key when you have entered both coordinates of a point. *The Geometer's Sketchpad* allows you to continue entering point coordinates until you click **Done**.
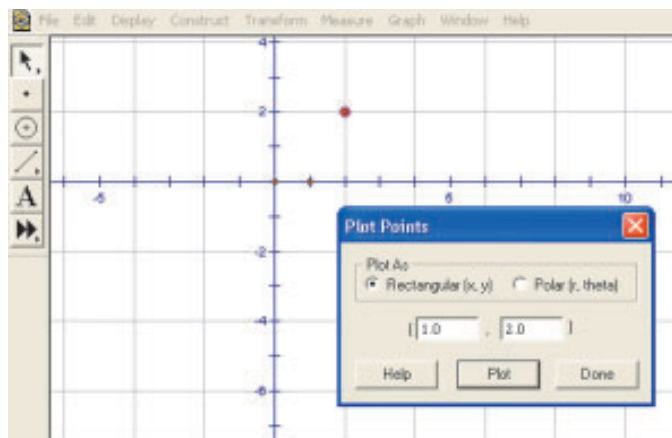
B–14 Placing Points on a Cartesian Coordinate System: The Point Tool
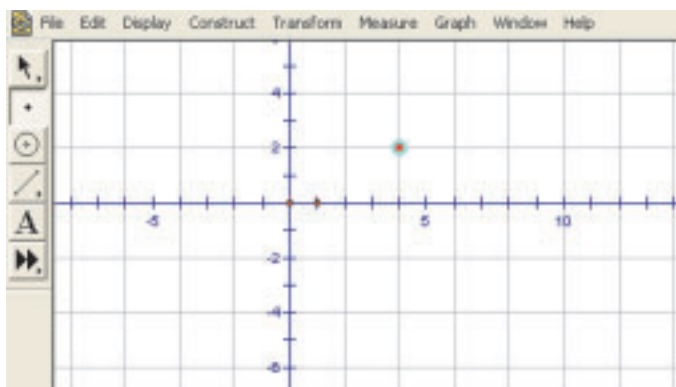
Sometimes, you want to plot points without graphing a relation. For example, suppose you want to plot (4, 2).

1. **Turn on the grid.**

2. **Select the Point Tool.**
   The selection arrow will now look like a dot to indicate that when you click on the grid, a point will be placed at the location you clicked.

B–15 Determining the Coordinates of a Point
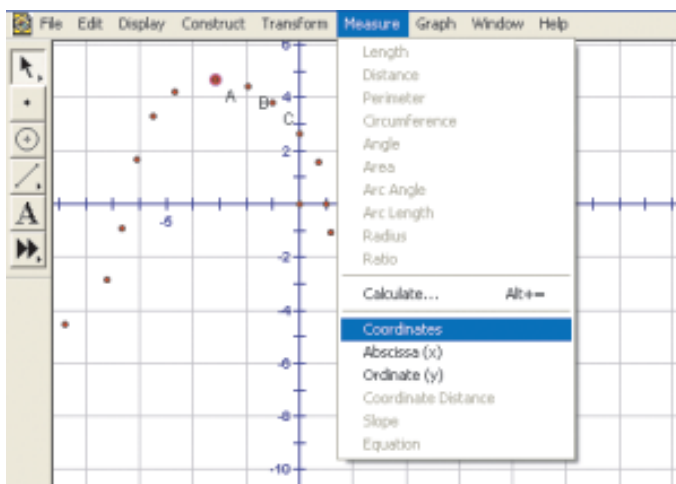
1. **Turn on the grid.**

2. **Plot some points on the grid.**

3. **Use the Selection Tool to select a point.**

4. **From the Measure menu, select Coordinates.**
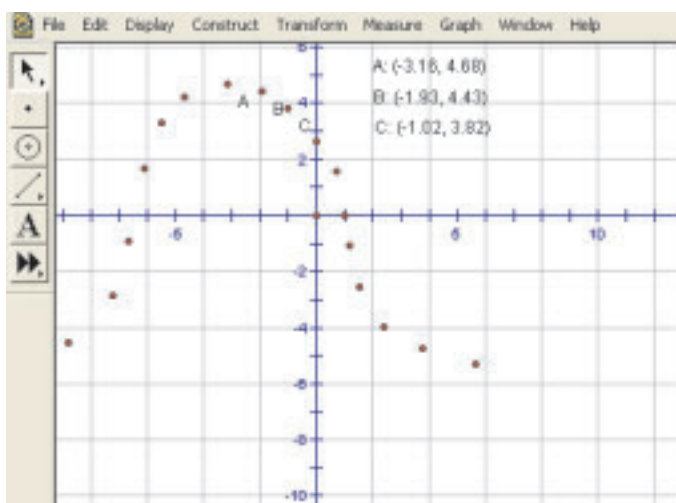
The coordinates of the selected point(s) will be displayed.

B–16 Constructing a Line, Segment, or Ray Through a Given Point

1. **Turn the grid on.**

2. **Plot the point you want the line to pass through.**

3. **Plot a second point anywhere on the grid.**

4. **Shift-click to make sure both points are selected.**

   If you are constructing a ray, make sure the point from which the ray begins is selected first.

5. **From the Construct menu, select Line (or Segment or Ray).**
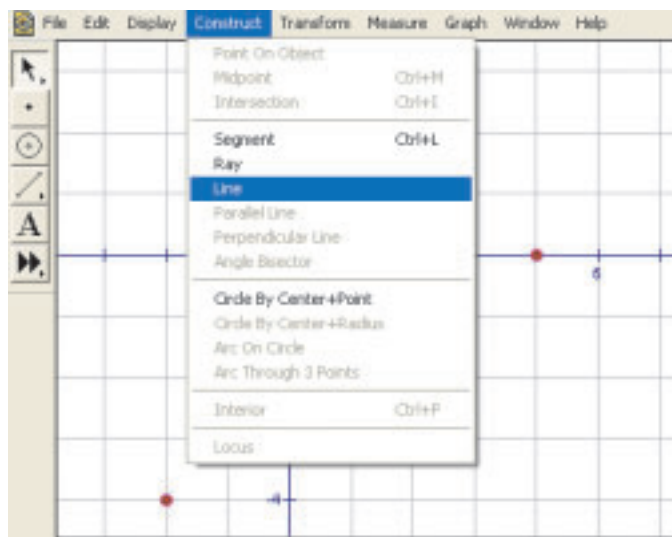
B–17 Constructing and Labelling a Point on a Line, Segment, or Ray

1. **Turn the grid on.**

2. **Draw a line (or segment or ray).**

3. **Select the line by clicking on it.**

4. **From the Construct menu, select Point On Line.**
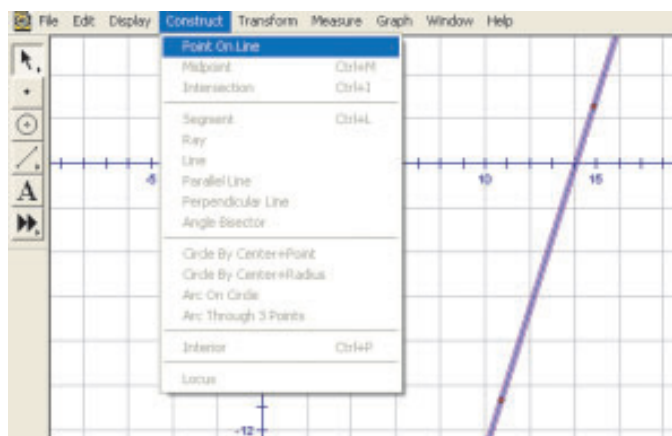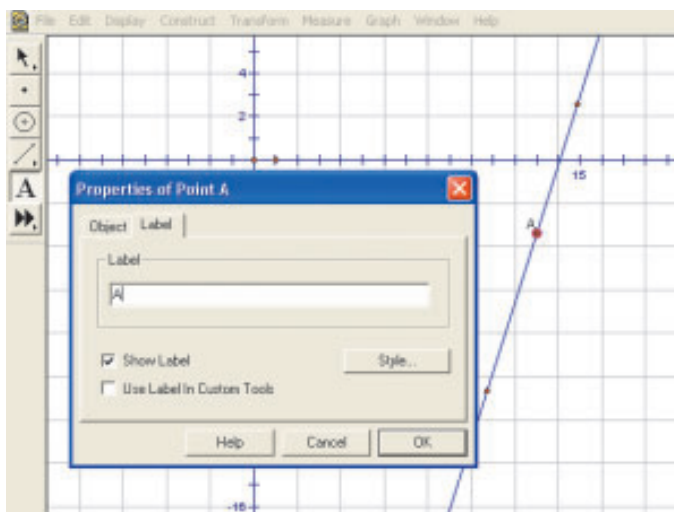
5. Select the Label Tool. Use it to double click on the point you constructed.

A label will appear beside the point, as well as a Properties box for the point. You can change the label of the point by changing the contents of the label entry in the Properties box.

B–18 Determining the Slope and Equation of a Line
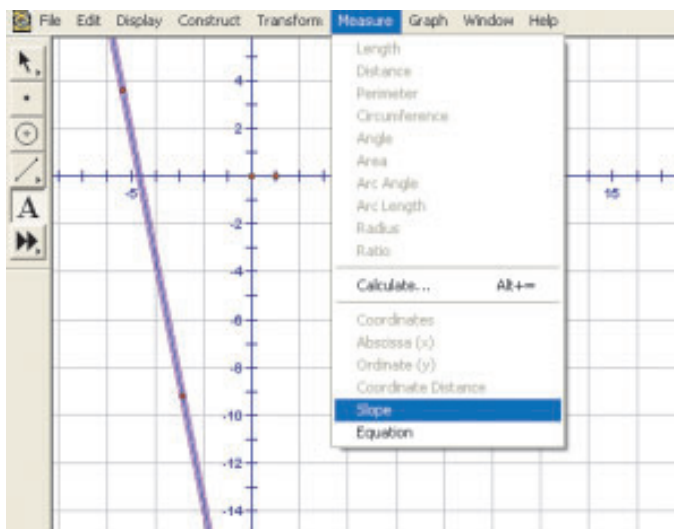
1. Turn the grid on.

2. Draw a line.

3. Use the Selection Tool to select the line.

4. From the Measure menu, select Slope or Equation.

B–19   Moving a Line

1. **Turn the grid on.**

2. **Draw a line.**

3. **Copy the line by clicking Copy and then Paste from the Edit menu.**

4. **To keep the new line parallel to the original line:**
   Use the Selection Tool to click and hold only the line. Hold the mouse button down while you move the mouse. The line will move parallel to the original.
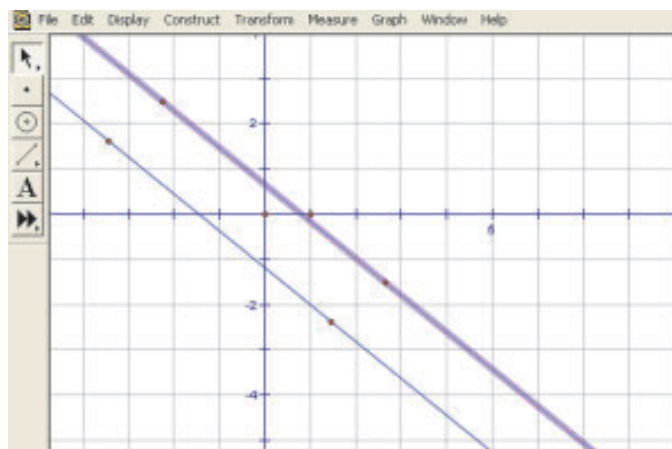
5. **To move the new line so that one point stays in the same position:**
   Use the Selection Tool to select a point on the line other than the one that is to stay in the same position. Hold the mouse button down while you move the mouse. The line will move as the mouse moves, but the original point will stay fixed.
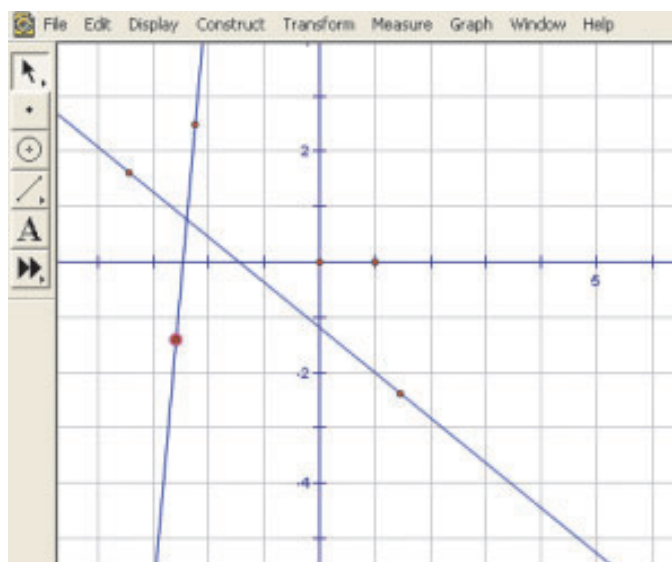
B–20 Constructing a Triangle and Labelling Vertices
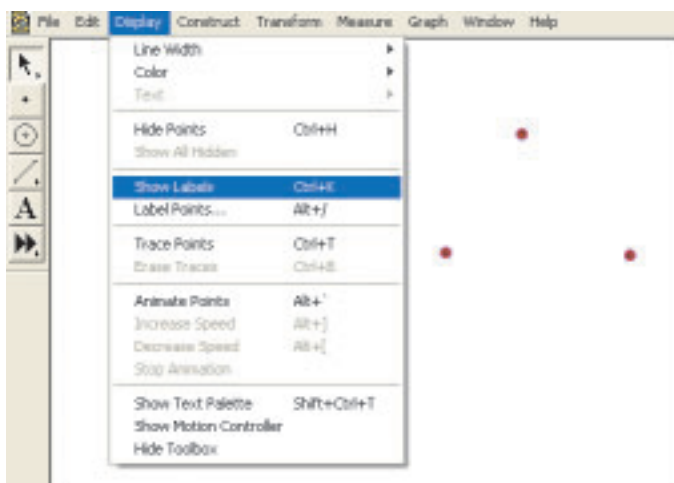
1. **Open a new sketch.**

2. **Use the Point Tool to place three points.**
   If you hold the Shift key down while you place the points, all of the points will remain selected as you place them.

3. **From the Display menu, select Show Labels.**
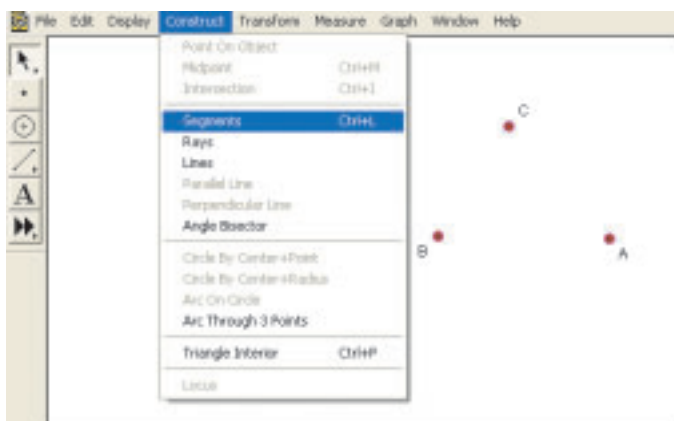
4. **From the Construct menu, select Segments.**
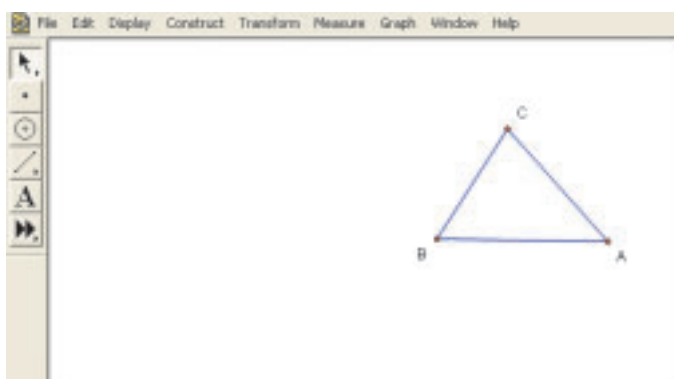
5. **The three triangle sides will be displayed.**

B–21 Measuring Interior Angles in a Triangle

1. **Open a new sketch and draw a triangle with vertex labels displayed.**

2. **Shift-click to select the vertices that form an angle.**
   To measure $\angle ABC$, select vertex A, then vertex B, and then vertex C.

3. **From the Measure menu, select Angle.**
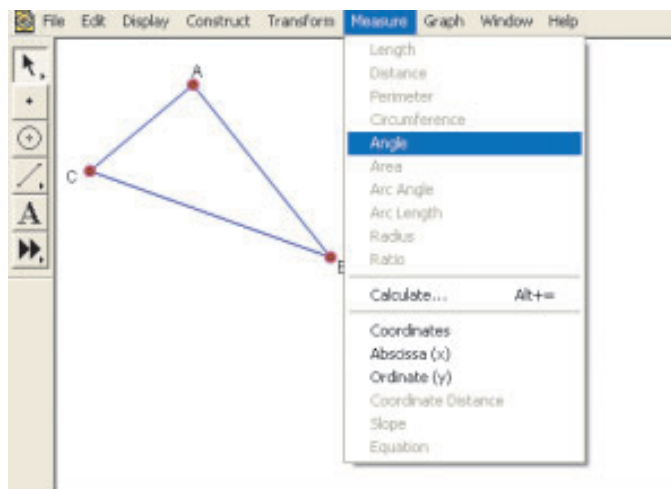
4. **Repeat for each angle.**
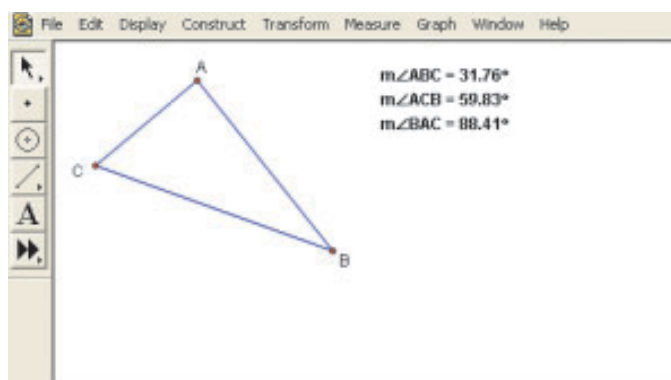
B–22 Constructing and Measuring an Exterior Angle of a Triangle

1. **Open a new sketch and draw a triangle with vertex labels displayed.**

2. **Select two vertices. From the Construct menu, select Ray.**
   This extends one side of the triangle to form an exterior angle.
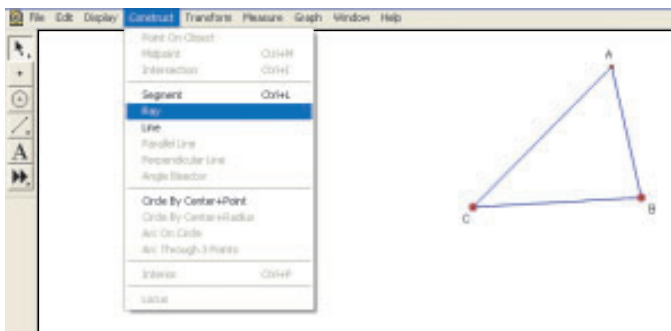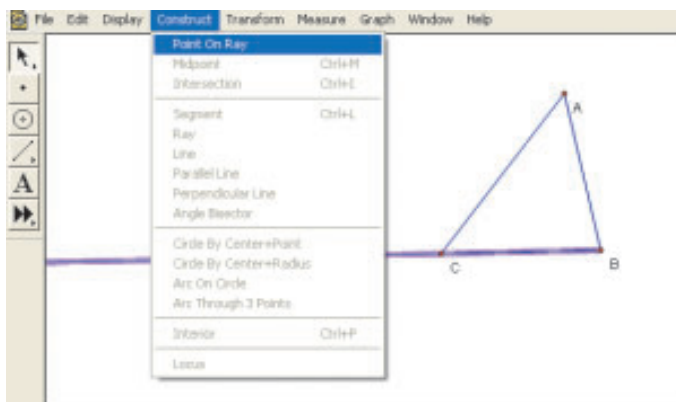
3. While the ray is selected, from the Construct menu, select Point On Ray.
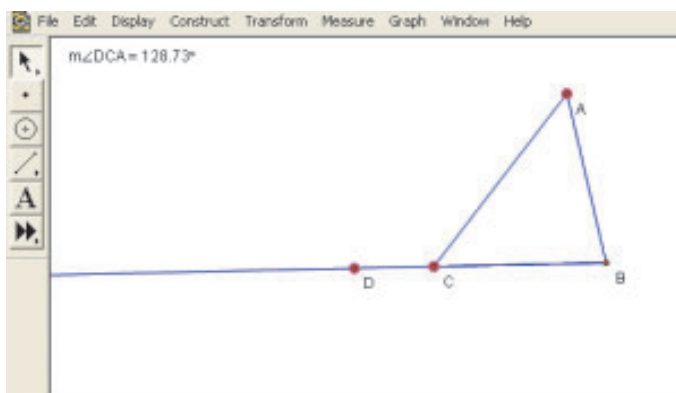
4. Drag the point so that it is outside the triangle. Display the label for the point.

5. Select the point, then the vertex for the angle, and then the final vertex. From the Measure menu, select Angle.

B–23   Determining the Sum of the Interior Angles of a Triangle
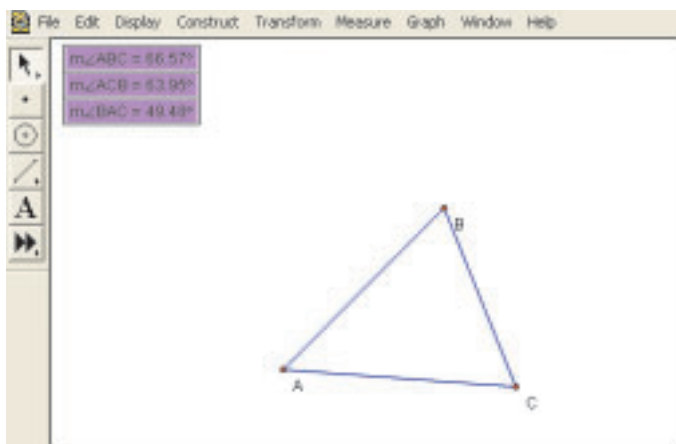
1. **Open a new sketch and draw a labelled triangle.**
   Measure all three interior angles.
   Shift-click to select all three angle measures.

2. **From the Measure menu, select Calculate.**
A New Calculation window will appear.

3. **Use the Values pop-up menu to create the formula for the sum of the selected angles.**
Choose an angle from the Values pop-up, then enter "+" and continue entering addends until the formula is complete.
Click **OK** when you are finished.

B–24   Measuring the Length of a Line Segment

1. **Open a new sketch and draw a line segment.**

2. **While the line segment is selected, choose Length from the Measure menu.**

3. The length will be displayed.

m $\overline{AB}$ = 3.45 cm

A

B

B–25   Constructing the Midpoint of a Line Segment
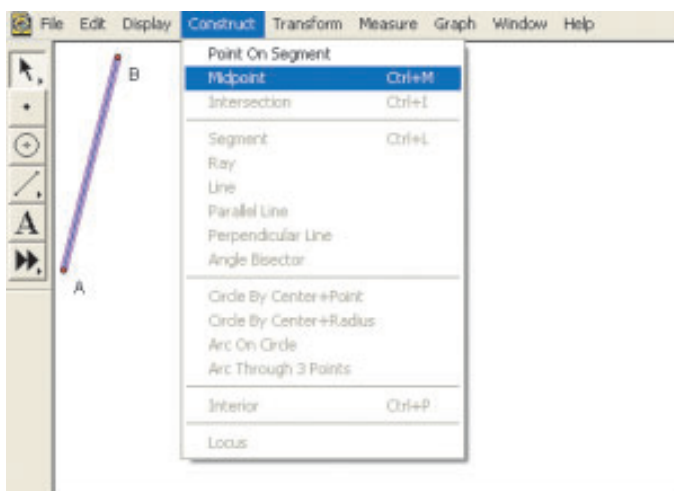
1. Open a new sketch and draw a line segment.

2. With the line segment selected, choose Midpoint from the Construct menu.

File Edit Display Construct Transform Measure Graph Window Help

Point On Segment
Midpoint   Ctrl+M
Intersection   Ctrl+I

Segment   Ctrl+L
Ray
Line
Parallel Line
Perpendicular Line
Angle Bisector

Circle By Center+Point
Circle By Center+Radius
Arc On Circle
Arc Through 3 Points

Interior   Ctrl+P

Locus

B

A
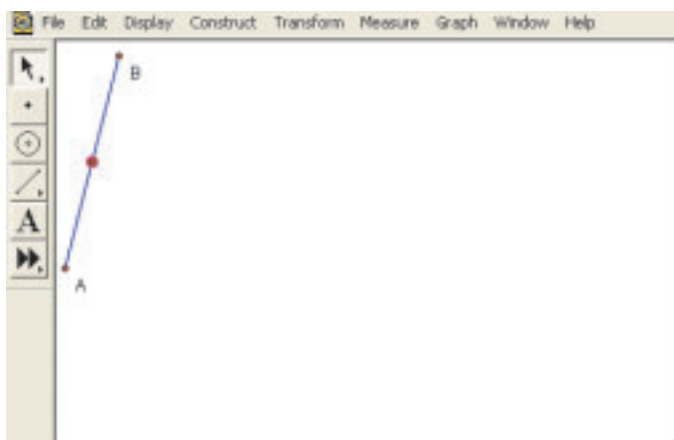
3. The midpoint will be displayed.

B

A

B–26   Constructing the Perpendicular Bisector of a Line Segment

1. **Open a new sketch and draw a line segment.**

2. **With the line segment selected, choose Midpoint from the Construct menu.**

3. **Select the segment and the midpoint.**

4. **From the Construct menu, choose Perpendicular Line.**
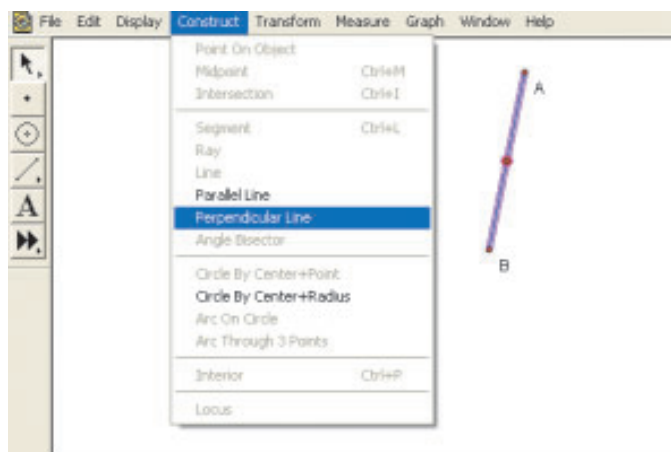
5. **The perpendicular bisector will be displayed as a line through the selected point.**
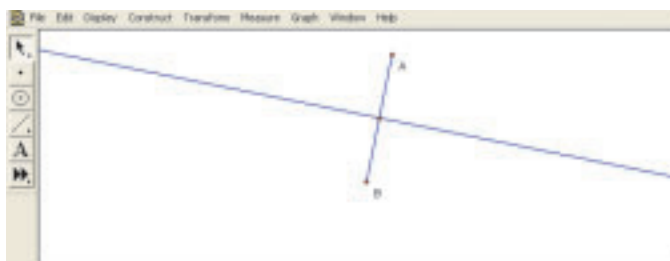
B–27   Constructing the Bisector of an Angle

1. **Open a new sketch and place three points to form an angle.**

2. **Use the Ray Tool or the Segment Tool to draw the angle.**

3. **Select the vertices that form the angle.**

4. **From the Construct menu, choose Angle Bisector.**
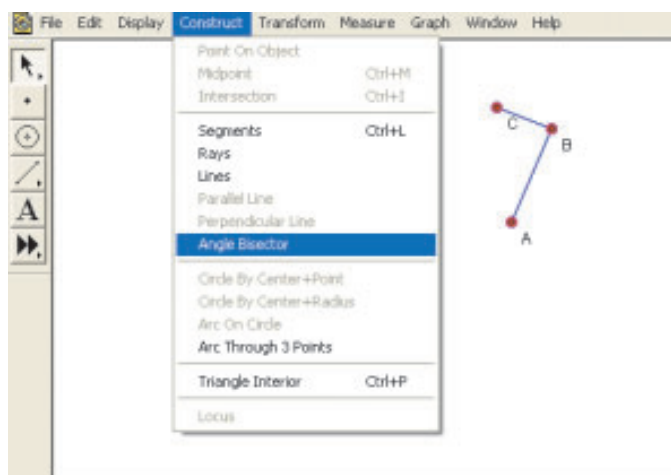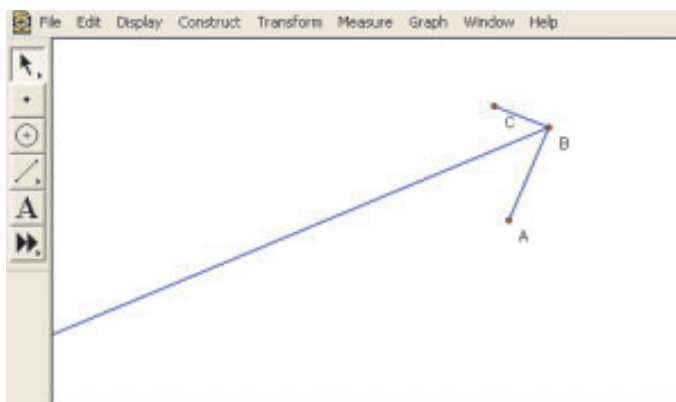
5. The angle bisector will be displayed as a ray going out from the angle.

B–28   Measuring the Area of a Polygon

1. Open a new sketch and place points to form the vertices of a polygon and their labels.

2. While the points are selected, use the Construct Polygon Interior operation in the Construct menu to form a polygon.
The Geometer's Sketchpad will name the polygon depending on the number of vertices you have selected.
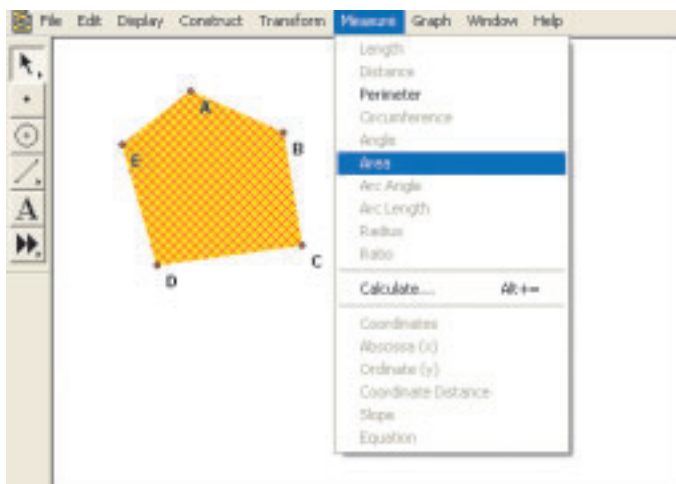
3. While the interior is highlighted, select Area from the Measure menu.

4. The area will be displayed.

Area ABCDE = 8.63 cm²
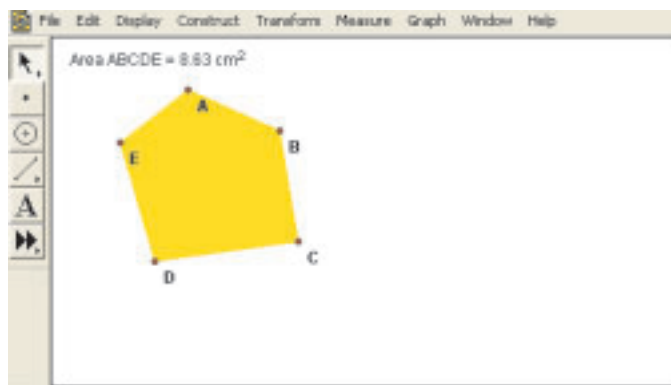
PART 3 USING FATHOM

B–29 Creating a Scatter Plot from Data

1. **Create a case table.**
   Drag a case table from the object shelf, and drop it in the document.
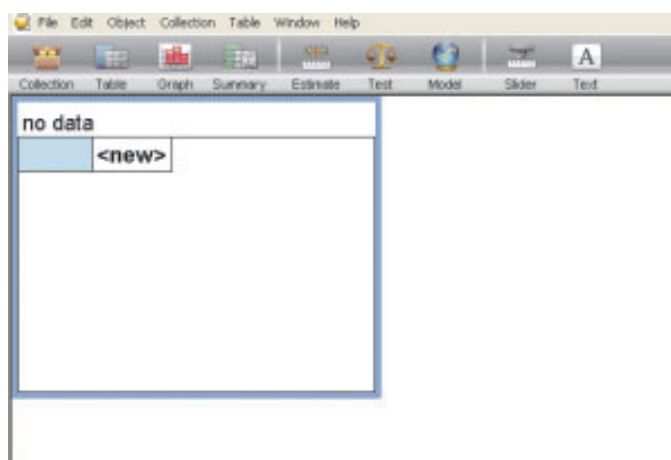
2. **Enter the Variables and Data.**
   Click the <**new**> button, and then type a name for the new variable or attribute. Press the Enter key. (If necessary, repeat this step to add more attributes; pressing the Tab key instead of the Enter key moves you to the next column.)

   When you name your first attribute, *Fathom* creates an empty collection to hold your data (a small empty box). The collection is where your data are actually stored. Deleting the collection deletes your data. When you add cases by typing values, the collection icon fills with gold balls. To enter the data, click in the blank cell under the attribute name and begin typing values. (Press the Tab key to move from cell to cell.)

   Collection 1

	Time	Height
1	0	2
2	1	27.1
3	2	42.4
4	3	47.9
5	4	43.6
6	5	29.5
7	6	5.6

   Collection 1
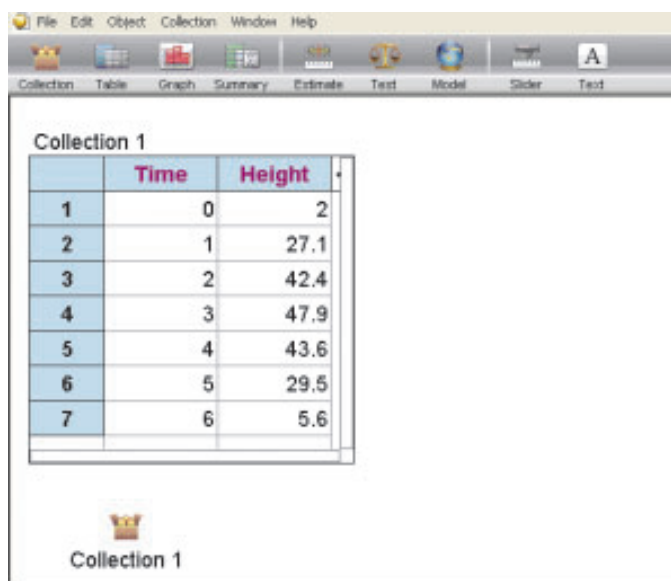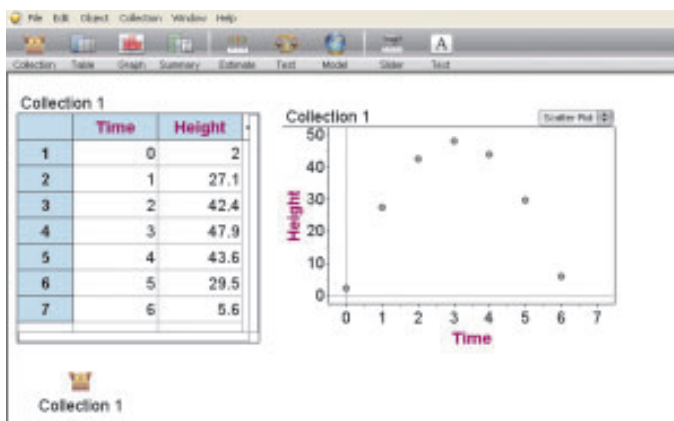
3. Graph the data.
Drag a new graph from the object shelf at the top of the *Fathom* window, and drop it in a blank space in your document. Drag attributes from the case table, and drop them on the prompts below and to the left of the axes in the graph.

PART 4 USING A SPREADSHEET

B–30 Introduction to a Spreadsheet

A spreadsheet is a computer program that can be used to create a table of values and then graph the values. It is made up of cells that are identified by column letter and row number, such as **A2** or **B5**. A cell can hold a label, a number, or a formula.

Creating a Table

Use spreadsheets to solve problems like this: How much interest will you pay if you borrow $3000 and pay it back at an interest rate of 5% per year over 8 years using the Add-On charge method?

	A	B
1	**Time (years)**	**Amount ($)**
2	0	0
3	=A2+1	=A3*3000*0.05
4		
5		
6		
7		
8		
9		
10		
11		
12		

To create a spreadsheet, label cell **A1** as "Time (years)" and cell **B1** as "Amount ($)". Enter the initial values "0" in **A2** and "0" in **B2**. Enter the formulas "=A2+1" in **A3** and "=A3*3000*0.05" in **B3** to generate the next values in the table.

	A	B
1	**Time (years)**	**Amount ($)**
2	0	0
3	1	150
4		
5		
6		
7		
8		
9		
10		
11		
12		

Notice that an equal sign is in front of each formula and an asterisk (*) is used for multiplication. Next, use the cursor to select cells **A3** to **B3** and several rows of cells below them. Use the **Fill Down** command. This command inserts the appropriate formula into each selected cell.

When the **Fill Down** command is used, the computer automatically calculates and enters the values in each cell, as shown.

	A	B
	Time (years)	**Amount ($)**
1		
2	0	0
3	1	150
4	2	300
5	3	450
6	4	600
7	5	750
8	6	900
9	7	1050
10	8	1200
11	9	1350
12	10	1500

Creating a Graph

Use the spreadsheet's graphing command to graph the results. Use the cursor to highlight the portion of the table you would like to graph. In this case, select columns **A** and **B** to graph Amount vs. Time.

	A	B
	Time (years)	**Amount ($)**
1		
2	0	0
3	1	150
4	2	300
5	3	450
6	4	600
7	5	750
8	6	900
9	7	1050
10	8	1200
11	9	1350
12	10	1500

Different spreadsheets have different graphing commands. Check your spreadsheet's instructions to find the proper command. A graph like this will appear.

You will pay $1200 in interest over 8 years.

Amount of Interest vs. Time

Appendix B: Review of Technical Skills   **541**