



Problem 1

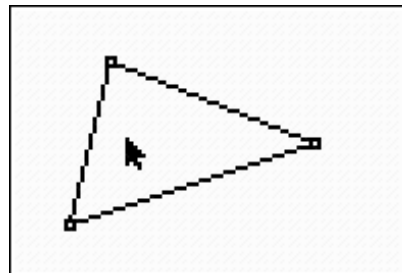
To start, open the *Cabri Jr.* application found in the **Apps** menu.

Open the *Cabri Jr.* document called **TRIANGLE**. Press $\boxed{Y=}$ to open the **F1:File** menu and choose **Open....** Then choose **TRIANGLE** from the list.



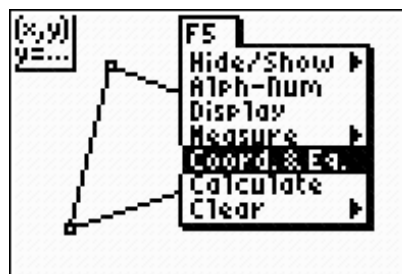
The area of a triangle with vertices (x_1, y_1) , (x_2, y_2) , and (x_3, y_3) is given by the formula:

$$\text{Area} = \frac{1}{2} \left| \det \begin{bmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \\ 1 & 1 & 1 \end{bmatrix} \right|$$

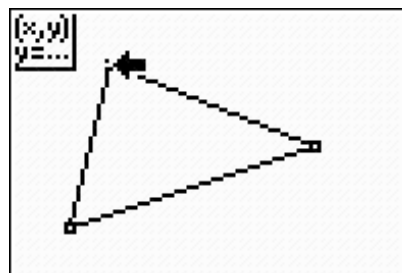


To find the area of the triangle on the screen, first find the coordinates of each vertex.

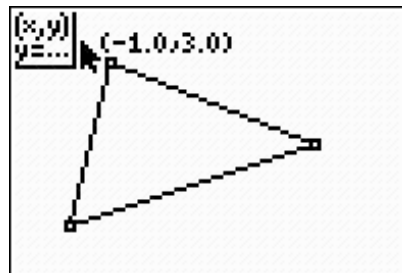
Step 1: Press $\boxed{\text{GRAPH}}$ to open the **F5:Appearance** menu and choose **Coord. & Eq.**



Step 2: Use the arrow keys to move the cursor to one of the vertices of the triangle. When it reaches the point, the cursor changes to a large solid arrow. Press $\boxed{\text{ENTER}}$ to choose the point.



Step 3: Use the arrow keys to move the coordinates to an appropriate place on the screen. Press $\boxed{\text{ENTER}}$ to place them.



Label all three points with their coordinates. Press $\boxed{\text{CLEAR}}$ to exit **Coord. & Eq.** Record the coordinates of the vertices below.

x_1 : _____ y_1 : _____
 x_2 : _____ y_2 : _____
 x_3 : _____ y_3 : _____

Save your changes by pressing $\boxed{Y=}$ to open the file menu and choosing **Save**. Then press $\boxed{2\text{nd}} \boxed{\text{QUIT}}$ to exit the *Cabri Jr.* app.

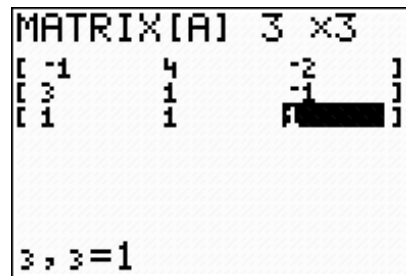
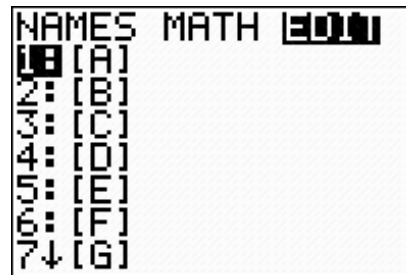
Determining Area

The next step is to create the matrix:

$$\begin{bmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \\ 1 & 1 & 1 \end{bmatrix}$$

Press $\boxed{2\text{nd}}$ $\boxed{[MATRIX]}$ to open the **Matrix** menu. Arrow over to **Edit** and choose **[A]**.

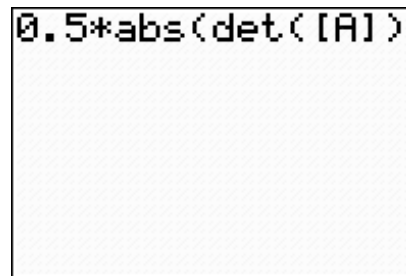
Set the size to 3×3 and enter the values into the matrix. You must press \boxed{ENTER} each time for the value to be recorded in the matrix. Press $\boxed{2\text{nd}}$ $\boxed{[QUIT]}$ to exit.



On the Home screen, calculate the formula:

$$0.5 * \text{abs}(\text{det}[A])$$

Note: The **abs(** and **det(** commands can be found in the **Catalog** ($\boxed{2\text{nd}}$ $\boxed{[CATALOG]}$).

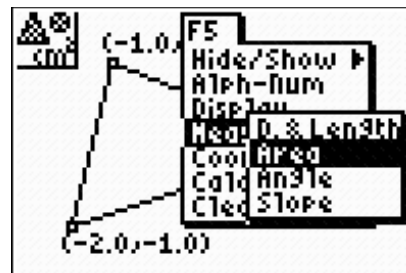


area = ____ square units

To check your answer, return to *Cabri Jr.* The application displays the last open file, **TRIANGLE**.

Step 1: Press \boxed{GRAPH} to open the **F5:Appearance** menu. Select **Measure**, then **Area**.

Step 2: Move the cursor to the triangle and press \boxed{ENTER} twice to see the area.



Save your file. Compare it with the result of the formula.

Exercises

Use the formula to find the area of a triangles with the vertices listed below.

1. $(-2, -1)$, $(5, 0)$, and $(0, 3)$
2. $(5, 3)$, $(2, -1)$, and $(-2, 4)$

To confirm your answer:

Step 1: Using the **TRIANGLE** file turn on the Axes. Press \boxed{GRAPH} and open the Hide/Show submenu. Highlight **Axes** and press \boxed{ENTER} .

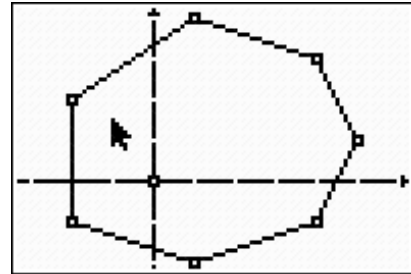
Step 2: Move the vertices to the correct locations. (Press \boxed{ALPHA} to grab the point.) The area of the triangle will automatically update on the screen.



Problem 2

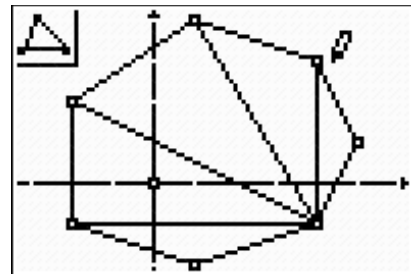
Now let's find a similar formula for the area of a heptagon. Start *Cabri Jr.* and open the file **HEPTAGON**. This file shows a heptagon. Find the coordinates of its vertices and record them below.

x_1 : ____ y_1 : ____ x_5 : ____ y_5 : ____
 x_2 : ____ y_2 : ____ x_6 : ____ y_6 : ____
 x_3 : ____ y_3 : ____ x_7 : ____ y_7 : ____
 x_4 : ____ y_4 : ____



Cabri Jr. cannot calculate the area of a heptagon automatically. However, you can use the formula for the area of a triangle! Use the **Triangle** tool to divide the heptagon into triangles. There are many ways to do this. One is shown.

Then use the **Area** tool to find the area of each triangle. Add to find the area of the heptagon.



area of heptagon: _____ square units

Now on the Home screen, confirm your answer using the given at the beginning of the activity to find the area of each triangle, adding to find the total.

Note: This method can be used to find the area of *any* convex polygon!

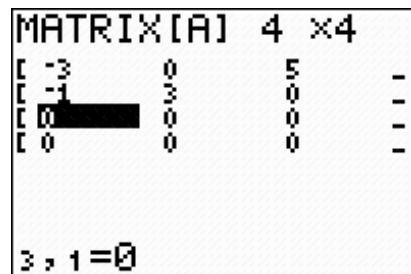
Exercise

Open a new file and draw a quadrilateral with vertices $(-3, -1)$, $(0, 3)$, $(5, 0)$ and $(1, -1)$. Find its area by dividing it into triangles and applying the formula. Check your answer using the **Area** tool.

Problem 3

In this problem, you will find a formula for the area of a quadrilateral given its vertices. The formula is similar to that for the area of a triangle, but it involves a 4×4 matrix.

To build the formula, create a 4×4 matrix. Use the coordinates of the quadrilateral in the Problem 2 Exercise to fill in the first two rows.





Determining Area

Now you need to fill in the third and fourth rows. Keep in mind that if a matrix has two identical rows, or any row that is a multiple of another row, its determinant is zero.

Hint: Try a combination of 1 and -1 in the fourth row.

<code>det([A])</code>

Calculate the determinant of the matrix. Keep trying different combinations in the fourth row of the matrix until the determinant is a divisible by the area you found in the Exercise at the end of Problem 2.

Write the formula. Like the formula for the area of a triangle, it should involve a determinant, absolute value, and multiplication by a fraction.

Area of a quadrilateral =

Exercise

Return to *Cabri Jr.* Drag the vertices of the quadrilateral to new positions. Use the new vertices in your formula. Then calculate the area using the **Area** tool. Is your formula correct?

New vertices: _____

New area: _____ square units