User Interfaces and Basic Tools

In this handbook we are dealing with GeoGebra Classic 5

1. User interface in GeoGebra

Once the installation is done, double click on the GeoGebra icon. Figure shows the window that comes up. GeoGebra has three basic interfaces

- Algebra View
- Spreadsheet View
- Graphics View and

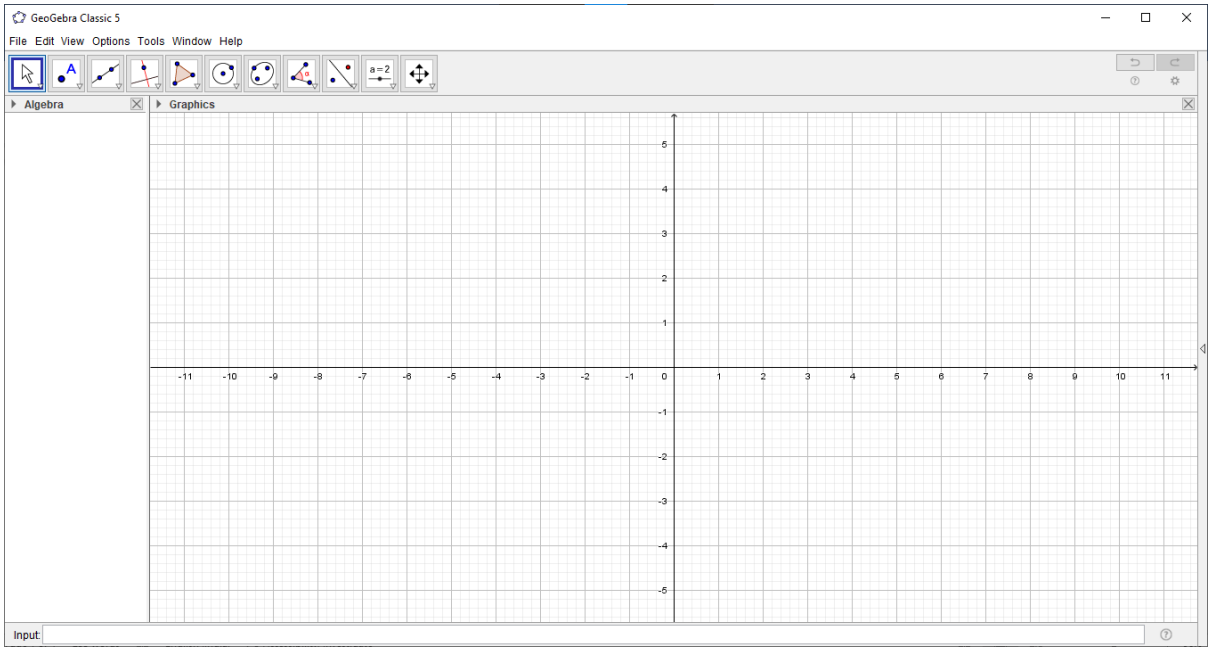


Figure 1: Default Screen of GeoGebra Classic 5

Two advanced interfaces

- 3D Graphics and
- CAS.

By default, two interfaces are shown. We can change the number of interfaces that we would like to see from the View menu.

Let us explore the basic features of the GeoGebra Classic 5 window. Look for Menu bar, Tool Bar, Algebra View, Graphics View, and Input Bar.

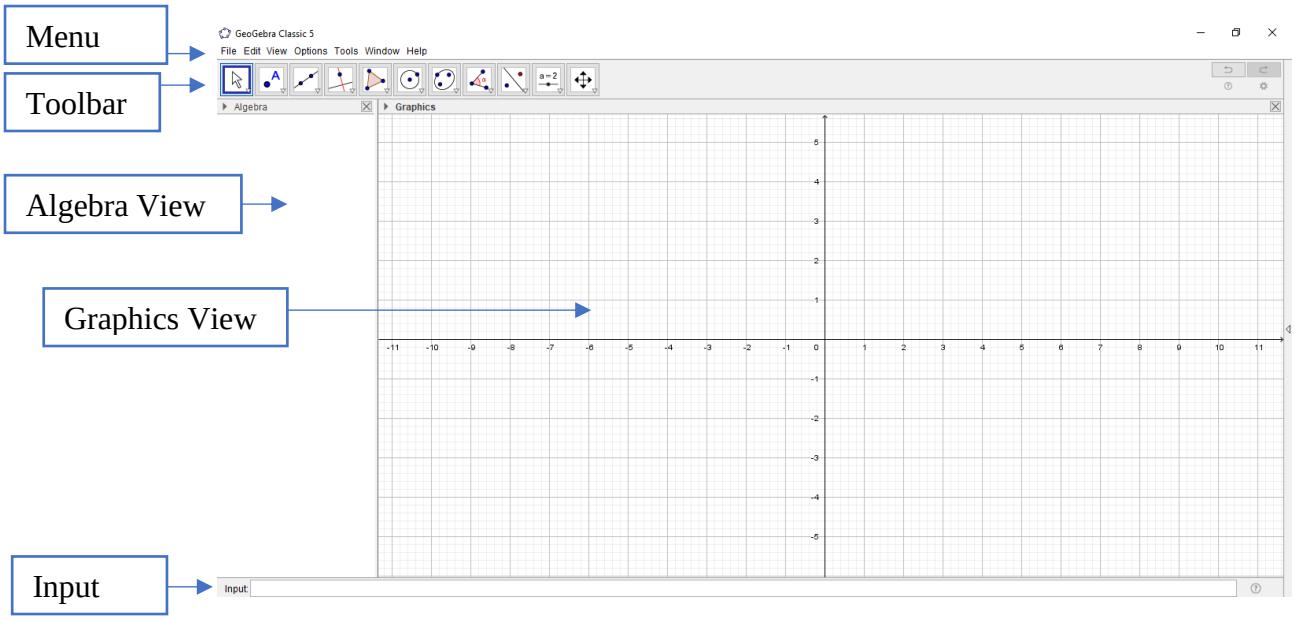


Figure 2: Screen of GeoGebra

Many of them are self-explanatory. We would explore some of these functions in due course.

For example, follow the below given sequence

View >> Spread sheet, what have you noticed?

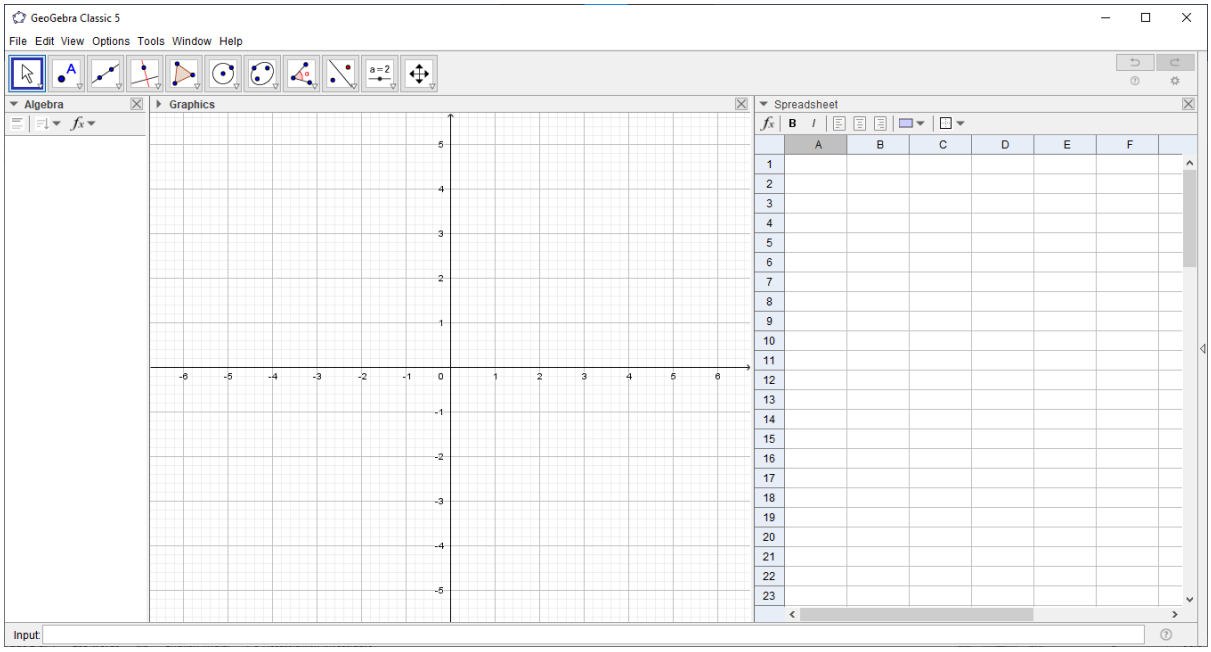


Figure3: Spread Sheet View

Similarly try out the 3D Graphics View

View >> 3D Graphics

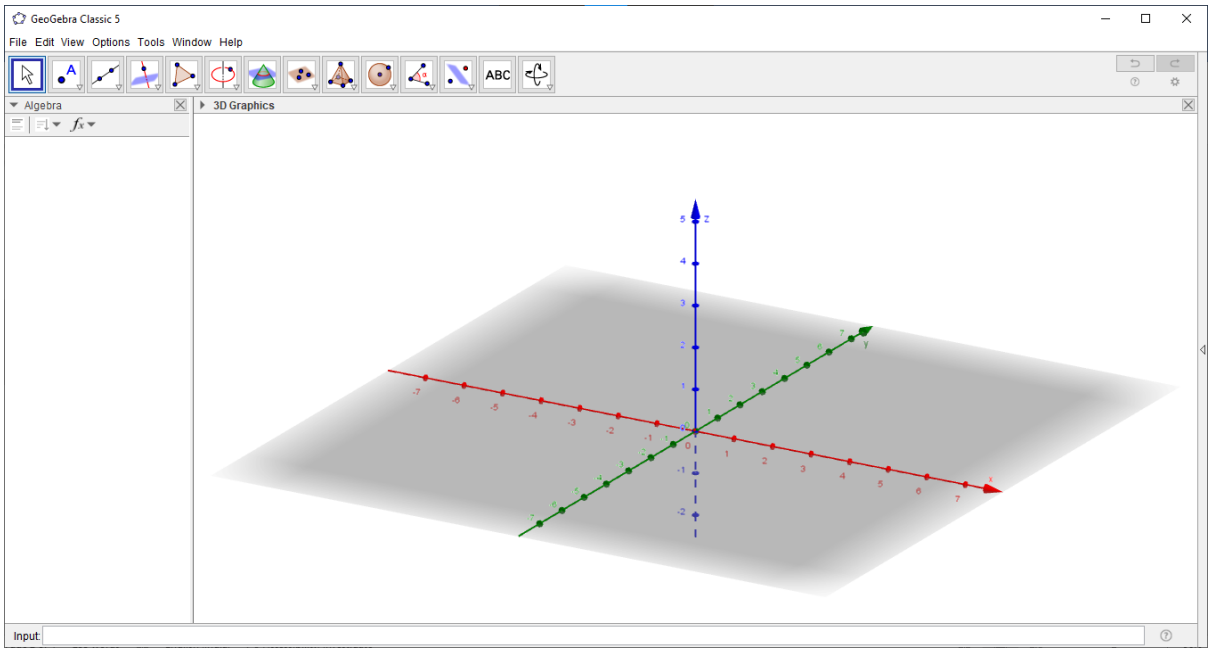


Figure 4: 3D Graphics View

The 3D Graphics interface issue full for generating 3D objects and working on it. An example is given in figure 5.

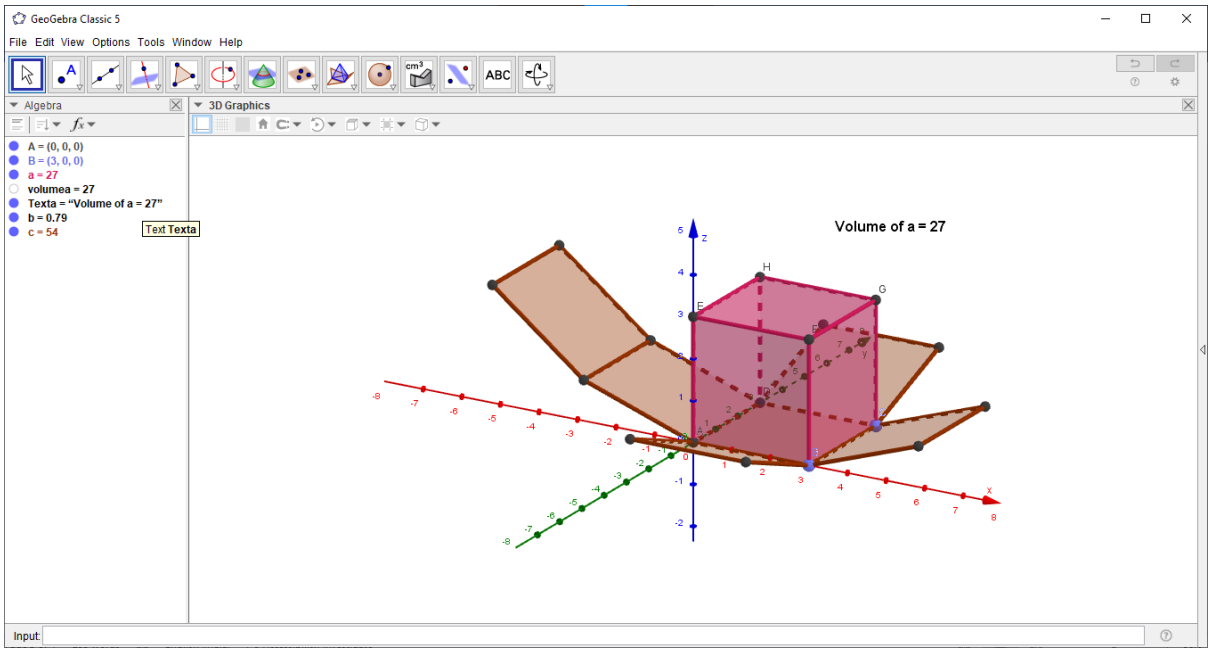


Figure 5: Volume of Cube

Now try out View>> CAS

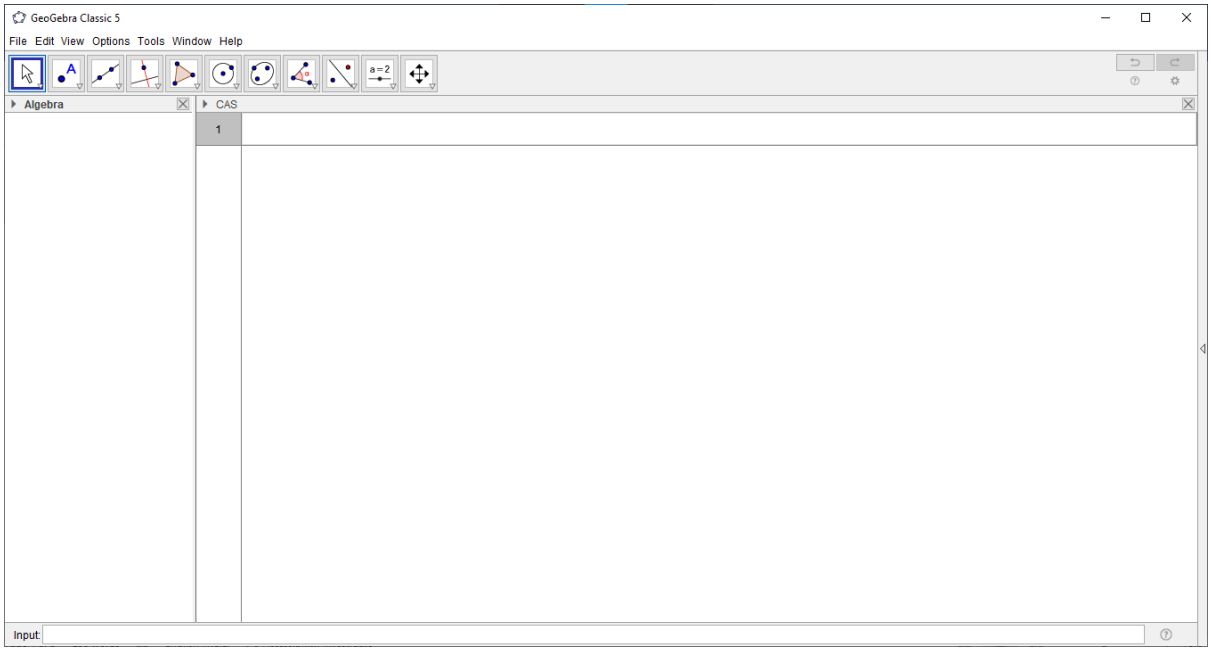


Figure 6: CAS View

The CAS interface is useful in doing mathematical problem solving.

For example, if the roots of an equation $x^2 - 5x + 6 = 0$ is to be found out, we enter the equation in the input, and select $x =$option to get the solution of the equation. You may try other such functions

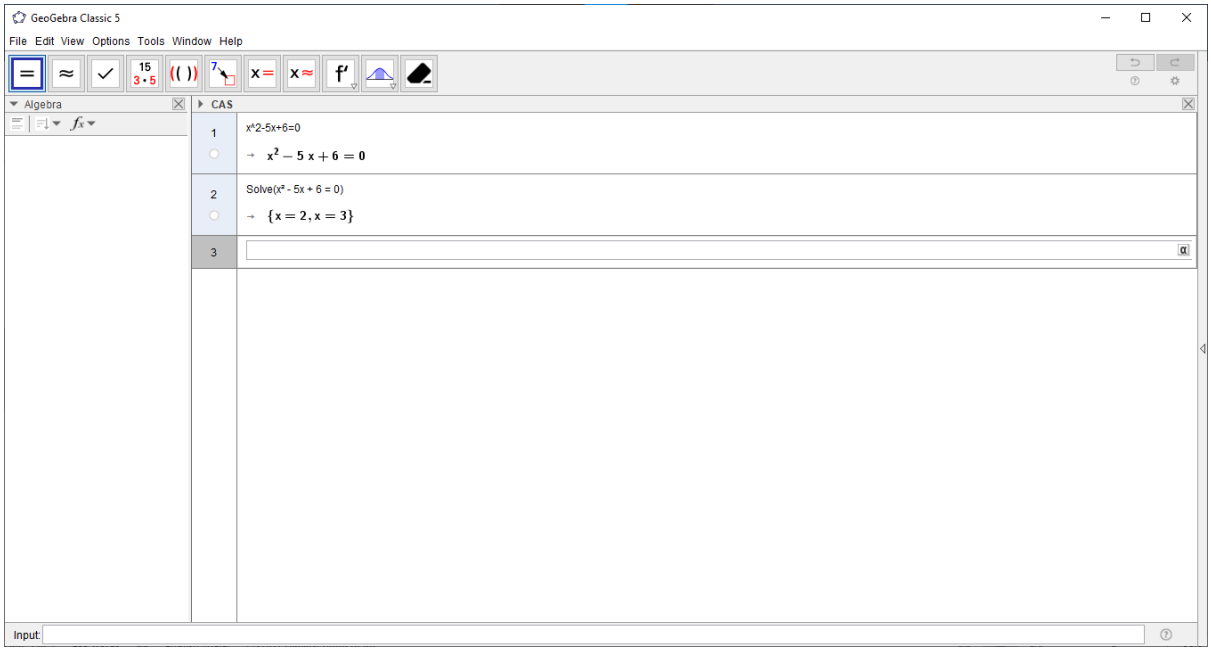


Figure 7: CAS

We can present two graphic interfaces simultaneously by the following sequence View>>Graphics 2>>3D Graphics>>Spreadsheet>>CAS

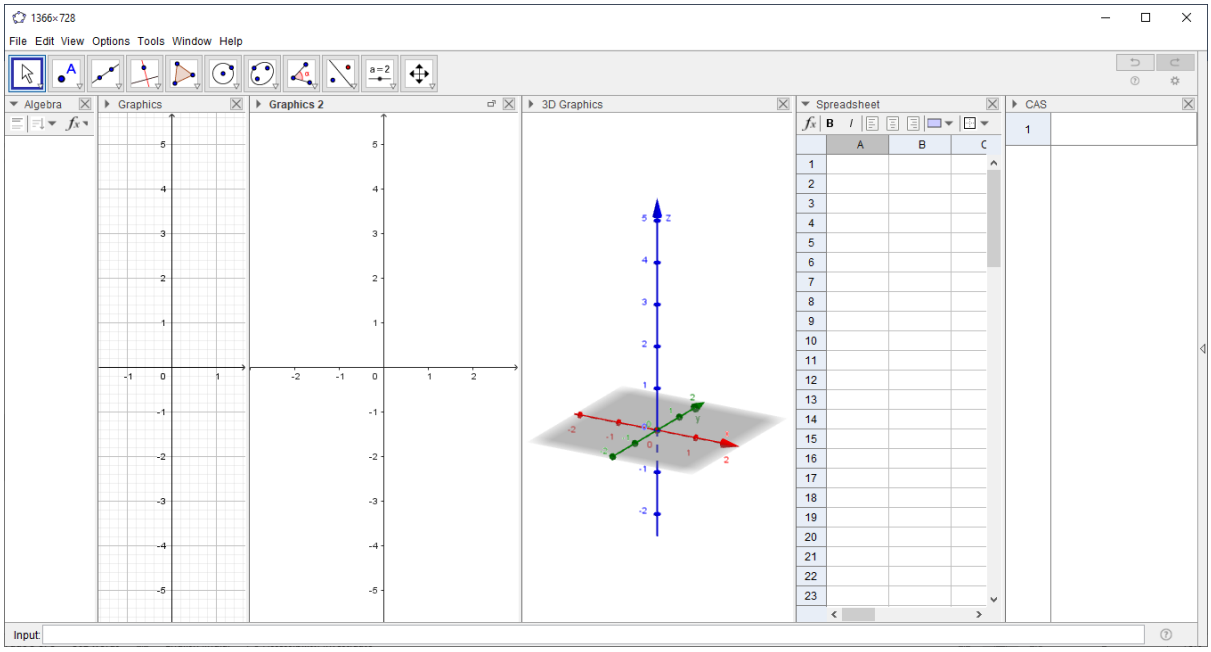


Figure 8: GeoGebra interfaces

The input bar is used for entering algebraic expressions in GeoGebra. Details of the input commands are discussed in the next section.

2. Basic Tools

In GeoGebra construction tools are arranged in 12 sets as shown in Figure 9.

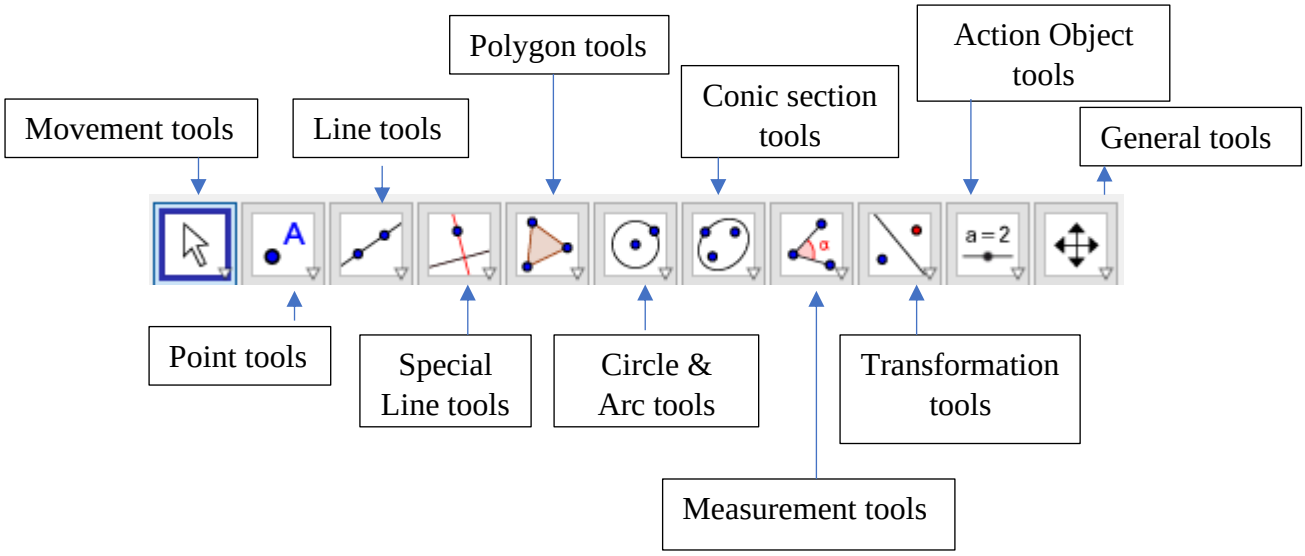


Figure 9: Basic tools

All the tools in each set are obtained by clicking on the small arrow at the bottom right corner of each icon as shown in Figure 10. Keeping the cursor on the tool, a brief description of the function of the tool is displayed.

Let us have a close look on some important tools from each set.

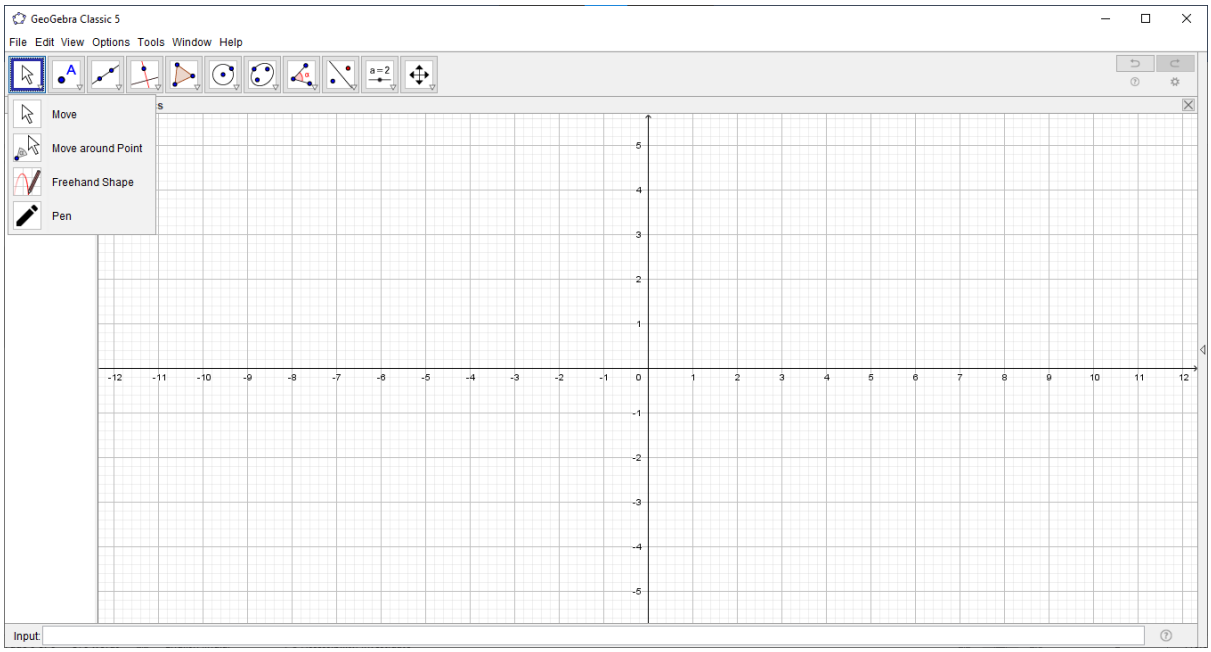


Figure 10: Set of tools

3. Movement Tools

This tool is used for moving Points, Geometrical figures, Graphics etc., in the Graphics view. For example, for moving triangle ABC select the move tool (by clicking on the icon), click and drag the triangle. By clicking and dragging on any vertex of the triangle we can move the vertex and the corresponding sides from it. For moving a point or a graph (say graph of x^2) we can also use the arrow keys on the key board along with the move tool. Using move tool click on a point or a graph, press and hold any of the arrow keys.

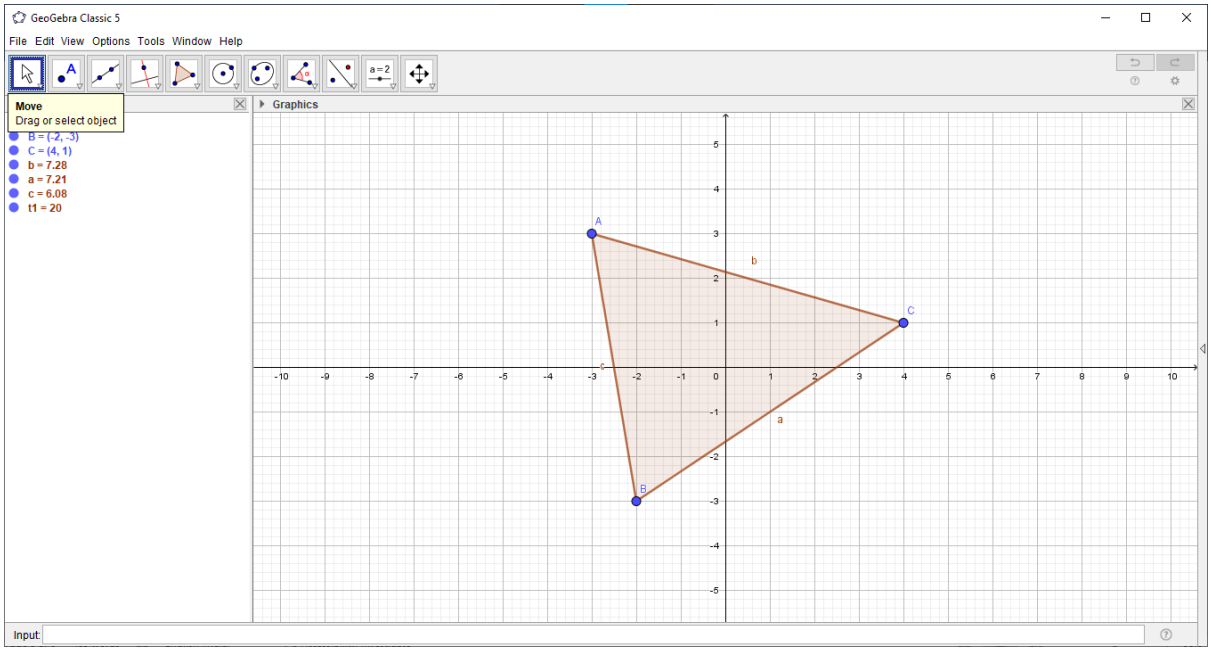


Figure 11: Movement of Triangle

4. Point Tools

4.1 Point

Click on the Graphics view, with the Point tool, gives a new point. If we click on a line, circle or a graph using the tool we get a point on it. It is possible to move the point only along the object using the move tool. You would have noticed the normally cursor will be on the Graphics view. But if we bring it on any object, it shows following indication.

4.2 Point on Object

With the Point on Object function active, it we click inside any geometric object, then the point can be moved inside the object (as well as on the object). Similarly, if we click on any geometric object, then the point can be moved on the object (but not inside the object). For example, if we click on any side of a triangle with the tool, we get a point which is movable only along the sides of the triangles. But if we click inside the triangle, the point obtained is movable inside the triangle as well as along the sides.

4.3 Attach/Detach Point

We can attach a point to an object by clicking on the point and the object. To detach a point from an object, click on the point with the tool.

4.4 Intersect Two Objects

This tool is used to mark the point of intersection of curves or Geometrical figures. Using the tool, click on the curves one by one and select the intersect two objects tool to get a point of intersection or directly identify the point of intersection by clicking on it.

4.5 Midpoint or Center

This tool helps in locating midpoint of a line segment or any two points. Click on a line segment/two points to get its midpoint or a circle/ellipse to get its center.

4.6 Complex Number

This tool helps in representing a given point in a complex number form. Locate any point on the Graphics view. Corresponding complex number form is displayed in the algebraic view

5.Line Tools

5.1 Line Through Two Points

Two clicks on the Graphics view with Line through two points tool active results in a line through the points.

5.2 Segment Between Two points

Two clicks on the Graphics view with segment between two points tool active results in a Segment Between Two points.

5.3 Segment with Given Length from Point

A click on the Graphics view with Segment with Given Length from Point results in the popup shown in Figure 12. Entering the desired number results in a line segment of mentioned length.

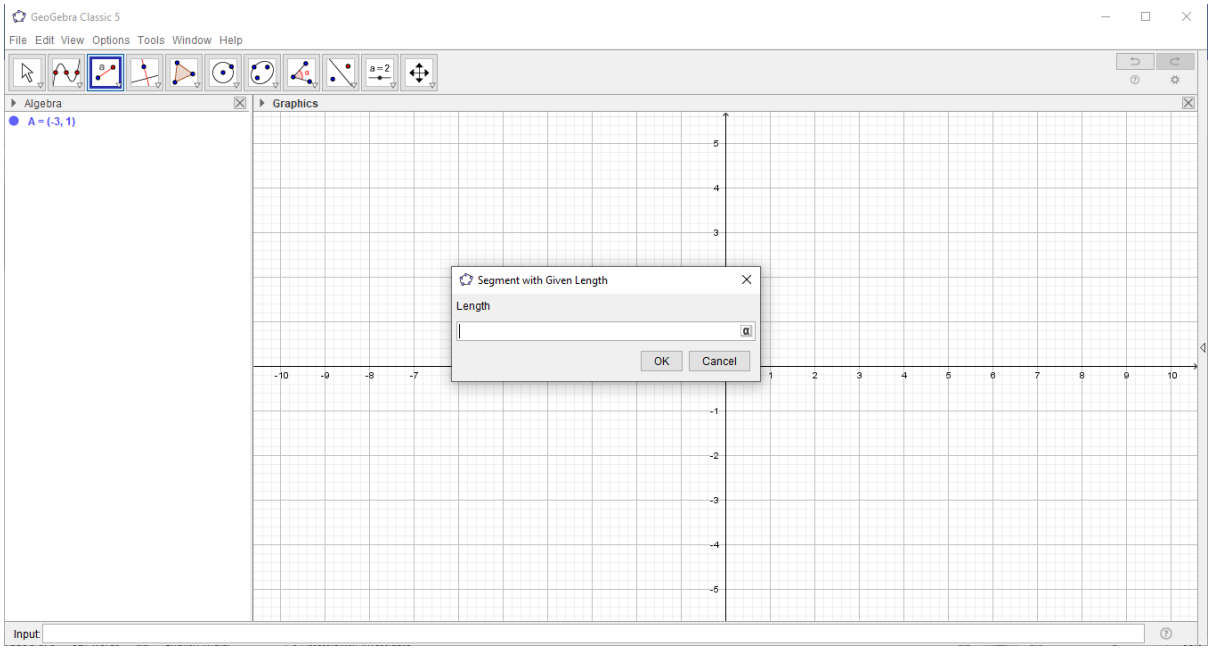


Figure 12: Segment with Given Length from Point

5.4 Ray

Two clicks on the Graphics view with Ray tool active results in a ray. The first click would be a fixed point and second click would represent the direction of the ray.

5.5 Polyline

Click on multiple points, the last point being on the initial point results in a figure called polyline.

5.6 Vector

First click on the Graphics view with Vector tool, active, would be a starting point of a vector. Second click would be the end point of the vector. The algebra view would display the dimensions of the vector.

5.7 Vector from Point

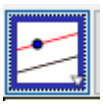
Create a vector and a point first. Now click on the point and vector in the sequence creates another vector having same magnitude and direction as the earlier vector through the point initially constructed.

6.Special Line Tools

6.1 Perpendicular Line

This tool allows us to draw a line perpendicular to a given line and passing through a given point. Draw a line. On activating perpendicular line tool, click on the graphics view to get a point and then select the line. The desired perpendicular line is drawn.

6.2 Parallel Line

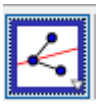


Parallel line to a given line through a point is drawn identical to drawing a perpendicular line. One needs to activate parallel line tool.

6.3 Perpendicular Bisector

Draw a line segment. Activate perpendicular bisector tool by selecting it. Click on the line segment results in a perpendicular segment to the given line.

6.4 Angle Bisector



Create an angle using line segment tool. After activating angle bisector tool, select the three vertices such that the vertex where angle is formed is in the middle. An angle bisector will be drawn.

6.5 Tangents

Tangents to a graph (for example a circle) of a function can be drawn in several ways, selecting a point A and a circle gives all tangents through A to the circle.

7.Polygon Tools

7.1 Polygon

Successive clicks when the polygon tool is active results in a polygon. The last click should be on the first point to close the polygon. Note: Algebra view displays the area of the polygon. The polygon formed is flexible. The vertices can be moved around.

7.2 Regular Polygon

The first two clicks would decide the length of the side of a regular polygon. A pop-up window appears. Number of sides in the desired regular polygon need to be entered.

7.3 Rigid Polygon

Identical to the polygon tool except that the polygon formed is rigid.

7.4 Vector Polygon

This tool generates a polygon with sliders for positioning the vertices. While we draw triangle

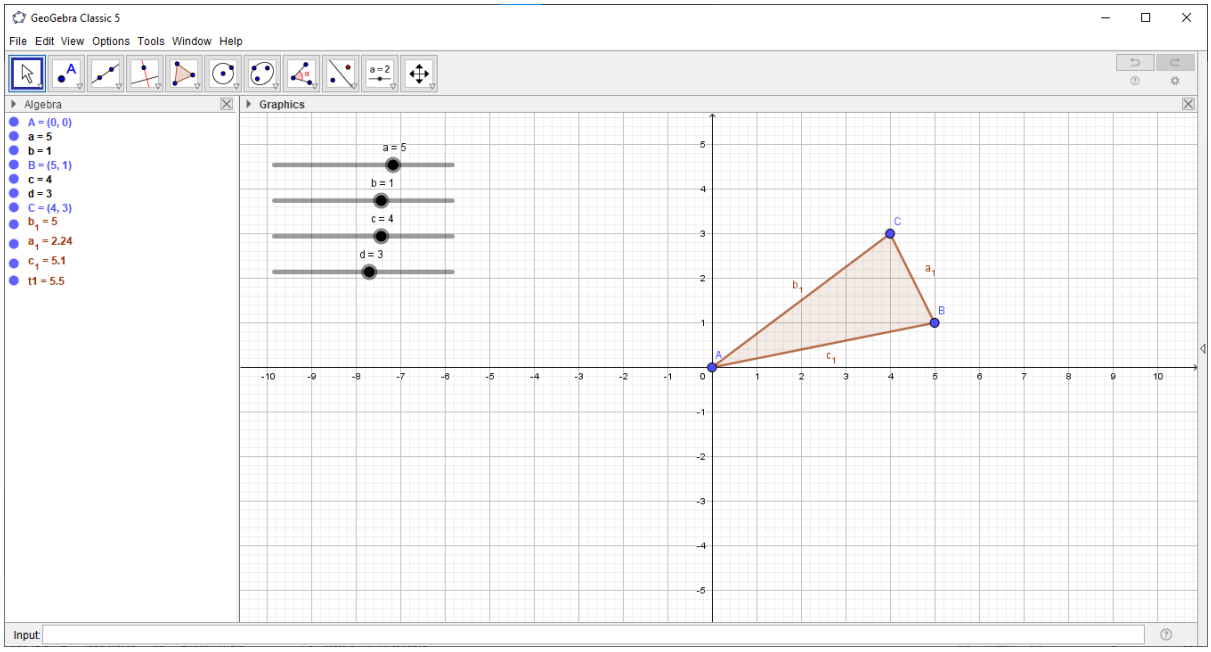


Figure 13: Vector polygon

ABC with the vector polygon tool, GeoGebra will create four sliders a, b, c and as shown in (By default, the sliders will be hidden from the Graphics view. We can show them by clicking on the corresponding bullets in the algebra window). Using the slider “a” we can move the vertex B horizontally and “b” helps us to move it vertically. Similarly with the help of “c” and “d” we can move C.

8.Circle and Arc Tools

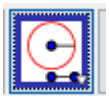
8.1 Circle with Center through Point

First click on the Graphics view with circle with center through point tool active would be a center of the circle. Second click would be a point on the circle.

8.2 Circle with Center and Radius

Identical to the first one except that the radius needs to be entered numerically in a pop-up window.

8.3 Compass



This tool is useful in duplicating a circle. After activating compass tool, select the circle to be duplicated. Click a point where the center of the duplicated circle is expected to be located.

8.4 Circle Through 3 Points

Three clicks on the Graphics view when the circle through three points active would result in a circle through the points identified through the clicks.

8.5 Semicircle through 2 Points

Two clicks on the Graphics view when the Semicircle through 2 points active would result in a semicircle.

8.6 Circular Arc

When circular arc tool is active, three click on the Graphics view results in a circular arc. First click defines the center of the arc, second an end point, and third the length of the arc.

8.7 Circumcircular Arc

Three clicks define a circumcircular arc with all the three points on the arc.

8.8 Circular Sector

When Circular sector tool is active, three click on the Graphics view results in a circular sector. First click defined the center of the sector, second an end point, and third the length of the sector.

8.9 Circumcircular Sector

Three clicks define a circumcircular sector with all the three points on the sector.

9.Conic section Tools

9.1 Ellipse

Three clicks on the Graphics view when ellipse tool is active results in an ellipse. The first two clicks would be the foci of the ellipse. The third click would define the ellipse.

9.2 Hyperbola

Three clicks on the Graphics view when hyperbola tool is active results in a hyperbola. The first two clicks would be the foci of the hyperbola. The third click would define the hyperbola.

9.3 Parabola

Draw a point and a line. With parabola tool active, click on the point and the line makes them focus and directrix resulting in a parabola.

9.4 Conic Through 5 Points

Five successive clicks on the Graphics view defines a conic through the five points. The location of the fifth point would define the nature of the conic section.

10 Measurement Tools

10.1 Angle

This tool helps in measuring the angles. Following are the list of angles measurement situations using Angle tool. Three sequential clicks on the end points of the intersecting line segments with the second click belong the vertex where angles are formed. Click on two segments to measure the angle between them. Click on two lines to measure the angle between them. Click on two vectors to measure the angle between them. Click on a polygon to measure all angles of the polygon.

10.1 Angle with Given Size

This tool is useful in creating an angle of desired size. For example, in order to create angle ABC with B = 400, first draw line segment AB, then using Angle with given size tool, click on A and B successively and enter 400 in the appearing dialogue box. Then we a get a new point A. Using segment between two points tools join BA, A is obtained below the line AB because the angle is created in the counter clockwise orientation. If we want A above AB, after entering 100 in the dialogue box click clock wise. Note: we may rename the point A by using Rename option available on the right click.

10.3 Distance or Length

This tool gives the distance between two points, distance of a point from a line, length of a line segment, perimeter of polygon, circumference of a circle/ellipse. Activate distance or length tool after doing each of the following to find the distance/length. Select two points to measure the distance between them. Click a point and a line to measure the distance of the point from the line. Click on the line segment. Click inside the polygon. Click on the circle/ ellipse.

10.4 Area

This tool gives the area of a polygon (constructed using polygon tool) or a circle/ellipse. Click on the polygon/circle/ellipse when the area tool activated would result in area display.

10.5 Slope

Click on a line/line segment results in display of the slope when slope tool is active.

11.Transformational Tools

11.1 Reflect about Line

This tool gives a reflection of an object about a line. Activate reflect about line then click on the object to be reflected and the line about which the object to be reflected.

Note: Reflection is not available on the graph of a function. In the Figure 14, if the line is created by giving x in the input box GeoGebra treats it as a function such as $f(x) = x$, so reflection is not available on it. Instead create it with the input $y = x$ or using line tools. Reflection is not available on the axes also. Use $x = 0$ or $y = 0$ in the input box.

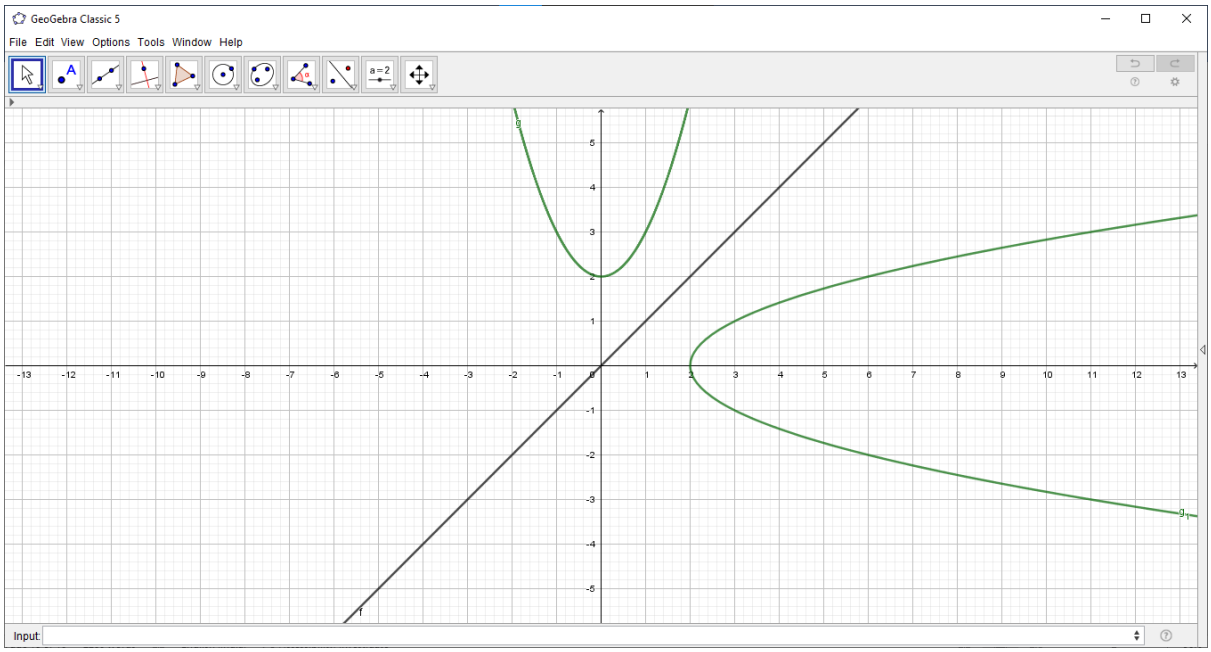


Figure 14: Reflect about line

11.2 Rotate around Point

This tool is useful to get the reflection of an object about a point. Click on the object and the point results in the reflection.

11.3 Reflect about Circle

This tool gives the reflection of an object about a circle, click on the object and the circle.

11.4 Rotate Object around Point

This tool helps in rotating an object around a point at a desired angle of rotation. Select the object. Click on a point specify the center of rotation and then enter the rotation angle into the text filed of the appearing dialogue window.

11.5 Translate by Vector

Select the object that we want to translate. Then click on a vector or two points. The object will be translated by the magnitude of the vector in its direction.

11.6 Dilate from Point

This tool allows us to enlarge/ reduce an object by a given factor.

12.Action Object Tools

12.1 Slider

Slider is the most powerful tool of GeoGebra which makes GeoGebra dynamic. Slider, can be considered as a variable, which takes any value between two numbers. To create a slider, select the Slider tool and click on the Graphics view. A window will appear as shown in Figure 15

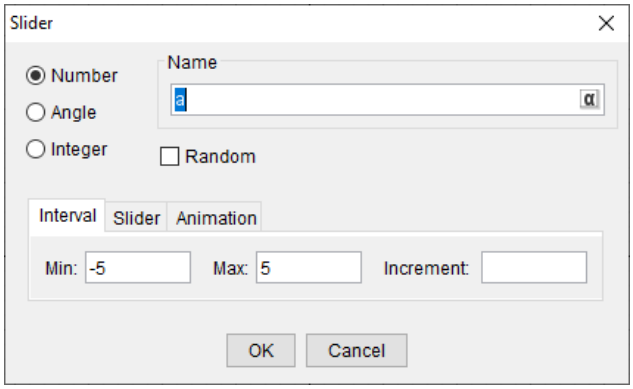


Figure 15: Slider

There are three options within it – Number, Angle, and Integer.

Number Slider

Select Number in the slider window. Give a name for the slider. This name is important as we need it in any construction using the slider. Set the Minimum value, Maximum value and Increment of the slider. Click Apply.

Angle Slider

Select Angle in the slider window. For Min and Max, enter values between 0˚and 360˚.

Integer Slider

Select Integer in the slider window.

Advanced Slider Properties

Create a slider with Min: -3 and Max:3. Enter $(x+a)^2$ in the input bar. We get a function in the Algebra View and its graph in the Graphics View. The function and its graph changes as we change the value of the slider (Note that the slider has a variable a, and there is also a variable in the function $(x + a)^2$. As we vary the value of *a*, the graph varies accordingly displaying a variation in *a*.

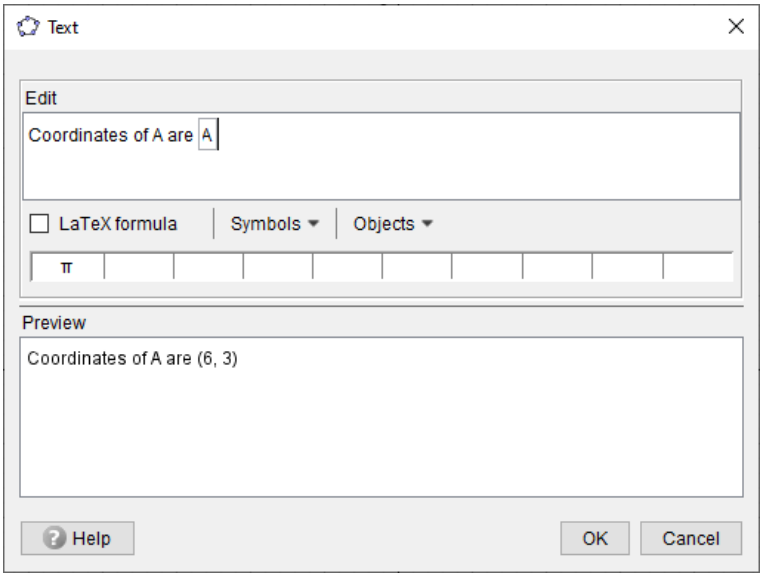
We can change the value of a slider in one of the following ways: Click on the slider and drag Click on the slider and press any of the arrow keys Right Click on the slider and click Animation On in the appearing window. Then a play/pause button appears at the bottom left corner of the Graphics View, with which we can start/stop the animation. Link the slider with an Input Box. We can change its value by typing there quired value in the input box.

Slider can be set for an already defined variable. In the above example, we start with a function$(x+2)^2$.

12.2 Text

This tool is useful in creating static and dynamic text in the Graphics View. At first, specify the location of the text in one of the following ways: Create a point on the Graphics view. Activate the Text tool. Click on a point to create a new text that is

attached to this point. Type the text in the dialogue box say for example Coordinates of point A are as Select A from the Objects drop-down list Click OK



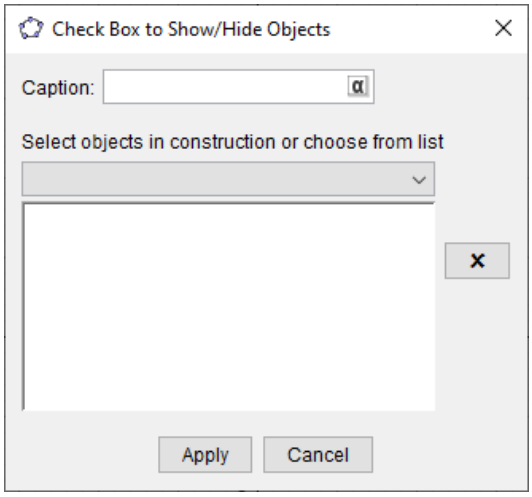
12.3 Image

This tool is used to insert an image. Click in the Graphics View, when the Image tool is active, to specify the position of the image's lower left corner. Then, a file-open dialogue appears that allows us to select the image from the files saved in the computer.

12.4 Button

12.5 Check Box

Check box is used to hide/view the objects that are constructed. Displaying and hiding objects comes to good use when we illustrate multi step processes. Click on the Graphics view with check Box tool active results in a pop-up window as shown in Figure 17.



A caption for the object needs to be given. The dropdown menu lists all the constructed objects. Select the one for which check box is added. There is another method to include objects in an existing Check Box. Create a Check box. Right click on the object. Object Properties - Advanced. Give the name of the Check box (not the caption, name is given in the algebra view under the heading Boolean. Mere right click on the check box also gives the name of the Check box) in box Condition to show object.

12.6 Input Box

Input Box can be used to enter a specific function/value of a variable. Click on the Graphics view with the tool and enter a caption in the box for it. From the Linked Object drop down menu select an object (which is already constructed) to link with the input box and click Apply. We can edit the properties of a linker object using the input box. For example, if an input box is created with the caption circle and the circle with center A and radius 2 is linked with it, we get an input box as shown in Figure 18. Instead of Circle [A,2] in the input box, if we give Circle [B,3], we get a circle with center Band radius 3. If we link a slider with an input box, we can change the value of the slider by typing in the box.

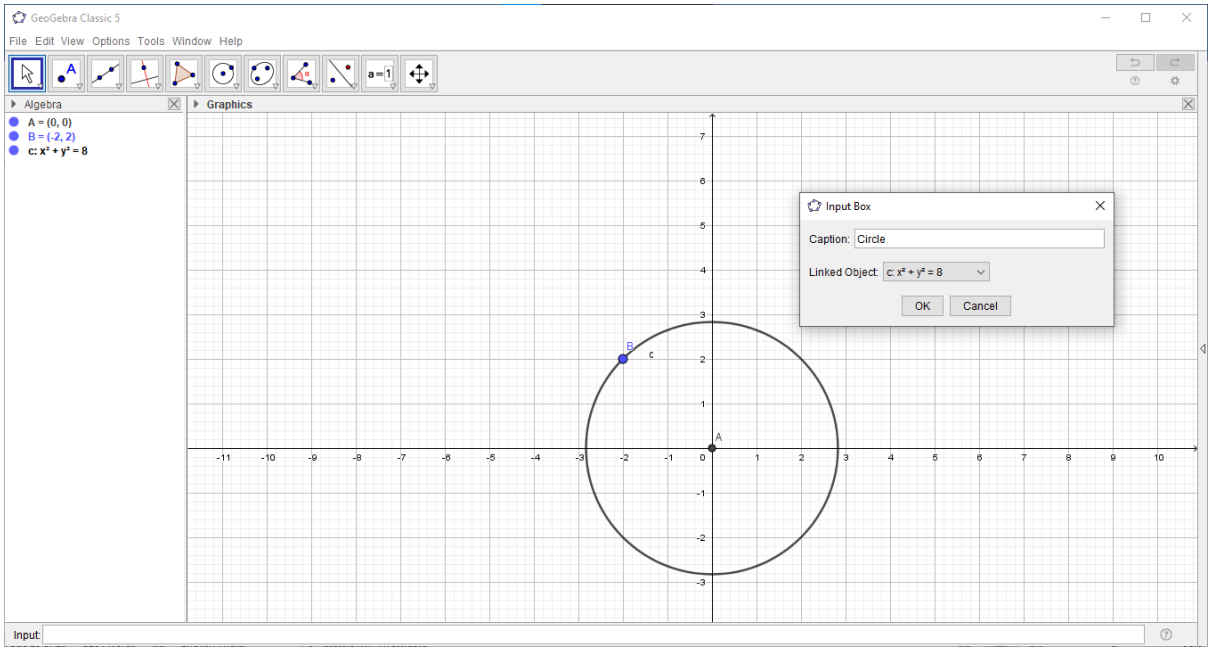


Figure 18: Input Box

13.General Tools

13.1 Move Graphics view

Used to move the Graphics view. Click, hold and drag the drawing pad in the Graphics View to change its visible area.

13.2 Zoom In

Click on any place on the drawing pad to zoom in.

13.3 Zoom Out

Click on any place on the drawing pad to zoom out.

13.4 Show/ Hide objects

If we click on any object with the tool, it will be hidden from the Graphics view when we select any other tool. To see the object again, select the tool.

13.5 Show/Hide Label

Click on an object to show or hide its label.

13.4 Copy Visual Style

This tool allows us to copy visual properties (e.g., color, size, line style) from one object others. To do so, first select the object whose properties we want to copy. Then, click on all other objects that should adopt these properties.

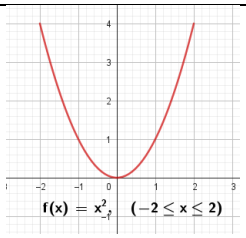
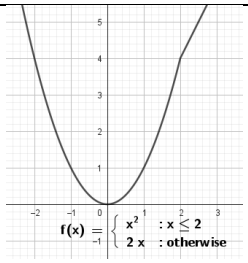
13.5 Delete Object

Click on any object that we want to delete. Note: We can use the Undo button if we accidentally delete the wrong object.

14. Input Commands

Most of the constructions can be done by typing commands in the Input bar. For giving a command, type it in the Input Bar and press Enter key. Output of the command is obtained in the Graphics view and the Algebraic view. A list of all input commands is available in the Input bar. The arrow key in the right of the input bar gives a list of input commands used recently. These commands can be edited and useful for a quick use.

Figure 19 Input Bar

Input Command	**Output**	
	Algebra view	**Graphics view**
x^2	Function $f(x) = x^2$	Graph of the function f
3x+2	Function $f(x) = 3x + 2$	Graph of the function f
abs(x)	$f(x) = \|x\|$	Graph of $\|x\|$
floor(x)	Greatest integer function	Graph of greatest integer function
exp(x)	$f(x) = e^x$	Graph of e^x
ln(x)	$f(x) = \log_e x$	Graph of $\log_e x$
asin(x)	$f(x) = \sin^{-1}(x)$	Graph of $\sin^{-1}(x)$
if[-2<=x<=2,x^2]	$f(x) = x^2 \; for -2 \leq x \leq 2$	
if[x<=2,x^2,2x]	$\begin{cases} x^2 : if\ x \leq 2 \\ 2x : if x > 2 \end{cases}$	
4x^2+9y^2=36	C: $4x^2 + 9y^2 = 36$	Ellipse $4x^2 + 9y^2 = 36$
x^2/4 -y^2/16=1	C: $\frac{x^2}{4} - \frac{y^2}{16} = 1$	Hyperbola $\frac{x^2}{4} - \frac{y^2}{16} = 1$
Derivative(f)	$f'(x)$	Graph of $f'(x)$
Integral(f)	$\int f(x)\, dx$	Graph of $\int f(x)\, dx$