

GeoGebra Workbook 2

More Constructions, Measurements and Sliders

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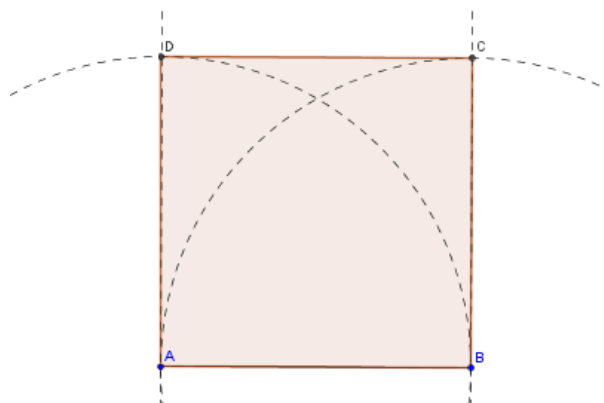
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1 - Square Construction and Measurement

Preparations

- * Open a new GeoGebra file.
- * Hide the algebra window and coordinate axes (View menu).
- * Change the labelling setting to “New points only” (menu Options → Labelling).








Introduction of new tools

	<p>Distance or length <i>New Tool!</i></p> <p><u>Hint</u>: Select two points, a segment, a polygon or circle to determine its length</p>
	<p>Area <i>New Tool!</i></p> <p><u>Hint</u>: Click on a polygon, circle or conic to determine its area</p>

Step-by-step Instructions

<p>1. </p>	<p>Create the segment AB that joins the points A and B</p>
<p>2. </p>	<p>Create a perpendicular line b to the segment AB passing through the point B</p>
<p>3. </p>	<p>Create a circle c with center B passing through the point A</p>
<p>4. </p>	<p>Calculate the intersecting point (C) of the perpendicular line b and the circle c</p>
<p>5. </p>	<p>Create a perpendicular line d to the segment AB passing through the point A</p>
<p>6. </p>	<p>Create a circle e with center A passing through the point B</p>
<p>7. </p>	<p>Calculate the intersecting point (D) of the perpendicular line d and the circle e</p>



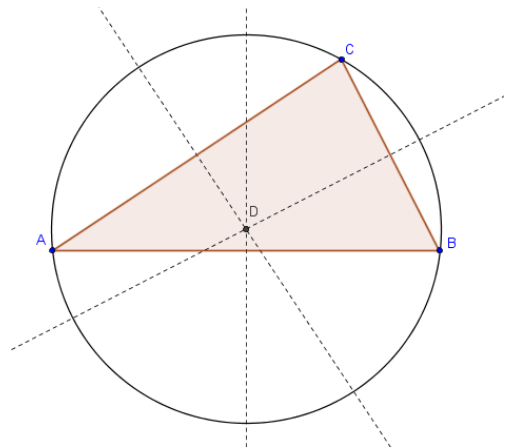
8.		Create the polygon ABCD by clicking on each of the vertices - remember to click on the first vertex again to close the polygon
9.		Hide the circles and the perpendicular lines
10.		Click on each of the line segments AB, AD, DC and BC to determine its length
11.		Click on the polygon ABCD to determine its area
12.		Apply the drag test to check if the construction is correct and to observe the changes to the lengths of the sides and the area of the polygon

Hints: Don't forget to read the toolbar help if you don't know how to use a tool. It might be helpful to try out all the new tools before you start the construction.


2 - Circumscribed Circle of a Triangle

Preparations

- * Open a new GeoGebra file.
- * Hide the algebra window and coordinate axes (View menu).
- * Change the labelling setting to "New points only" (menu Options → Labelling).



Introduction of new tools

	<p>Perpendicular bisector <i>New Tool!</i></p> <p><u>Hint</u>: Select two points or a segment to construct the perpendicular bisector of the segment</p>
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Hints: Don't forget to read the toolbar help if you don't know how to use a tool. It might be helpful to try out the new tool before you start the construction.



Step-by-step Instructions

1.		Create an arbitrary triangle ABC
2.		Use the perpendicular bisector tool to bisect each side of the triangle ABC
3.		Calculate the intersecting point of any two of the line bisectors
4.		Create a circle with center D (intersection point) passing through one of the vertices of the triangle ABC
5.		Apply the drag test to check if the construction is correct

Time to think....

Modify your GeoGebra construction to answer the following questions:

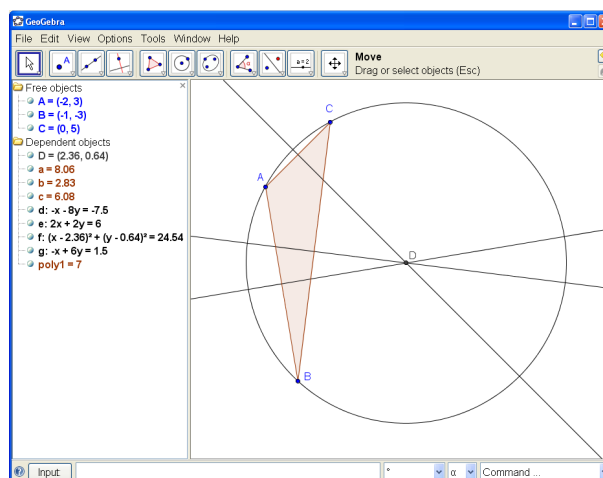
- * Can the circumcenter of a triangle lie outside the triangle?
- * If yes, for which types of triangles is this true?

3 - The Input Field

GeoGebra offers algebraic input, via the input field, using only your keyboard. Every tool in the menu bar has a matching command and therefore, can be applied without using the mouse. GeoGebra offers more commands than geometry tools. Therefore, not every command that is possible in GeoGebra has a corresponding geometry tool in the menu bar!

Preparations

- * Open a new GeoGebra file.
- * Hide the coordinate axes (View menu).
- * Show the input field and the algebra window (View menu).
- * Change the labelling setting to “New points only” (menu Options → Labelling).





Before we start . . .

- * Check out the list of commands at the end of the input field and look for commands whose corresponding tools were already introduced in this workshop or the last one.

We saw in the last activity how the circumscribed circle of a triangle can be done by using geometric construction tools only. We will now recreate this construction by just using keyboard input.

Step-by-step Instructions

1.	$A = (-2, 3)$	Create the point A
2.	$(-1, -3)$	Create the point B - GeoGebra will automatically label the point with the next available letter
3.	$(0, 5)$	Create the point C
4.	<code>Polygon [A, B, C]</code>	Creates a polygon joining the points A,B and C

We can clearly see that the points A,B and C appear as *Free objects* in the algebra window whereas the polygon appears as a *Dependent object*. While free objects can be directly modified either using the mouse or the keyboard, dependant objects adapt to changes of their parent objects.

Task: Activate “Move” mode and double click an object (point A for example) in the algebra window in order to change its algebraic representation using the keyboard. Hit the “Enter” key once you are done.

5.	<code>PerpendicularBisector[a]</code>	Create the perpendicular bisector of polygon side labelled a in the list of dependent objects
6.	<code>PerpendicularBisector[b]</code>	Create the perpendicular bisector of polygon side labelled b in the list of dependent objects
7.	<code>Intersect[d, e]</code>	Calculate the intersection point of the two perpendicular bisectors
8.	<code>Circle[D, A]</code>	Create a circle centred at D passing through the point A

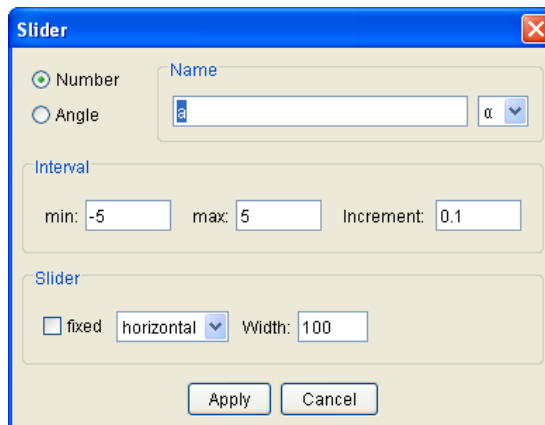
Tasks: Activate “Move” mode and either double click an object in the algebra window or use your mouse in the drawing pad to check whether your construction is correct. Change the properties of some of the objects in order to improve the constructions appearance.

Note: Most people find it easier to use the geometric construction tools to complete a task as they are not required to remember any commands. Unfortunately with more complex construction it will not be possible to totally avoid using the input field and so we should become as familiar as possible with using the input field to enter commands.



4 - Sliders

The slider button is found in the toolbar across the top of GeoGebra. When you select it and click on the drawing pad a window pops up asking for the properties of the slider. These properties include the name, interval, increment of the slider and the position of the slider (fixed or moveable). Once you click the apply button the slider bar, with the name you selected, appears on the drawing pad. The name you give the slider serves as a variable (whose value dynamically changes when you drag the point on the slider bar).



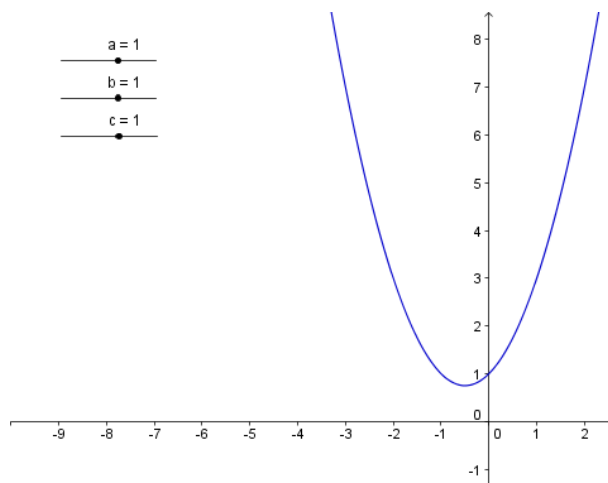
The slider, serving as a variable, can be used to show how a certain graph or function behaves as we change the values (or drag the slider). You can make as many sliders (or variables) depending on the need of the function or graph. We will show in the next section how to use sliders to graph a quadratic function and explore how the change in the values of the sliders (coefficients) effects the overall shape of the graph.

5 - The Quadratic Function


In this section we shall explore the impact of the parameters on the function $f(x) = ax^2 + bx + c$ by using sliders to modify the parameter values.

Preparations

- * Open a new GeoGebra file.
- * Show the coordinate axes, input field and the algebra window (View menu).
- * Change the labelling setting to “New points only” (menu Options → Labelling).







Introduction of new tools

	<p>Slider</p> <p><u>Hint:</u> Activate the tool and click on the drawing pad. Adjust the settings if needed and click Apply</p>	<i>New Tool!</i>
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Hints: Don't forget to read the toolbar help if you don't know how to use a tool. It might be helpful to try out the new tool before you start the construction.

Step-by-step Instructions

1.		Create the slider a . The default value is $a = 1$
2.		Create the slider b . The default value is $b = 1$
3.		Create the slider c . The default value is $c = 1$
4.		Using the input field enter the quadratic function $f(x) = a * x \wedge 2 + b * x + c$ Hint: You will get $*$ by typing Shift-8 and \wedge by typing Shift-6
5.		Use the move tool to adjust the sliders a , b and c . Observe the effect on the function $f(x)$

Note: It is possible to change the ratio of the x-axis to the y-axis so that we can see more of the function being graphed on the screen. If you right-click anywhere on the drawing pad you will see an option there for xAxis : yAxis. Change the xAxis : yAxis = 1 : 5.


Tasks: Change the properties of the function $f(x)$ in order to improve the constructions appearance. Fix the position of the sliders so that they don't get moved around the drawing pad by accident (properties dialog).

6 - Challenge: Incircle of a Triangle

Construct the incircle of a triangle - the circle in the interior of the triangle that touches all three sides of the triangle.

Hints: Don't forget to read the toolbar help if you don't know how to use a tool. Try out all the new tools before you start the construction.

To complete this challenge you will need to use the following tools.

	<p>Polygon</p> <p><u>Hint</u>: Click on the drawing pad or already existing points in order to create the vertices of a polygon Connect the last and first vertex to close the polygon!</p>
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	<p>Angle Bisector <u>Hint:</u> Click on three points of two lines to bisect the angle between them</p>	<p><i>New Tool!</i></p>
	<p>Intersect two objects <u>Hint:</u> Click on two lines to determine their intersection point</p>	
	<p>Perpendicular line <u>Hint:</u> Click on an existing point and then a line to create a perpendicular line through this point</p>	
	<p>Circle with centre through point <u>Hint:</u> Your first click is the centre of the circle, your second click determines the radius of the circle</p>	
	<p>Move <u>Hint:</u> Click on an object to move it with your mouse</p>	

Things to remember

- * Don't forget to read the toolbar help if you don't know how to use a tool.
- * Try out all new tools before you start the construction.

