

# GeoGebra 4

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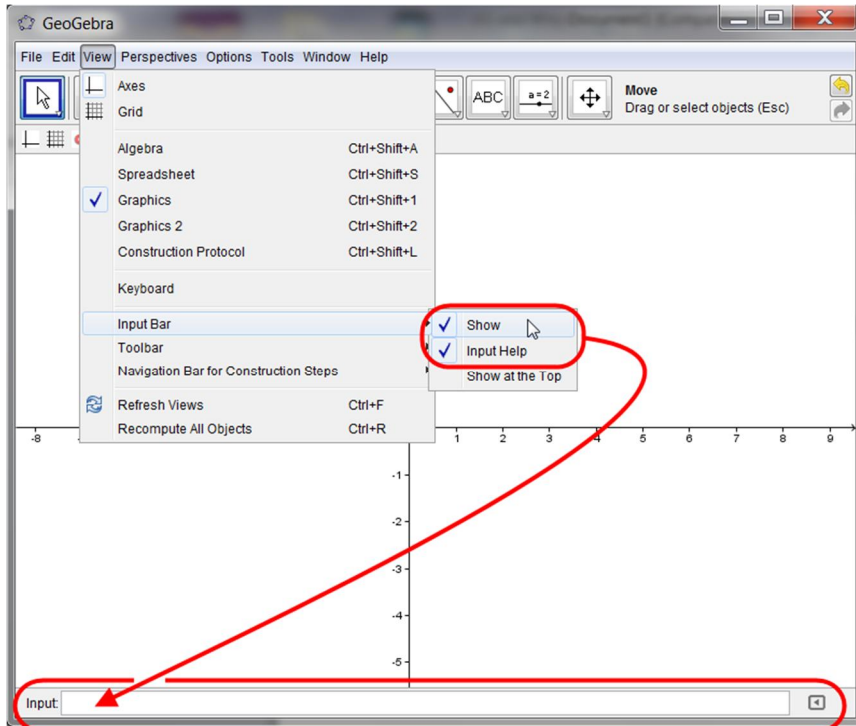
EMM: Plotting the Trajectory of a particle

# GeoGebra basics

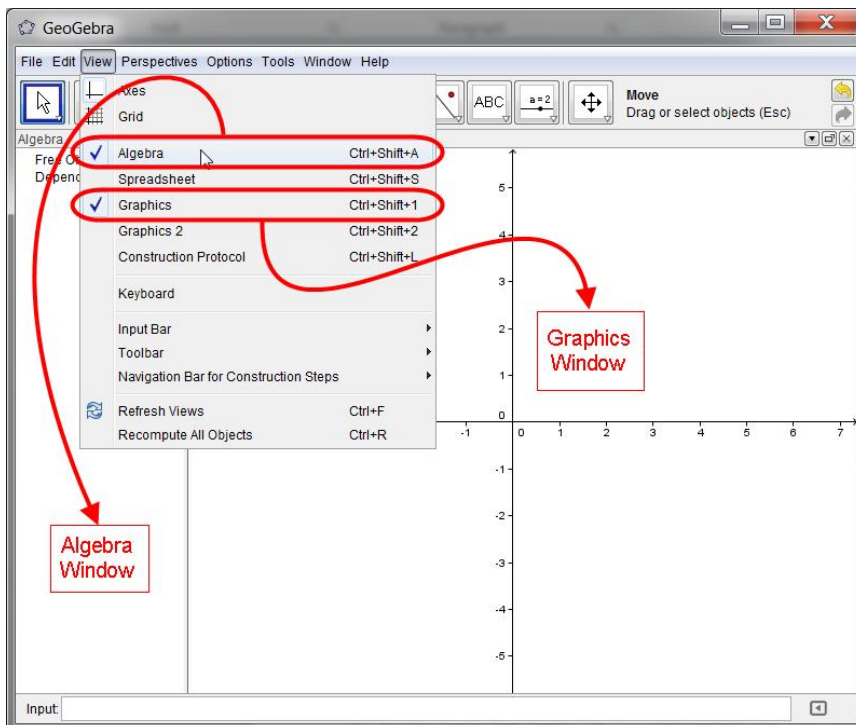
## Setting up the Interface

Steps required:

- If not visible then show the "Input Bar", through the "View" option on the Toolbar.




- Make sure that the Algebra Window and Graphics Window are both visible, again through the "View" option on the Toolbar.

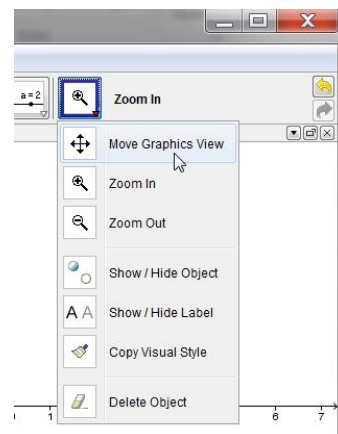


## Moving the Axes

The Slow method:

- If the “Move Graphics View” icon  is visible as the face on the last Icon set on the Toolbar then click on it to select it
- Next, click the Left Mouse Button anywhere on the Graphics Window, hold it down and then drag the mouse. You should see the axes moving around the screen as you drag the mouse

Notice that if you cannot see the “Move Graphics View” icon on the last icon set on the Toolbar then click on the little arrow at the bottom right of whichever icon picture is visible. You will notice that as you move the mouse towards this little arrow then it will change colour from white to red. Once it is red you can click the left Mouse Button to see the full set of GeoGebra Tools associated with this icon in the resulting drop-down menu.




The Quick method:

- Regardless of which Tool is currently selected from the icons in the Toolbar simply press and hold down the <CTRL> key and then click and hold down the Left Mouse Button whilst over the Graphics Window. Dragging the mouse will now drag the axes.

## Selecting or Dragging Objects using the “Move” Tool

The Slow method:

- If the “Move” icon  is visible as the face on the first Icon set on the Toolbar then click on it to select it. If another Tool is selected on this first icon then click on the white/red triangle and select the “Move” option from the resulting drop-down menu.

The Quick method:


- Regardless of which tool is currently selected from the icons in the Toolbar simply press the Escape Key <esc>.

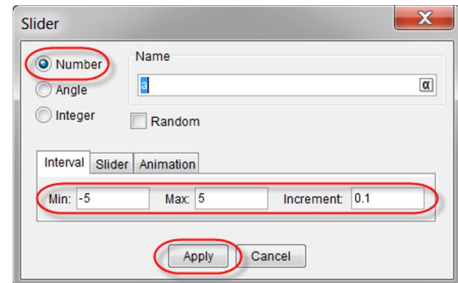
Selecting and dragging objects within the Graphics Window will now be possible.

## Creating a Slider

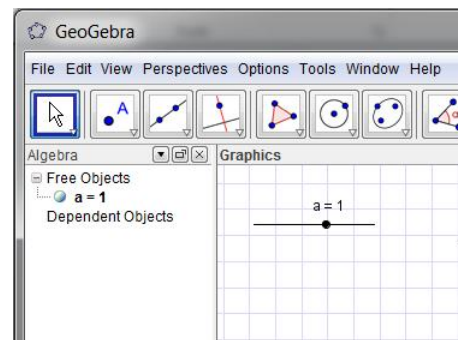
A Slider is a very useful Tool as it can be used to define and thereafter, vary, the value of a parameter that may be used within any construction/curve in GeoGebra.

### A Number Slider

- If the “Move” icon  is visible as the face on the penultimate Icon set on the Toolbar then click on it to select it. If another Tool is selected on this icon then click on the white/red triangle and select the Slider option from the resulting drop-down menu.
- Next, left mouse click within the Graphics Window at the point where you wish your slider to go. This will automatically open the Slider dialogue box as shown here to the right.

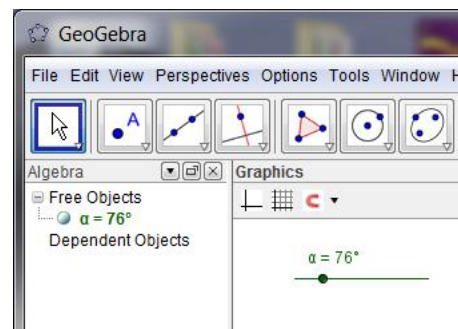
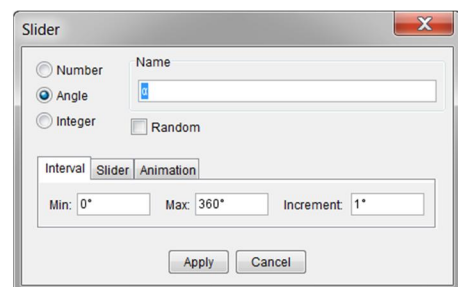


Adjust its settings if required and then press the “Apply” button. The Slider control named “a” (Unless you re-named it!) should now be visible in the Graphics window as shown here to the right.



### An Angle Slider

- Go through the same procedure as above but this time once the Slider dialogue box is open choose the following options as displayed to the right.
- **It is of the utmost importance that you do not remove the small degrees symbol from the end of your angles – without them the Angle Slider will not work correctly, if at all!**
- Note that Greek lettering is automatically provided for angles. However, if you wish to give it a name of your own then simply type it into the Name Text Input Box.



Adjust its settings if required and then press the “Apply” button. The Slider control named “α” (Unless you re-named it!) should now be visible in the Graphics window as shown here to the right.

Notice that if you Left-click the mouse into the Angle Name text box then a small Icon appears to the right of the box, namely:

The image consists of three screenshots of the GeoGebra Slider dialog box, illustrating the steps to name an angle slider with a Greek letter.

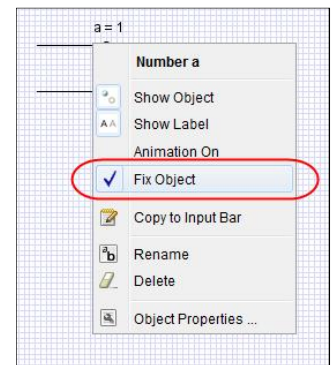
- Top Left:** The dialog box is open with the "Angle" radio button selected. The "Name" text box is empty. A red circle highlights the text box, and a red arrow points to it from a text box below.
- Top Right:** A small icon (a square with a Greek letter alpha) has appeared to the right of the "Name" text box. A red circle highlights this icon, and a red arrow points to it from a text box above.
- Bottom:** A Greek letter menu is open, showing various Greek letters. The letter beta ( $\beta$ ) is selected and placed into the "Name" text box. A red circle highlights the letter beta in the menu, and a red arrow points to it from a text box to the left. Another red circle highlights the letter beta in the text box, and a red arrow points to it from a text box to the right. A third red circle highlights the "Apply" button, and a red arrow points to it from a text box to the right.

Text boxes with red borders provide instructions:

- "To alter the name of an angle first click anywhere in the angle's 'Name' text box"
- "Next, click on the small Icon that appears to the right of the text box"
- "Next, from the Greek Letter menu that appears, select a letter for your angle. The act of clicking on it places the angle into the Name box. Pressing the 'Apply' button gives your angle this name"
- "Notice that Greek Letters do not need to have the degree symbol included (as do number values when used in angle calculations)"

## Moving a Slider Control around the screen

If you wish to move a Slider Control around the screen, perhaps to move it out of the way of the graph, then Left-mouse click on it, and whilst holding down the mouse button simply drag them to where you want to place them on the screen. If, when you try this, they alter their value instead of moving then they may be "Fixed" on the screen. In this case, Right-mouse click on the slider and you will see a tick on the "Fix Object" option. Select this option to remove the tick and the Slider can then be dragged to a new position.



## Plotting a projectile trajectory that depends upon sliders

Start with a new GeoGebra file. Create an Angle Slider named " $\alpha$ " and two Number Sliders called "U" and "H", respectively. Please use capital letters for both of your Number Sliders in this instance.

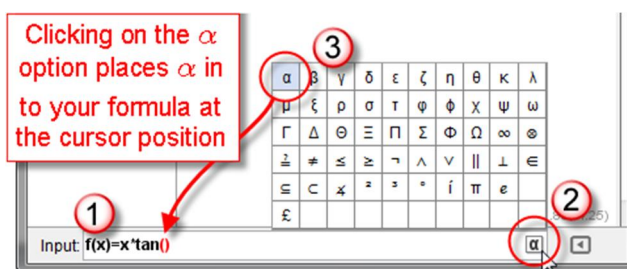
Type the following equation into the Input Bar and press the <RETURN> or <ENTER> key.

$$f(x) = x \cdot \tan(\alpha) - 9.8 \cdot x^2 \cdot (1 + (\tan(\alpha))^2) / (2 \cdot U^2) + H$$

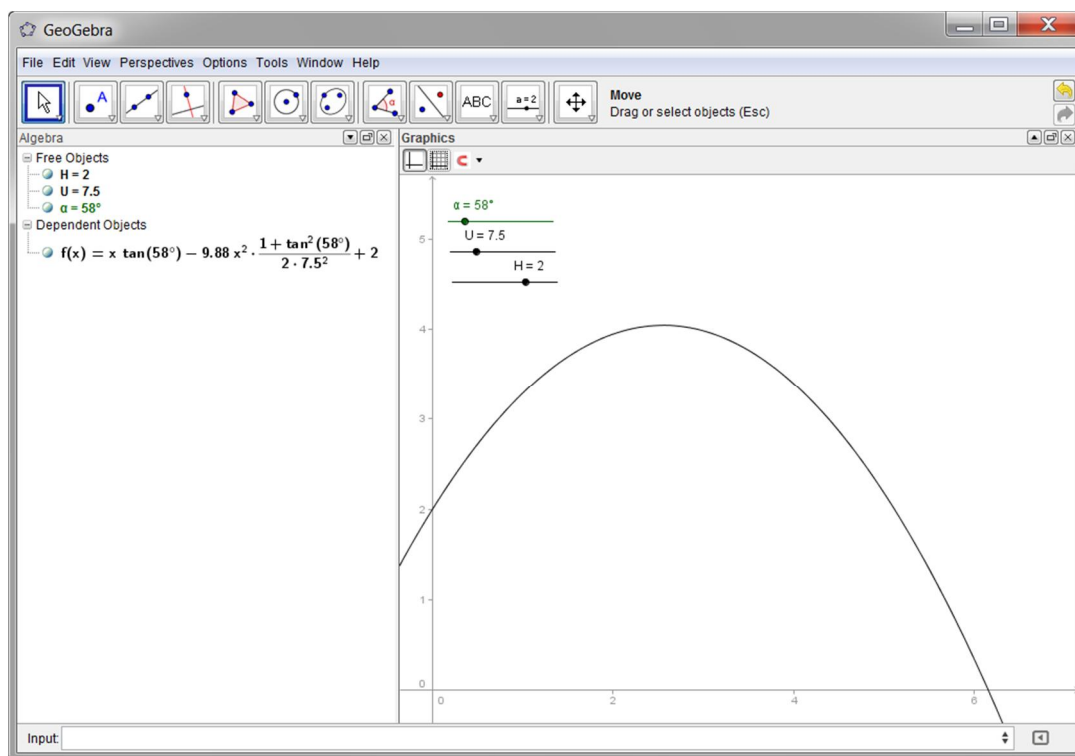
That is, the familiar Trajectory Equation of a particle projected from a height  $H$ . Namely:

$$f(x) = x \tan(\alpha) - \frac{gx^2}{2U^2} (1 + \tan^2(\alpha)) + H$$

*Notice: To enter angles into formulae when typed in to the Input Bar, follow the steps outlined here to the right.*



On completion, you should see a picture like the one below:



Alter your Slider Controls to see the effects on the trajectory of the particle.

For example, what observations can be made about the maximum horizontal distance possible, given fixed values of  $H$  and  $U$  as  $\alpha$  is varied?