TWGHs Wong Fut Nam College
Using GeoGebra and Its Resources to Facilitate
Self-Directed Learning in Secondary Mathematics

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Materials of the Workshop   https://ggbm.at/w76hmvhc

A. Using GeoGebra Resources to Facilitate Self-Directed Learning in Mathematics

Repositories of GeoGebra Resources

gMath   www.gmath.hk

GeoGebra Institute of Hong Kong   www.geogebra.org.hk/materials

GeoGebra Official Website   www.geogebra.org/materials

Examples

1. Area of Two Rectangles   https://ggbm.at/d4sjckah

2. Exterior Angles of a Polygon   https://ggbm.at/434

3. Error in Measurement   https://ggbm.at/4974291

4. Area of Circles   https://ggbm.at/279

5. Volume of Spheres   https://ggbm.at/166700

6. Addition and Subtraction of Directed Numbers:
   Counters Model   https://ggbm.at/33506637 , https://ggbm.at/33641299
   The Elevator Model   https://ggbm.at/30179336 , https://ggbm.at/30179640

7. Exploring Congruence of Triangles   https://ggbm.at/8480831

8. Quiz on Solving Right-angled Triangles   https://ggbm.at/2860441

9. Quiz on Special Lines in Triangles   https://ggbm.at/2212935

B. Using GeoGebra to Draw Mathematics Figures and Graphs

Installing GeoGebra

Download and install **GeoGebra Classic 5** at https://download.geogebra.org/package/win .
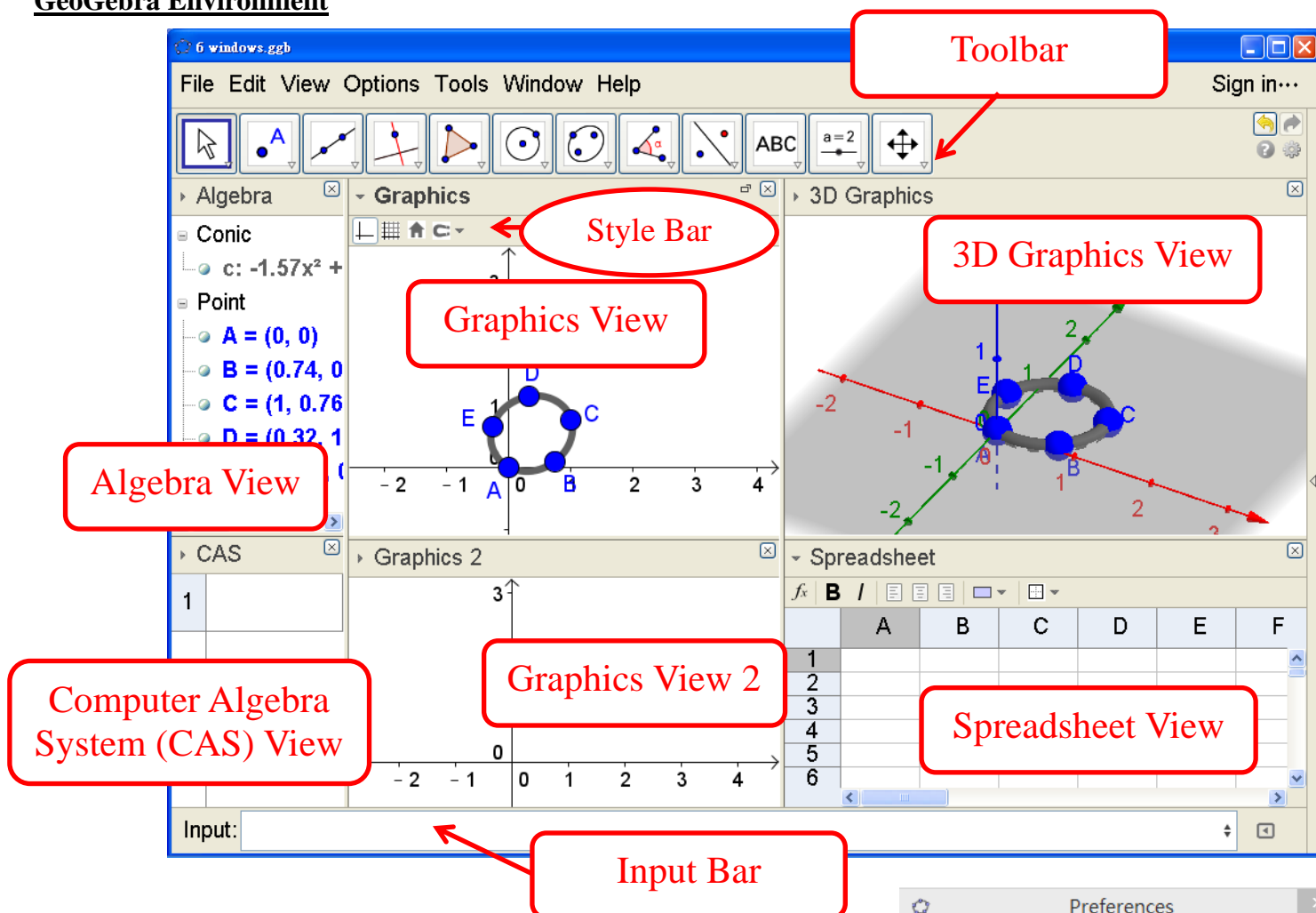
(DO NOT download Classic 6 if you are using desktop or notebook computers.)

Alternatively, download and run **GeoGebra Classic 5 Portable** at

https://download.geogebra.org/package/win-port.

GeoGebra Environment

Basic Settings:

1. Options | Language | English (US)
2. Options | Labeling | No New Objects
3. Options | Font Size | 20 pt
4. Show the Style Bar by clicking "▶" at "Graphics"
5. Uncheck
6. Right-click any space in Graphics view, choose **Graphics** and **Grid** tab. Choose and check boxes as shown.
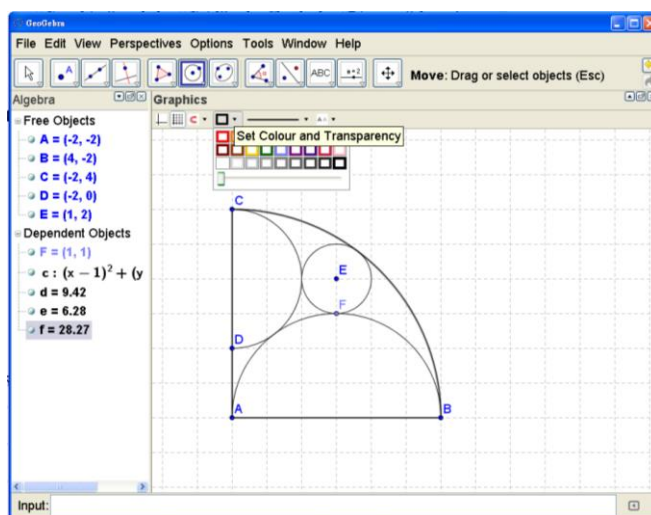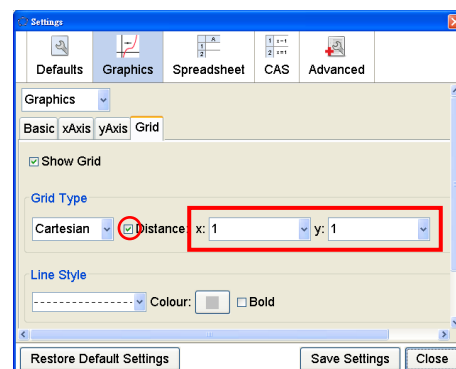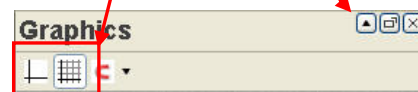7. Options | Save Settings
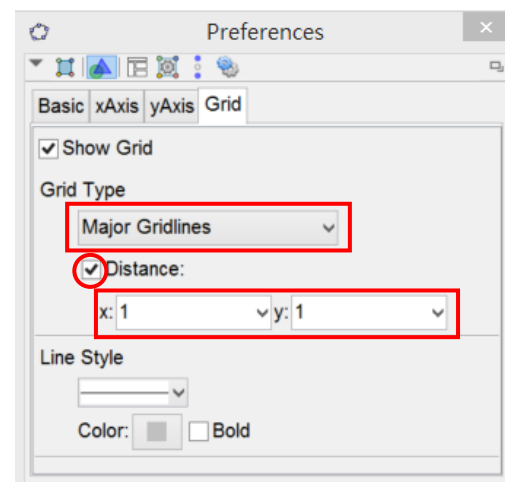
Task 1 Drawing Figures on Grid

1. Show the Styling Bar of the Graphics view. Hide the axes and show the grid.

Show/Hide Axes and Grid   Toggle Styling Bar

2. Right-click at any position in the Graphics view. Choose "**Graphics**" and the "**Grid**" tab. Check the "Distance" box and set the distances of x and y be both "1", as shown in the figure.

3. Use the "**Circular Sector**" tool, "**Semicircle**" tool and the "**Circle with Centre through Point**" tool in the Circle and Arc toolbox to draw the figure below. Note that the sector is drawn in the anti-clockwise direction while the semicircle is drawn in the clockwise direction.

4. Select the sector. In the Styling Bar set the colour of the sector to "Black" and set it to transparent.

5. Choose from the menu bar "**Edit | Object Properties**" (or press **Ctrl**+**E**). In "Object Properties", click "Point" to select all the points. In the "Basic" tab, uncheck the "Show Object" box to hide the points.
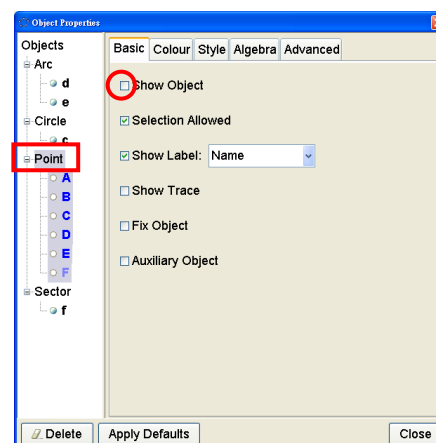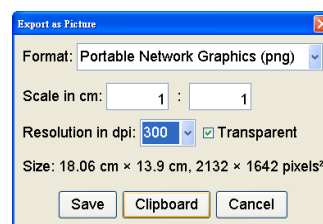
Task 2   Exporting Figures to Word

1. In the previous task, hide the grid.

2. Select the figure.
   Choose from the Menu ""**File| Export| Graphics view as Picture (png, eps) … Ctrl+Shift+P**". Set the "Format", "Scale in cm" and "Resolutionin dpi" according to the figure.
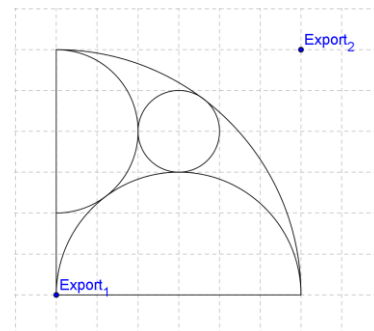   Click "Clipboard" button afterward.

3. In Microsoft Word, press "**Ctrl+V**" to paste the figures. The figure is exported precisely in the scale 1 cm = 1 unit.

4. Use the Point tool [●A]. Click at any two positions to create two points.

   Right click each of them, choose "**Rename**" and enter respectively "**Export_1**" and "**Export_2**" to rename the points as "$Export_1$" and "$Export_2$".

5. Show the grid. Drag these two points "$Export_1$" and "$Export_2$" to positions such that the rectangle defined by them just enclose the figure.

6. Hide these two points and the grid.   Press "**Ctrl+Shift+P**", click the "Clipboard" button and then paste the figure in Word.   Save your file if necessary.

   ** If you create points "Export_1" and "Export_2" and do not make any selection, the content in the rectangle defined by these two points would be exported.

Task 3　Graphing Functions

1. Visit https://ggbm.at/4084945.
2. Set: Scale X=1, Scale Y=2, min. X=-2, max. X=5, min. Y=-4, max. Y=12, Step X=1, Step Y=2
3. Input: `If(-2<x<5,x^2-3x+1)`
4. Change the function to black color.
5. Check "Set margin". Adjust the margin by the slider. Zoom in or zoom out when necessary.
6. Drag the axis labels to appropriate positions. Then uncheck "Set margin".
7. You can choose among 3 output file sizes for PNG file format.
8. Click the button "Save PNG" and right click the graph to copy it to clipboard.
9. In Microsoft Word, insert the graph into your document by pressing Ctrl-V.
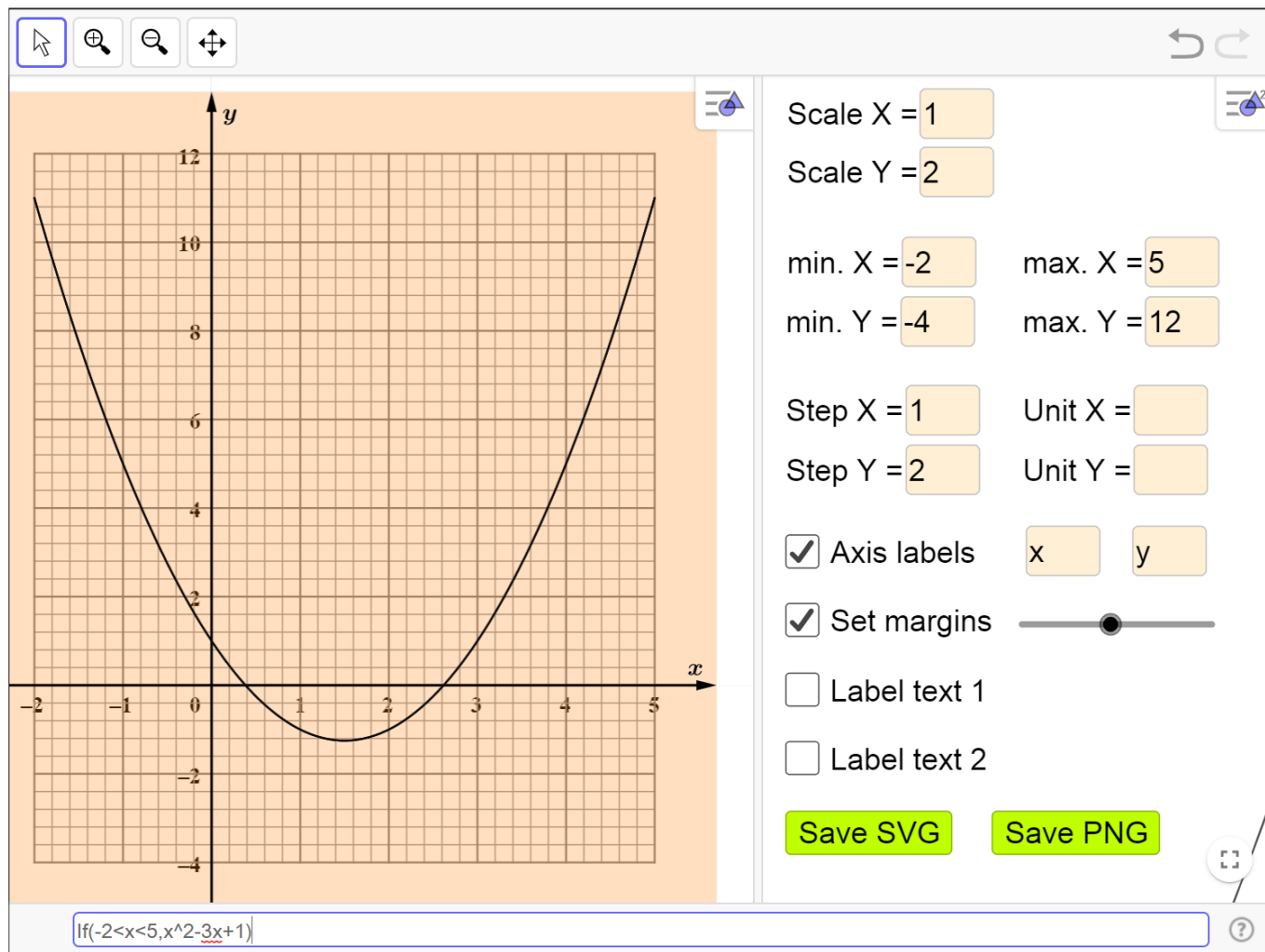
C. Creating Simple GeoGebra Applets

Task 1   Rotation on the Coordinate Plane

1. Show the Styling Bar of the Graphics view. Click the icon in the Styling Bar to show the grid.

2. Use the "**Rigid Polygon**" tool. Click respectively on the positions (0, 0), (4, 3), (4, 0) and then back to (0, 0) to construct a right-angled triangle.

3. Drag the triangle or A to translate it. Drag B to rotate it.

4. Right-click B, choose "Rename" and enter "P" to rename it as P.

5. In the Algebra view, uncheck the button of A to hide it.

6. Press and hold the "Ctrl" key to select the horizontal side (named b) and vertical side (named a). In the Styling Bar choose to label the sides by "Value".

7. Select the right-angled triangle and the point P. Press "**Ctrl+C**" and then "**Ctrl+V**" to copy and paste the triangle and the point. Move the mouse pointer to a position so that the two triangles overlap. Click to fix the position of the copied triangle.

8. Drag the point P_1 to rotate the copied triangle. Rename point P_1 as P'.

9. Right-click P and choose "Object Properties". Check the "Fixed Object" box to fix it.

10. In the styling bar of the Graphics view, choose "Snap to Grid".

11. Drag P' to investigate the coordinates of the point P when it is rotated through 90°, 180° and 270° anti-clockwise about *O*.
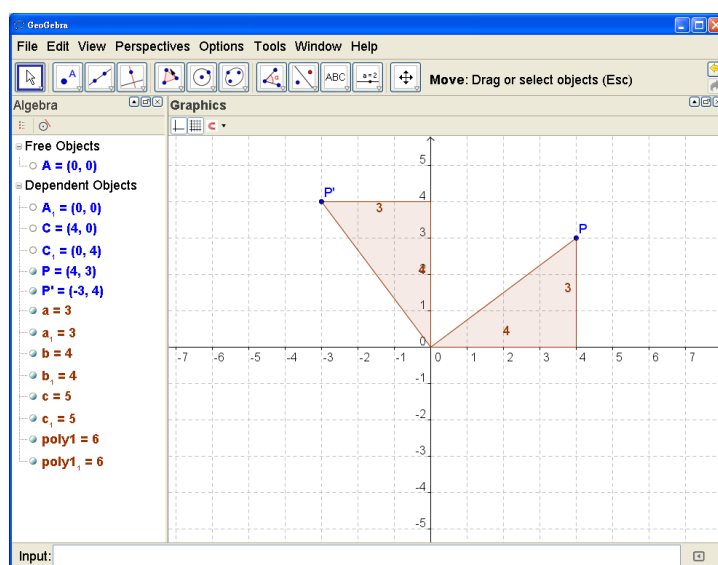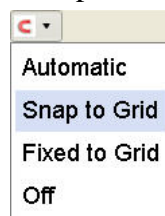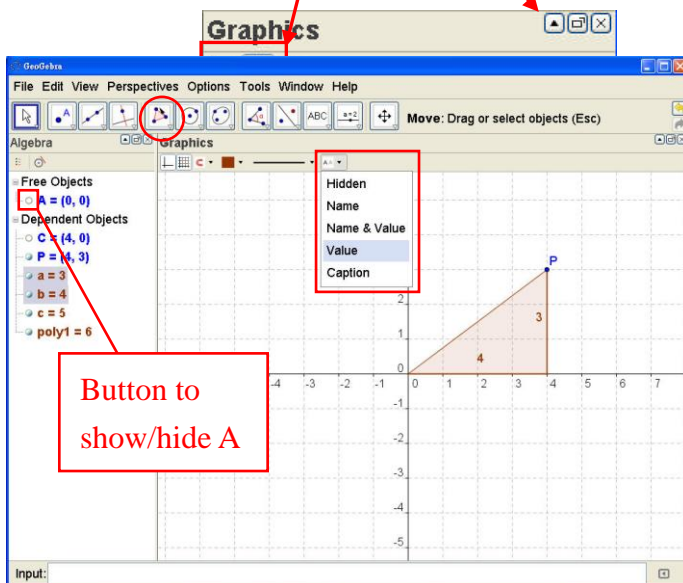
Task 2   Graphs of Trigonometric Functions

1. In the input bar enter:

   `sin(x°)`

   Enter ""°"" by clicking ![α] in the input bar, or press "**Alt + o**".

2. Right click on the empty space of the Graphics view. Choose "Graphics" and set values in the tabs according to the following figures.

3. Drag the curve to see that it is movable (and its equation changes accordingly). To fix it, press **Ctrl**+**Z** to undo the action, then right-click the curve and choose "Properties". In the "Basic" tab check the "Fix Object" box.

4. To confine the curve in the range $0° \leq x \leq 360°$, double-click the curve and redefine it as:

   `If(0<x<360, sin(x°))`

5. Enter in the input bar the command

   `a = 1`

   In the Algebra view, check the button of *a* to show the slider controlling its value.
   Drag the slider to the right hand side of the Graphics view.
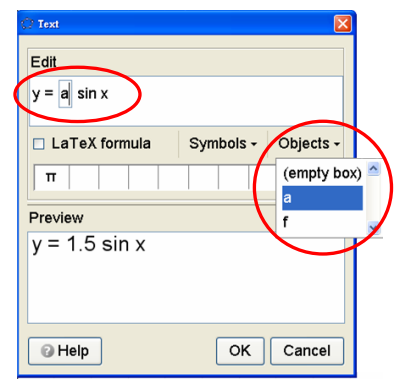
Buttons to show/hide objects

6. Double-click the slider. Adjust the range of values of *a* as shown in the figure.

7. Double-click the curve and redefine it as:
    `If(0<x<360, a sin(x°))`

8. Use the "Insert Text" [ABC] tool. Click on an appropriate position. In the Text window type the content as shown in the figure. The boxed variable a is obtained by choosing "a" in the "Objects".

9. To obtain square grid, enter the command
    `SetAxesRatio[30,0.25]`
    Use the slider to change the value of *a* and see how the graph changes accordingly.

10. Upload your applet to www.geogebra.org.