ScienceWord and Class drawing basic notions

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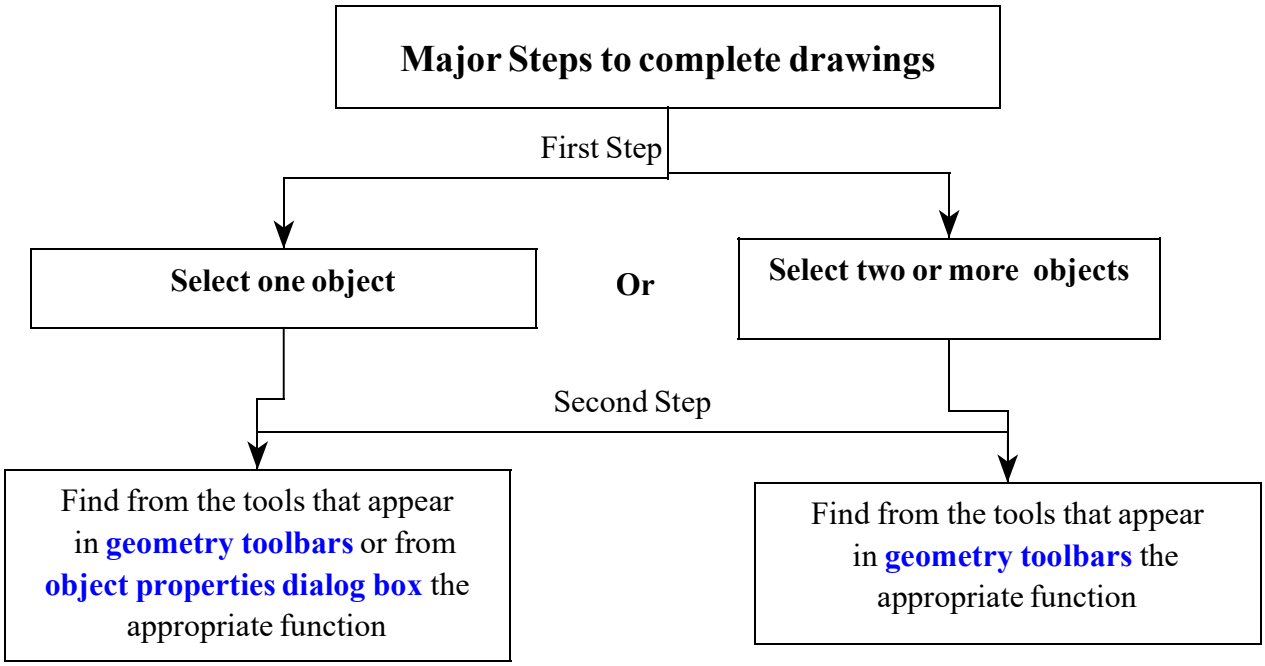
Introduction

Like in any traditional application, you can draw in ScienceWord or Class by proceeding through alignment, superposition or grouping of objects. But this is a method whose efficiency is believed to be limited. ScienceWord and Class make it also possible to draw on the basis of plane basic elements (point, line, triangle, circle, etc.) , plane geometric transformations (rotation, symmetric, translation, enlargement) and drawing practical tools that appear in the Geometry Toolbar when one or several basic elements are selected. The additional option of drawing lines in the natural way even in continuous mode for the purpose of parallelism, perpendicularity or linking objects through a specific relationship makes geometrical drawing easier. The options in "objects Properties" and "motions properties" contribute also in a no small way in the making of drawings. Finally the animation concept based on variable objects and variable data widens the applications of ScienceWord and Class to be powerful education teaching and investigation tools at all educational levels.

1) A big revolution in drawing process

a) The General process

All kinds of drawings follow not more than two major steps and all the needed functions to complete a drawing are available at not more than two locations (Geometry toolbar and Object properties dialog box)



When any basic plane gemetric object is drawn (but under selection) , some useful tools pop up automatically in geometry toolbar.

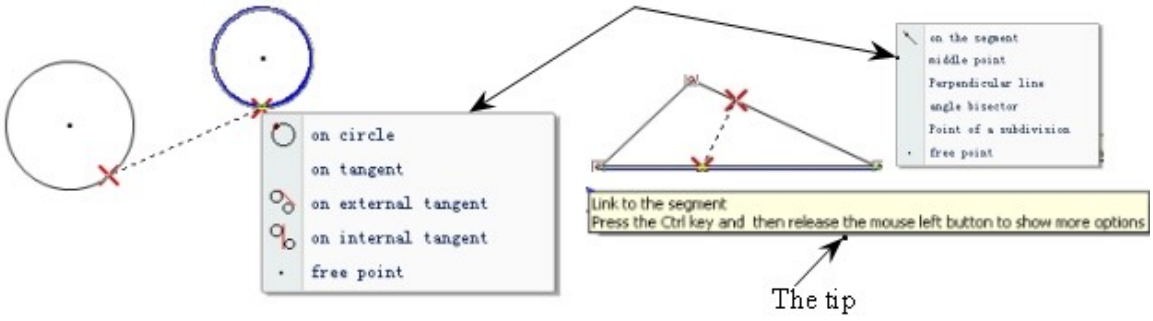
For example, when a point of a plane is selected, the tools for drawing a half-line coming from this point or a circle centered on this point pop up in the drawing toolbar . Similarly, when two points of the plane are selected, the tools appear in the drawing toolbar for the purpose of: drawing the segment linking these two points, subdividing this segment into a number of equal parts, determining the symmetry of one of the points in relation to the other, determining the rotation of one point around the other, drawing the circle centered on one of the points and passing through the other, or defining a vector defined by a couple of these points. ***There is generally a perfect correspondence between the basic geometric drawings under consideration and the geometric tools required for creating a geometrical object****.*

b) An additional option for drawing lines, circles and points

i) The natural way to draw a line

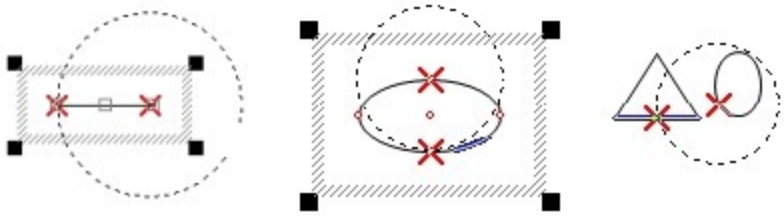
When you draw a line to an object or from this object, a tip appears automatically showing the current action and a prompt screen tells you that you could press Ctrl key and release the mouse to access more options ..

Some menus that appear when
Ctrl key is pressed down



ii) The natural way to draw a circle

You can draw directly a circle centered to a point of an object or passing a point of this object diirectly. as shown below,



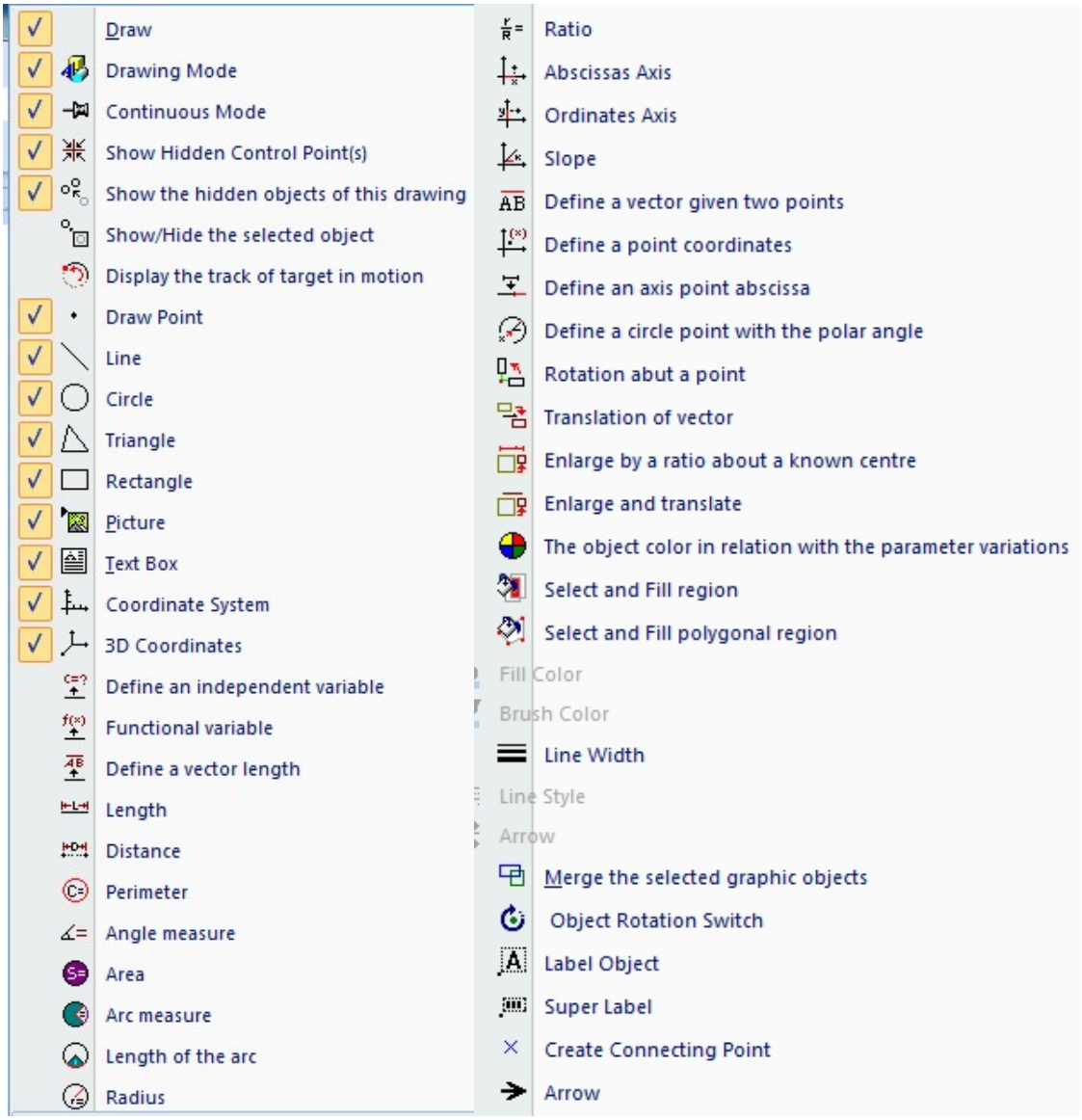
iii) The natural way to draw a point

You can click on the point tool to draw directly even in continuous mode a point on a segment, any side of a polygon, a circle, an arc, an ellipse or an intersection point of a segment and a circle or two circles.

Note: The following tools , , that appear in geometry toolbar when a line, a polygon or a curve (circle or arc of circle, ellipse) is selected, help to draw a point only on the selected object. That point can be shifted all along the object on which it is drawn.

c) The complete list of tools that appear in Geometry toolbar

We are showing as folows the complete list of tools that appear in geometry toolbar
As it is said above, these tools appear only when the selection of geometry objects have been made



d) Manipulation of the tools that appear in geometry toolbar

i) The principle of manipulation

- Firstly, place the pointer on the tool momentarily to make the function it executes appear

- Secondly, click on the tool.

* Either a result is obtained immediately; this is the case for example with the inscribed circle of a triangle.

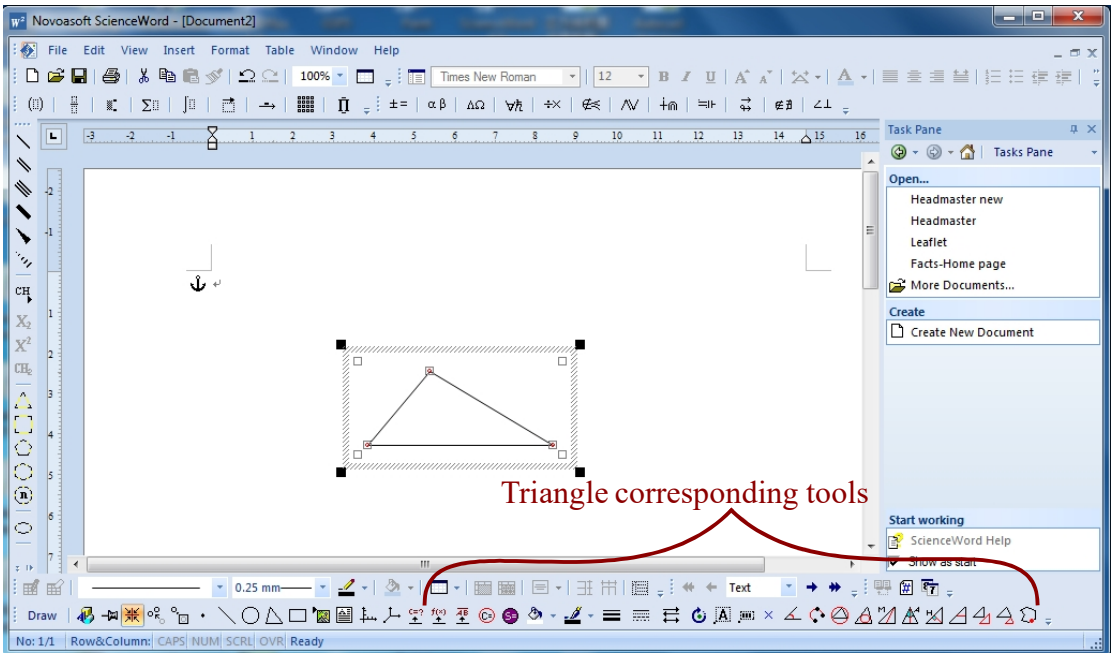
* Or a dialog box appears and you simply type simple text; this is the case for example in **"Label Object "** ().

* Or a text zone appears and where you can type a text including formulae. this is the case for example in **"Super Label**  **"**

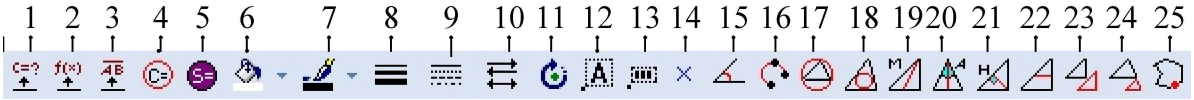
* Or the pointer takes a particular shape: the shape  , when clicking directly onto the workspace; the shape  when clicking at a precise place, for example on the vertex of a triangle (to draw a median line, to create an arc of a circle) or at a point of a straight line in order to select this point, etc.

ii) Example of geometric corresponding tools of the triangle

For example, to draw a triangle in ScienceWord, click once on the "  " button in the geometry toolbar, then slide the pointer to the workspace. When the pointer changes to a pencil  , click on your workspace to get the triangle. It appears in a rectangular region called the " Selection Region" which has a tiny white square at every corner: this is the "Selection Mode" (see the figure below) . After selecting it , you can shift it using the directional keys (→ , ← , ↑ , ↓) . You could also move it with the mouse whilst it is selected. Practically, move the pointer towards the triangle and when it takes the form  , make a left-click and slide the mouse to get the shift desired..



In fact, as soon as the triangle appears, the tools also appear in the geometry toolbar.

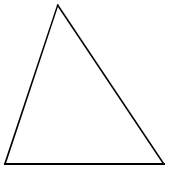


The tasks assigned to these tools are listed as follows in increasing numerical sequence:

1 - Define an independent variable; 2 - Functional variable; 3 - Define a vector length; 4 - Perimeter; 5 - Area; 6 - Fill Color; 7- Brush Color; 8 - Line Width; 9 - Line Style; 10 - Arrow; 11 - Object Rotation Switch; 12 - Label Object; 13 - Super Label; 14-Create Connecting Point; 15 - Angle Label Arc; 16- Arc passing three known points; 17- Draw circumscribed circle of triangle; 18- Draw inscribed circle of triangle; 19 - Draw median of triangle; 20 - Draw angle bisector of triangle; 21 - Draw altitude of triangle; 22- Draw line segment bisecting two sides of triangle; 23 - Draw congruent triangle; 24 - Draw similar triangle; 25 - Select a point of a polygon.

Note: When you click outside the triangle, the tools beneath would disappear. This indicates simply the fact that the triangle is no more selected. To select again the triangle, move the pointer to one of its sides, then click on this side when the pointer changes to  *shape.*

In the following, we shall be seeing the effect of each of the mentioned above tools ***(the five first will be study further)*** *. In each case here, the tool shall be applied on the triangle opposite:*

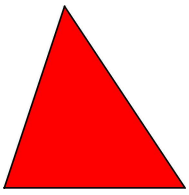


"*Fill Color* () **"**

To colour the inside of the triangle, click on the  button. The opposite palette of colours pops up;

Click for example on the red colour.

The inside of the triangle would get coloured red as in the following figure.



"*Brush Color* ( ) "

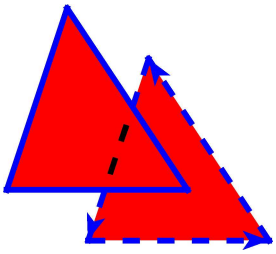
To colour the sides of the triangle, click on the button. To select a colour, click on the corresponding drop down arrow and the same palette of colours pops up as previously.
For example, by clicking the colour blue, you would get the opposite figure;
Similarly, you could define the sides of the triangle with;

"***Line Width***" ( ), for getting the desired thickness of the line.

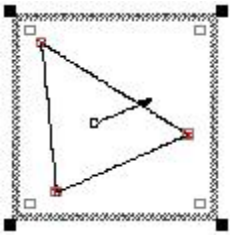
"***Line Style***" ( ), for getting the desired style of the line.

"***Arrow***" ( ), for putting the arrowheads desired on the ends of the sides of the triangle.

"*Object Rotation Switch* ( ) "



To make the triangle undergo a rotation, click on the button

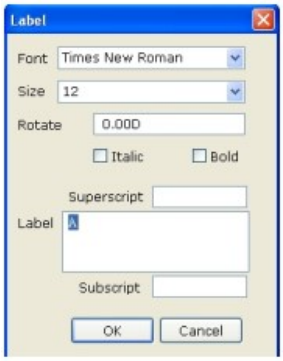


You would obtain the figure:

Move the pointer to the arrowhead of the arrow that appears by default (automatically) at the center of gravity of the triangle. When the pointer takes the following shape , hold down the left button of the mouse and then move the mouse in the direction you wish, in order to effect slight movements of the triangle and then get the desired rotation.
To move the center of rotation to a given point, just move the arrow so as to place its origin at the chosen point which then becomes the new center of rotation.

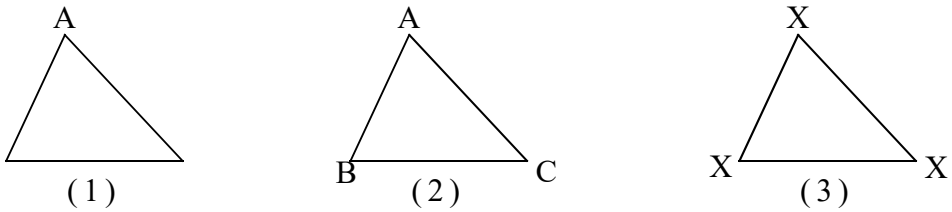
"*Label Object*"

ScienceWord makes possible label objects by using the **"*Label Object*"** function ( ). For example, to label the top point of the triangle, select the triangle and then click on the button in the geometry toolbar. In the opposite dialog box opens up, type in label box the name, then select the size by clicking on the drop down arrow of the "size" field. Confirm your choice by clicking on "OK ". Then you can adjust the position of the label A with the help of mouse of arrow keys. (See (I))



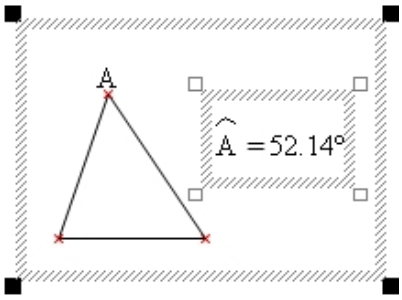
Note:

- If you want to label the other vertices B and C, you just need to select them in the corresponding order and click on the label tool . (See (2))
- If you want to label all the three vertices with the same letter X, then select one of them and click on the label tool ; next, write X and type once on the space bar to add a space and click OK. Then select the two other vertices and click on the label tool to get the result..Actually, the letter "A" appears as an image. (See (3))



"*Object* Super *Label*"

ScienceWord makes possible label objects by using the ***"Super Label Object"*** function where it is possible to write text with several lines, symbols, formulae of all kinds and even insert pictures exactly like in Text Box! (See picture below) .



"Connecting Point ( ) **"**

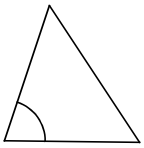
You could also create an interdependent point of the triangle by clicking on the button, then click at the place desired on your workspace.

Generally, any modification of the position of the interdependent point is made by means of the mouse (the arrow keys are not suited for this) .

"*Angle Label Arc* ( ) **"**

To create an arc at any corner of the triangle, click on the button " " . When the pointer

of the mouse changes on the workspace to , click exactly on the corresponding vertex to the corner in question.

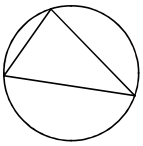
An arc of the circle centered at the vertex chosen appears 

Using a process similar to that of the creation of the arc of any corner of the triangle, you could draw:

- An arc of a circle intersecting the vertices of the triangle; by using the button.
- The median line exiting from a vertex of the triangle; by using the button.
- The interior angle bisector exiting from a vertex of the triangle; by using the button
- The altitude exiting from a vertex of the triangle; by using the button.
- The segment joining the middles of two sides of the triangle, by using the button.

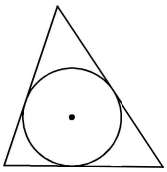
"*Draw circumscribed circle of a triangle* ( ) **"**

To draw the circumscribed circle of a triangle, just click on the button.

You will automatically obtain the following triangle 

"*Draw inscribed circle of triangle* ( ) **"**

To draw the inscribed triangle, click on the button.

You would automatically get the following figure 

"*Draw congruent triangle* ( )

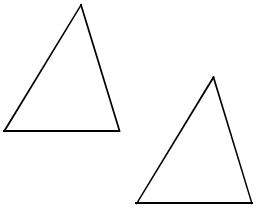
To draw a triangle congruent to a given triangle, click on the button.

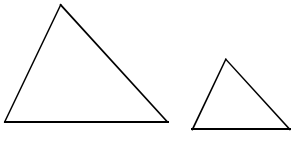
You would obtain in this way a triangle congruent to the initial.

You cannot modify the size of a congruent triangle.

"*Draw similar triangle* ( ) **"**

To draw a triangle similar to a chosen triangle, click on the button.

In this way, you would obtain a triangle similar to the original 

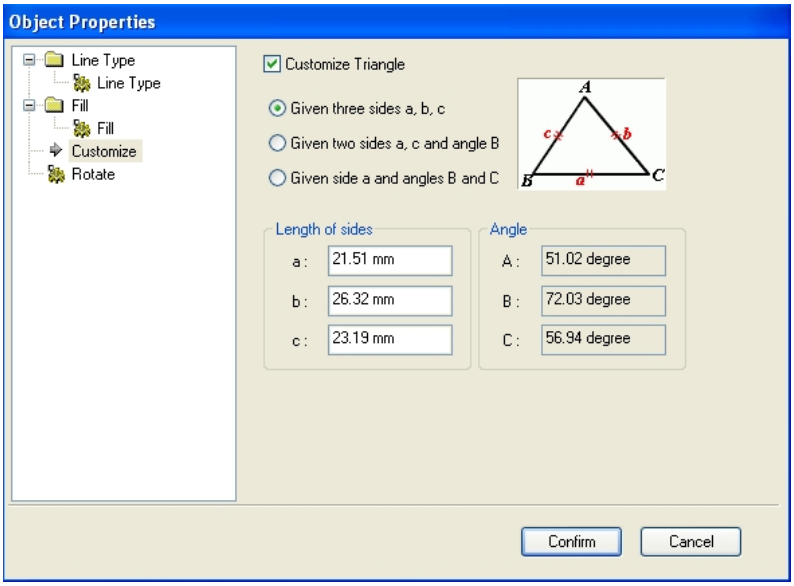


e) Object Properties dialog box

The properties of an object contain several options for carrying out modifications.

To get to properties of an "***Object Properties***"dialog box, click with the left button of the mouse on this object in order to select it; thereafter make a right-click with the mouse. Click on "***Properties*** " in the contextual menu that pops up.

To illustrate the importance of the properties of an object in ScienceWord, we present below in a practical application the "***Object Properties*** " of a triangle: the dialog box of this object properties provides data on various elements of the triangle. Modifications can be brought about to this triangle by acting directly on these data



To access these data, click on "Customize "and then tick off the Customize Triangle box (Customize Triangle) . Then you can modify them in order to configure the triangle in another way. There are in all, three options for modifying the dimensions of the triangle. Select each of these options and make modifications accordingly to the properties of a triangle ($a \leq b + c$ and $A + B + C = 180^0$) and then confirm by clicking on "OK".

2) Principles of selecting drawings

Every selection of a drawing is based on the plane geometric objects, i. e. **basic geometric shapes.**

A basic shape consists of **points** or **segments** designated here by the term **elements.**

In a single selection (selection of **a single** object or of **a single element**) .

i. To select a basic shape or a point, just click on this shape or this point..

ii. To select an element of a basic geometric shape just hold down the " Ctrl" key and click on this element . Then, when the selection is done, release the Ctrl key..

During a multiple selection (selecting or deselecting **several** elements or objects) , the

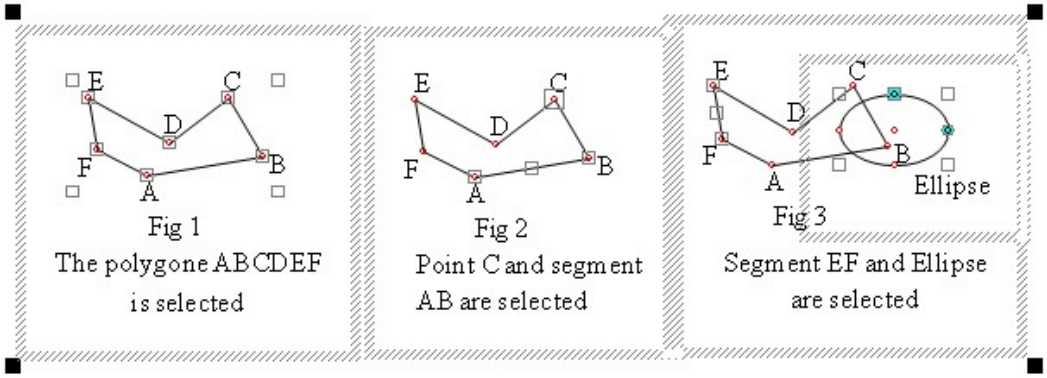
rule is as follows, where any key used should be realeased at the end of this selection:

iii. To select or deselect a point or any object, only the "Shift" key must be depressed simultaneously whilst you click on the point or the object.

iv. To select or deselect an element of any object, both "Ctrl" and "Shift" keys must be pressed simultaneously whilst you click on the element.

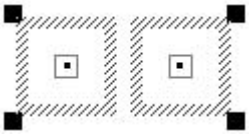
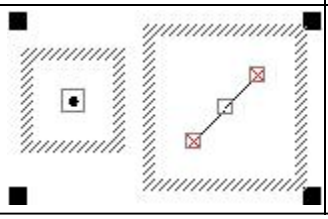
v. To cancel the whole series of selections, jsut click in the empty space.

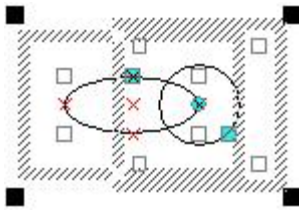
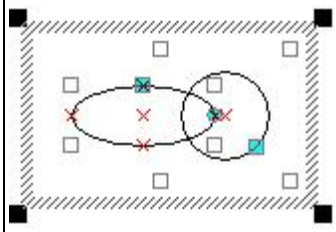
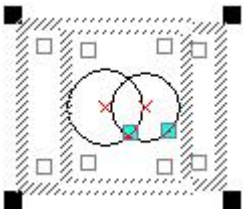
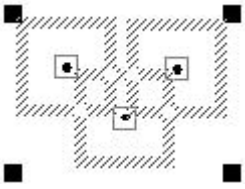
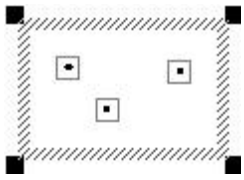
a) Examples of objects and elements selected



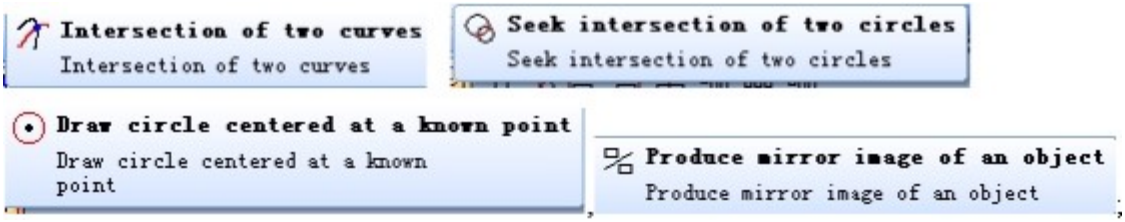
b) Selected objects and corresponding tools

We are giving in the following table some examples of objects selections and the corresponding tools that appear in geometry toolbar.

Type of selection	Appearence of the selection	Tools that appear in geometry toolbar
A point is selected		
Two points are selected		
A point and a line are selected		

A circle and an ellipse are selected		
A circle and an ellipse are selected and grouped with Combine tool		
Two circles are selected		
An ellipse is selected		
Three points are selected		
The three selected points are Combined with tool		

Note that you can place the pointer on the tool momentarily to make the function it executes appear.as shown as follow::

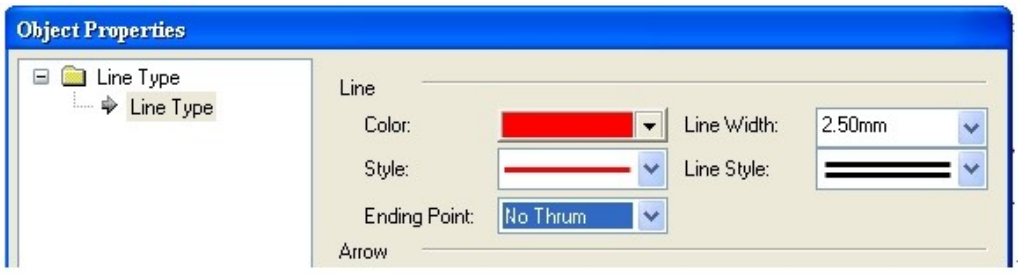


c) Practical examples

i) Example 1 (Symmetry)

- Click from the task pane on the button  in the geometry toolbar to draw six sides ordinary polygon ABCDEF. Then move the vertices in order to get the polygon as show in Fig1.

- Select the side AF, right click to access object properties dialog box and customize the line color, the line style and the ending point as shown as follow



- Click on button 

. Then you obtain the result as shown in Fig2.

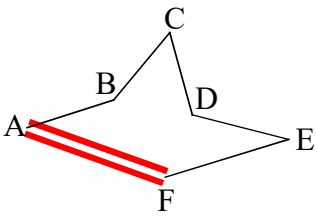


Fig 2

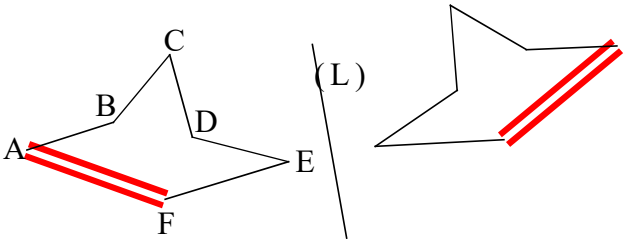


Fig 3

Select the polygon and the line in that order, then click on the icon  that pops up in the geometry toolbar to obtain the symmetry across the line (L) of the polygon (see Fig3).

ii) Example 2 (Intersection and difference of regions)

Draw a circle and an ellipse as shown in Fig4. S

Select them and click. in geometry toolbar on the icon  Select and Fill. The result is shown in Fig5.

Click in the hatched region to select it and right click to access object properties dialog box.

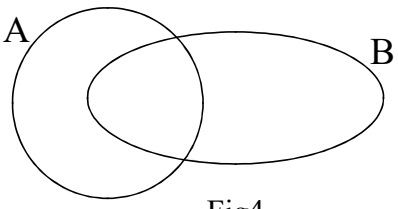


Fig4

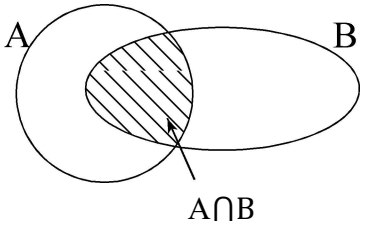
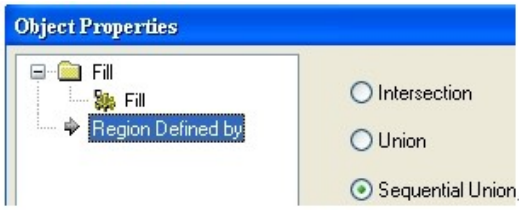


Fig 5

Select "Region defined by" and click on button 

to get the following dialog box



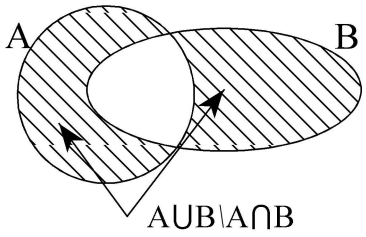


Fig 6

Check Sequential Union and click on button 

to get the result of Fig6..

Remark:

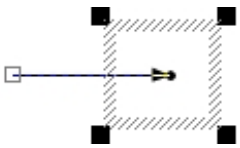
Given R_n *(* $n \geqq 2$ *),* *the set determined by the application of the* ***"Sequential Union-Intersection"*** *option* to *N*sets (objects) $A_1, A_2, \ldots A_n$.

- If $n = 2$ then, $R_2 = A_1 \cup A_2 - A_1 \cap A_2$ (see *example* 3 above).
- If $n = 3$ then, $R_3 = R_2 \cup A_3 - R_2 \cap A_3$.
- For every integer *i* such as $4 \leq i \leq n$, then: $R_i = R_{i-1} \cup A_i - R_{i-1} \cap A_i$

3) Specific drawing techniques

a) The point

When the point is selected, the "Arrow  " tool appears in geometry toolbar; click on it. An arrow appears as the figure below shows.



Get hold of the arrow by the left end (i.e., when the pointer turns into the following

shape , click on the left end point of the arrow) . Hold down the left button of the mouse depressed and then position the arrow conveniently by using slight targeted movements of the mouse. You could go to the properties of this arrow by means of the contextual menu and carry out modifications of your choice

b) The straight line

Generally to draw a line, click on icon in the Geometry toolbar, then click on your worksheet or hold down the left button of the mouse and drag it in the appropriate direction. In the first method, we obtain an horizontal segment line which starting point is at the upper left whereas for the second, we obtain a segment line of any direction which starting point is the first drawn.

i) To draw a horizontal or vertical line, press the "***Shift*** " key whilst drawing the straight-line.

ii) After having drawn a non-horizontal or non-vertical straight line, you could make it horizontal or vertical. To do this, keep the "***Alt*** "key pressed down, get hold thereafter on one end of the line by means of the pointer of the mouse, then make movements in the appropriate direction with the mouse.

iii) The position of the starting point of a segment line does not change when its length is modified from the "Object Properties" dialog box.

c) The triangle

Click in geometry toolbar on the icon "Ordinary triangle" tool. Then, move the pointer of the mouse to the working page and as it turns into a pencil , hold down the left button of the mouse and drag the mouse to draw a triangle. A vertex of the triangle can be shifted with the mouse or any of four directional keys of the keyboard.

d) The square

To draw a squre, just click on the rectangle button and hold down the Shift key whilst drawing'

e) Round-angled Rectangle

Click on the button in the toolbar and then click on the workspace. Then a rounded-angled rectangle appears, as in Fig 1 :

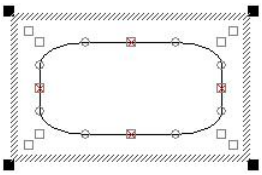


Fig 1

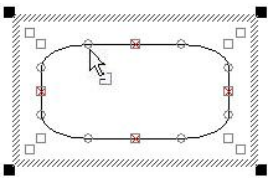


Fig 2

Take note that there are eight small rounds "○" on this rounded- angled rectangle. They serve as a support to the construction of other specific shapes of the rectangle. In the following, we shall consider four types of constructions, with a round as the departing point.

Move the pointer of the mouse to a round as shown in Fig 2..

As soon as the pointer changes to the  shape, click on the round and hold down the left button of the mouse. You could thereafter:

i) Move directly the round using small movements of the mouse; in this case, this is a total modification of the round-angled rectangle.

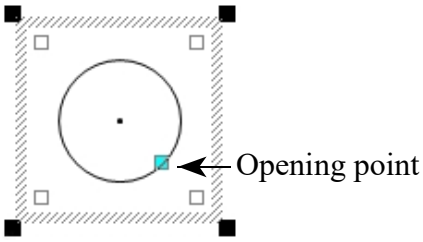
ii) Press the ***"Ctrl"*** key and hold it down, then move the round ; in this case, the modification has been done to half of the part of the round-angled rectangle previously modifiable in ii)

iii) Press the ***"Shift"*** key and hold it down, then move the round ; in this case, the modification has been done to half of the part of the round-angled rectangle previously modifiable in iii)

Remark: The tools that appear when the rounded-angled rectangle is selected and the options available in the "Object Properties " dialog box can be useful for other modifications.

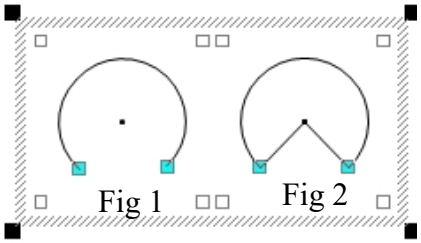
f) The opening point of the circle

Let consider the following selected circle:



The point termed the opening point of a circle is the green point by default of the circle. The radius joining this point and the horizontal line passing through the center of the circle form an angle of 45^0.

Click on the opening point and hold down the left button of the mouse. Whilst you slide the mouse, make a pushing movement of the pointer towards the exterior part of the circle (Fig 1) or a movement of the pointer in the direction of the inside of the circle (Fig 2) .

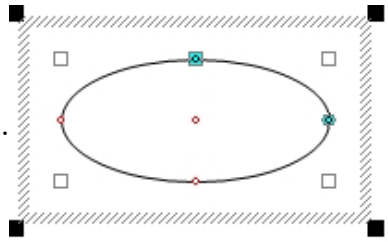


In all the cases, you would obtain an arc having two ends. You could join these two ends again, so as to get the entire circle with a different position of the opening point..

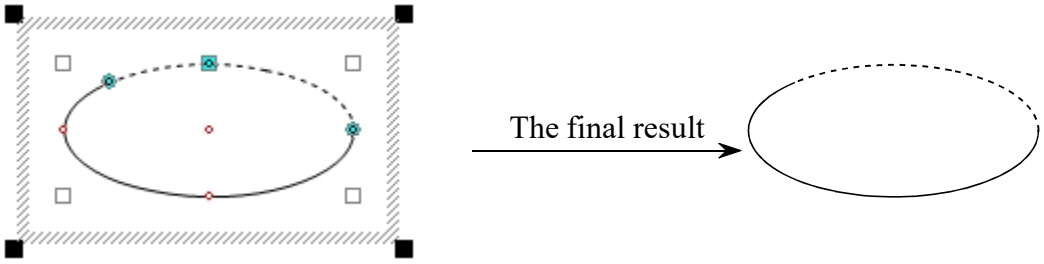
g) The opening point and dotted line point of the ellipse

Click on the ⬭ button in plane geometry toolbar, then on the workspace.

You would obtain an ellipse in this way .



You would notice that the ellipse, like the circle, possesses an opening point (the small green square) . But it also has another point (round and green) which determines the dotted line of the ellipse. To obtain such a line, click on this green point, hold down the left button of the mouse, then, using slight movements of the mouse, propel this point in a rotating motion (for example, in the anti-clockwise direction) . The dotted line depends on the new position of this green point (See the following illustration) :

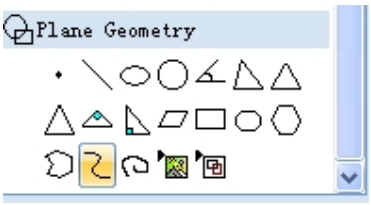


Here, the ellipse appears still selected and the green point is split. When you then click outside the ellipse, you would obtain the following final result.

As is the case with all objects, some tools appear in the geometry toolbar when the ellipse is selected. They help as ellipse properties bring about the modifications necessary for the realisation of a drawing.

h) The Bezier curve

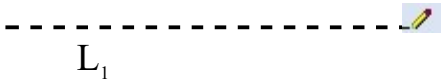
Click from "Plane Geometry " and finally on the " button" of the Bezier curve.



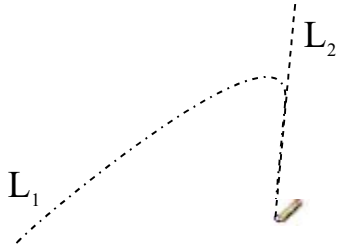
The pointer changes shape to a pencil ( ) on the workspace. You could then draw a Bezier curve.

Click then on the workspace. Then a point is drawn without the pencil disappearing.

i) Slide freely (horizontally for example) the mouse **without pressing** any button; then, a dotted line L, appears whilst the pencil is there (see the figure below) .

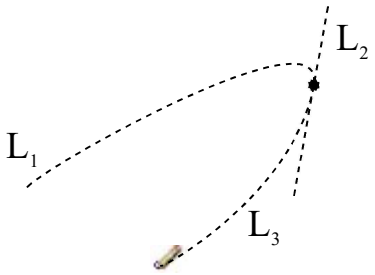


ii) Click again, hold the left button of the mouse down, then slide the mouse slightly whilst changing the direction; then a second line L_2 appears, whilst the first line L_1 curves slightly (see the following figure) .



iii) Release the left button, then restart with a free movement of the mouse

Try for example to obtain the following figure:

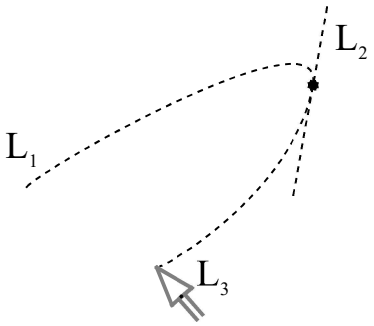


A third line L_3 is then obtained.

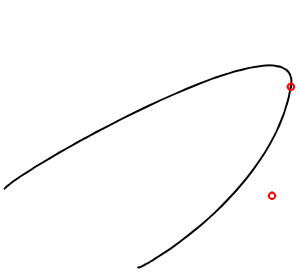
iv) We will now stop drawing.

- Click again; then a new point appears.

- Release the left button, then slide slightly the pointer in such a way as to position it beneath the new point. When the pointer changes to " " shape, click on the new point

(see the following figure) 

Now, the pointer has been freed from the curve and you would obtain the following curve

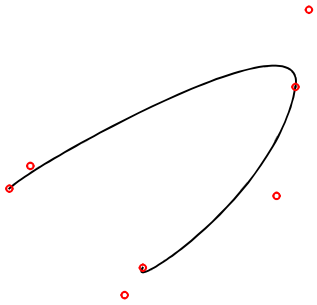


L .

The curve L obtained is the combination of the lines L_1 and L_3 . The invisible line L_2 is ***tangent*** to this curve at the point where the left button of the mouse had been kept held down: such a point is called a ***"tangential point"***. Every point on the curve that is not a tangential point is called the ***"singular point"***.

When the display mode of the control points is active, the ends of line L_2 can be seen. They help modify the curvature of two lines L_1 and L_3 which are both ends of the tangential point.

v) The curve L as it appears here conceals two other control points; one of these points helps to modify the curvature of L_1 and the other helps to modify the curvature of L_3 ; each of the two ends of the curve L conceals one of the points. If this is the case for the curve you have drawn, then click on one of these two ends. Press the left button of the mouse, hold it down and then move slightly the mouse. You would notice a control point that separates itself. Do the same thing to the second end.



vi) Now, you have to manipulate these control points that help modify the curvature of the line L. In this case, there are four control points (the two ends of the invisible line L_2 and the two previously isolated control points of the curve in v) .

Manipulating the two previously isolated points

- Click on one of the points isolated (for example that of the side of L_1) . Hold down the left button of the mouse in order to get hold of this point and then move it in different directions. Observe the different modifications of ***line*** $\boldsymbol{L_1}$.

- Click on the other isolated point and proceed as previously, then note the different modifications of ***line*** $\boldsymbol{L_3}$.

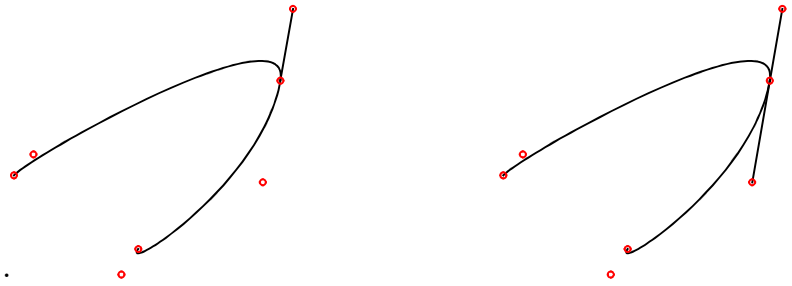
Manipulating the two ends of the invisible line L_2

- Click on any of the two ends of the invisible line L_2, and proceed as previously, then note the different modifications of the two ***lines*** $\boldsymbol{L_1}$ ***and*** $\boldsymbol{L_3}$**.**

- Click on any of the two ends of the invisible line L_2 . Hold down the left button in order to get hold of this point; press thereafter the ***"Alt"*** key, then move this point in different directions. Note the different modifications there are on **a single of the two lines** $\boldsymbol{L_1}$ ***and*** $\boldsymbol{L_3}$**.**

Interpreting the result

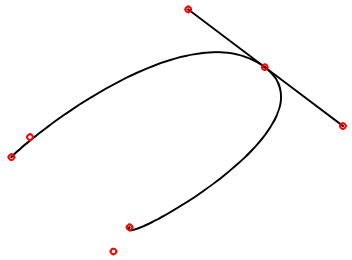
To better understand the manipulation of the ends of the invisible line L_2 , we propose that you draw **respectively** the **two segments** linking the said ends and the tangential point. These two segments should be moved to the bottom layer in order to help select the control points of the curvature of the curve; in other words, **select** every segment and apply to it the **"Move to Bottom**" option via "**Subject Overlay Order**". The following illustration shows the steps of depiction of the two segments (a segment gets drawn first, then finally the other) :



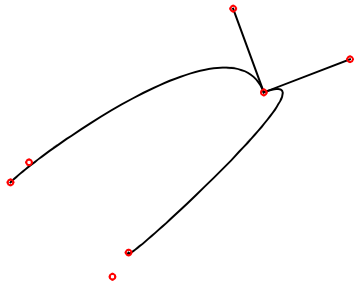
Click on any of the two ends of the invisible line L_2 previously joined at the tangential

point. Get hold of it and then move it without pressing the ***"Alt"*** key, then move it whilst the ***"Alt"*** key is depressed.

In the first case, the **two *portions*** L_1 ***and*** L_3 undergo modifications and remain any time tangent to both segments, which vary themselves as well.



In the second case, a single portion undergoes some modifications and remains any time tangent to a single segment that also varies.



Remarks:

Instead of stopping after the realisation of the line L_3, *we could have continued constructing other lines. These lines would have been obtained in the same manner, be it just after a click of the mouse or a click followed by a holding down of the left button of the mouse. At the stopping point, the same technique applied further above is used.*

In the following, we are considering that the realisation of the Bezier curve proceeds whilst the pointer changes to a pencil ( *). The Bezier curve is considered here as a series of lines, each of them having been generated within two clicks of the mouse.*

- A line is realised within two clicks on the workspace.

- The first click on the workspace begets the first end of the Bezier curve and a control point of the curvature of the first line that will be created.

- The last click on the workspace begets the second end of the Bezier curve and a control point of the curvature of the last line realised.

- An intermediary click, if it were done without the left click being made, begets a point of the curve and one control point of the curvature of the following line.

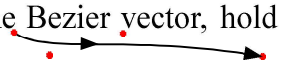
- An intermediary click, if it has done whilst the left click is being made, begets a point of the curve and two control points of the curvature of the preceding and following lines.

*The manipulation of these control points by combining the **"Alt"** key helps limit the control of the curvature exclusively to the previous line or to the following line.*

- The segment linking a point M_1 of the curve and a control point of the curvature M_2 resulting from the same click, is tangent to a line of the Bezier curve in M_1.

i) The Bezier vector

In "Plane Geometry Graph" click on the "  "" button image of the Bezier vector, hold down the left button of the mouse and drag it in the appropriate direction.



This is a particular Bezier curve having just two ***singular points.*** The middle arrow position can be modified with the mouse or through object properties.

j) The customized curve (Smooth Curve)

- Click on the button in the geometry toolbar.
- Click on the workspace and hold down the left button of the mouse to draw a customized curve or keep depressed any one of the "***Ctrl*** ", " ***Alt*** " and " ***Shift*** " keys whilst you draw the customised curve.

In each case, you would obtain a certain degree of flexibility of the curve.

You could customize different types of customized curve through "Object Properties".

k) Inserting an image

To insert an image into a ScienceWord document, click on the "  " button image in the geometry toolbar. Then the "Get Picture "dialog box opens up.

Find and select the image you want to insert into your document, then double-click on it or click on the "Open" button of the dialog box. Then,

- if the cursor is blinking somewhere in the text or in the table, the picture appears automatically at this location into text.;
- if some drawings are previously under selection, then the cursor turns into a pencil and you need to click on a convenient location on the work page to get the image.

Note: The "Save as Picture" option of contextual menu helps to save any drawing to image files. This option is available only in registered version of ScienceWord and Class.

4) Three types of ordinary modes for drawings

a) Show Control Points Mode

In ScienceWord and Class, the "Show Control Points " mode is active by default.
When some geometrical objects are drawn in ScienceWord or Class, they appear with some red points called control points. These control points are shown when the "Show Control Points " mode is active.

To deactivate this mode, just click on the button. To reactivate it, click on the same button.

For example when a triangle is drawn, the small red points at the vertices are the control points of this triangle. They are characteristic points of the triangle and they help modify spatial properties of the triangle.

The user should note that the control points do not appear either as a preview nor in printing.

b) Drawing Mode

In ScienceWord, when a new page is opened, the drawing mode appears inactive by default.

To enter into the drawing mode, click on the button within the geometry toolbar. The pointer changes to the shape on the workspace.

In the act of drawing the usual method of selecting objects remains valid. However, we have the advantage of selecting several objects at a go.

Thus, just hold down the left button of the mouse, then slide the mouse in such a way to draw a rectangle encompassing the set of objects as shown in Fig 1.:

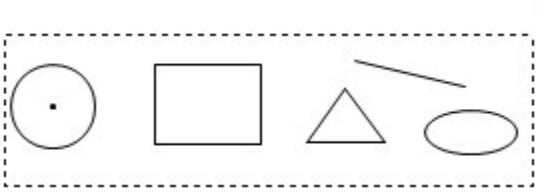


Fig 1

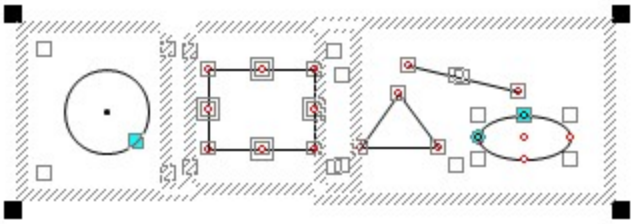


Fig 2

As soon as the objects appear totally surrounded, release the left button of the mouse. In the selection obtained (Fig2) , the triangle, the ellipse and the straight line appear thus in the same frame because they have the same selection region; in other words, if anyone of these objects is selected, it appears in the same selection region as the frame.

- If for example you no more want the group selection (triangle, ellipse and straight

lines) , then hold down the "***Shift*** " key, then click on the selection grid of this group. Then only this group would be unselected.

- If on the contrary you want only the selection group (triangle, ellipse and straight lines) , then hold down the ***"Ctrl"*** key, then click on one element of this group. Thus only this group would be retained.

Remark: In the drawing mode, it is not possible to write texts. To quit the drawing mode, just click on the  *button.*

c) Continuous Mode

During the opening of a new page, this mode appears inactive by default. To make it active, just click on the  button in the drawing toolbar.

When this mode is active, you could use continuously any basic geometric object (point, triangle, parallelogram, ellipse, circle, Bezier curves, customized curves, angles etc…) ; you can cancel any command in use in continuous mode with ***"Ctrl"*** key.

To deactivate the continuous mode, click again on the  button..

5) Embedded and floating objects in ScienceWord

a) Embedded objects in ScienceWord

You can insert an object at any desired point into the text where the cursor blinks. Such an object remains fixed to that point for good. It is said to be "embedded" in the text.

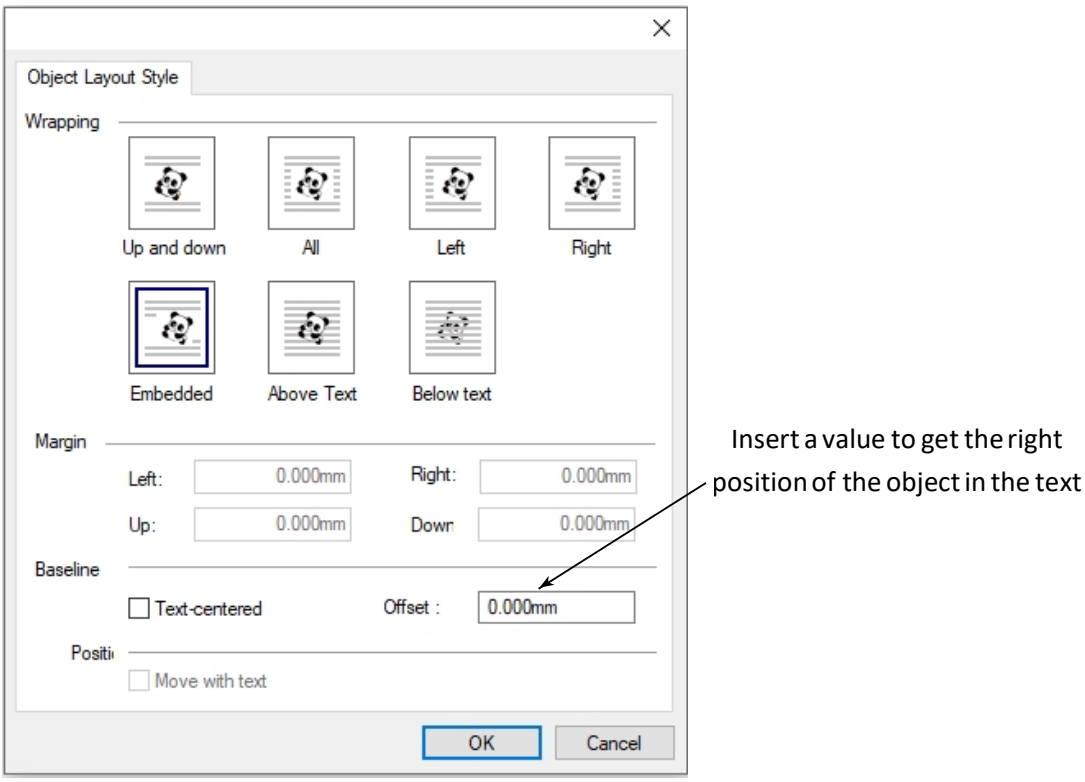
The insertion of an object into the text is done in a stunned way in ScienceWord! Suppose that you want to insert an object anywhere in the document (even on a page different from the one where you have the drawing) . All you need is to position the cursor at the specific point, then right - click on the drawing, and then in the contextual menu, click on "Insert into text (T) ". Then the drawing is inserted exactly at the place where the cursor blinks! There are in total four types of aligning along the vertical (Base Align, Centered Align, Bottom Align, and Top Align) of the embedded object.

Note:

The "Baseline" option helps to get the text up (positive value) to a particular level of the embedded object or down (negative values) from the bottom of the embedded object. In general, the vertical ruler helps to get the appropriate value,

In practical way to get this measure, click on line  icon in the Geometry toolbar and draw a vertical segment from the text level to the desired level of the embedded object. Then check the line size from its object properties dialog box. Copy the value found.

Then delete the line and select the embedded object; right-click to access the object layout style dialog box and paste the value in the Down Margin slot. Click on OK button to get the desired result.



b) Floating objects in ScienceWord

An object that is not embedded is said to be floating. Nonetheless, any floating object is linked to a paragraph. When you click on a floating object, the connecting symbol appears on the paragraph to which the object is connected. the removal, copy or moving of the whole paragraph entails the removal, copy or moving of the connected object.

There are six options of arrangement as shown in "Set Object Layout Style" dialog box: Up and down, All, Left, Right, Above text, Below text.

Floating and embedded objects can be positioned at any place of your choice.

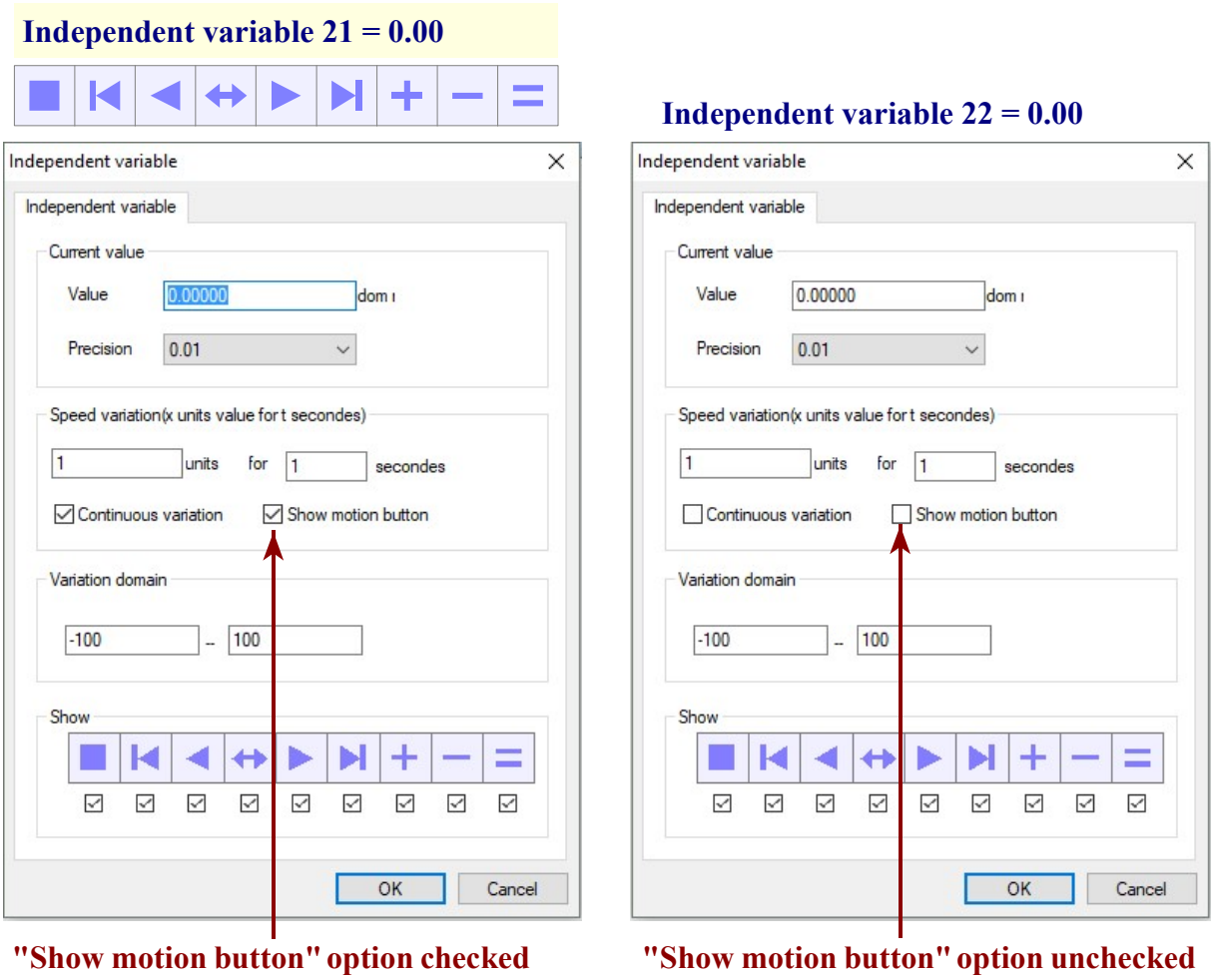
6) Basic notions on geometry dynamic constructions

a) Variables

i) Independant variable

An independant variable is just a data taking a real value that varies in a fixed domain. It could be anything (a length, an area, a force unit, any kind of measure) . For example, in the resistance formula $R = \rho L$, the independant could mean anyone of the three variables R, ρ or L .

The independent variable tool  is available in geometry toolbar when an object of the plane is selected. The following shows two independent variables defined under different options and their corresponding dialog boxes (Fig1 and Fig2)



ii) Functional variables

A functional variable is a function of numerical data (constant data or variable data) .

Let note that a variable data could be an independent variable, a variable distance of two points of a polygon, a variable area of an ellipse, etc.

The expression of a functional variable F is made of a maximum of 15 variables (x, y, z, a, b, c, d, e,f, g, h, i, j, k, l) .

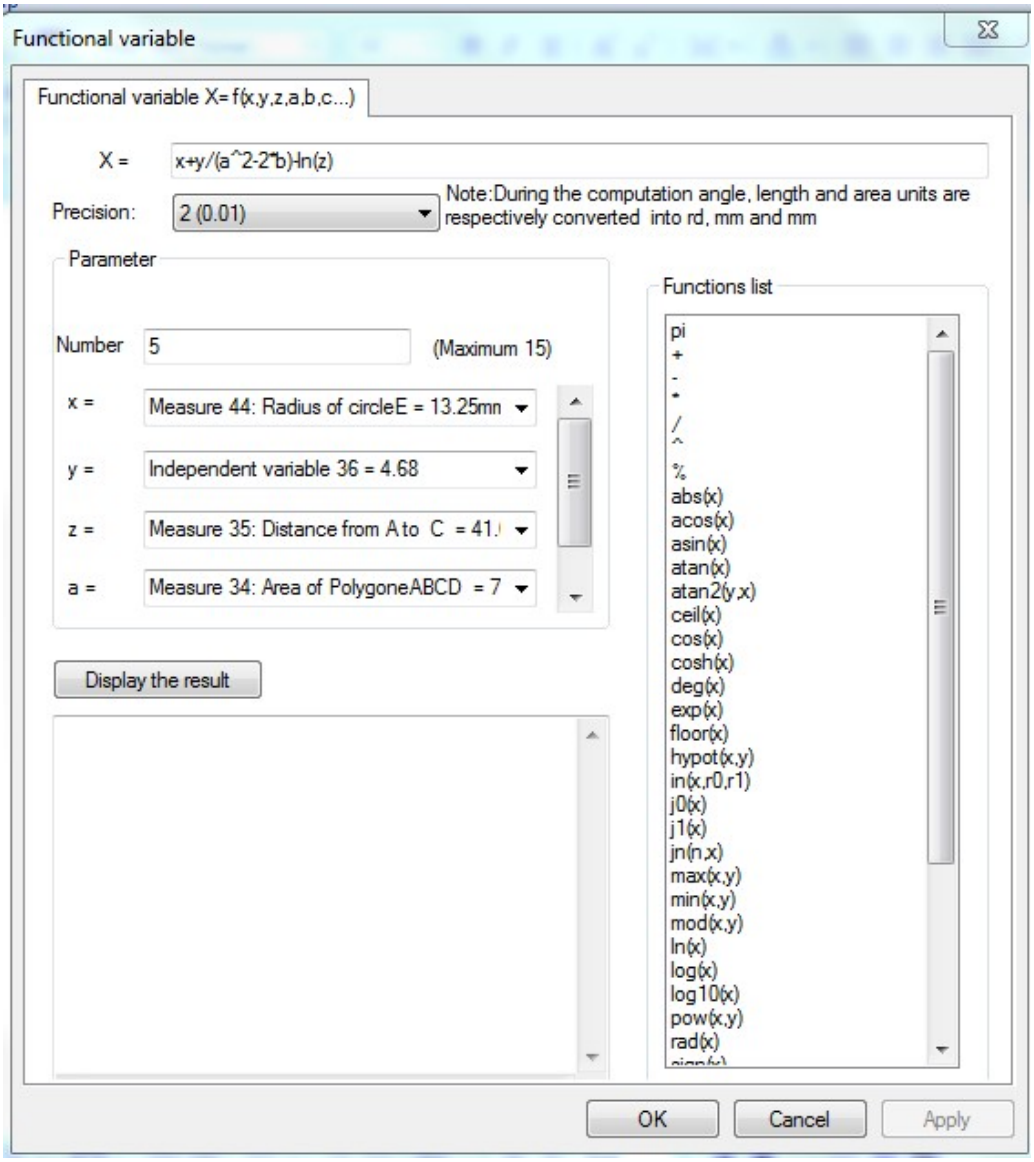
For example:

$F= xy-y^2-zx+z^3-1$ is a function of 3 varaibles.

$F= x+\frac{1}{a^2-2b}y- \ln(z)$ is a function 5 variables.

The functional variable tool  is available in geometry toolbar when an object is selected. Its

dialog box is shown below.

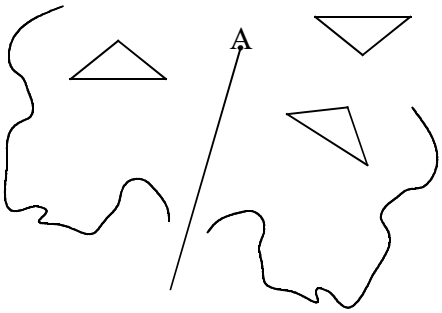


b) Geometry transfornation

Just let cite the basic ones: rotation, symmetric, translation, enlargement.

i) Symmetry of an object across a point or across a line

For the moment you can just get the symmetry of one object at once across a point or across a line. All you need to do is to select first the object and second the point or the line. Then click on the tool  that pops up automatically in geometry toolbar. The following shows the symetry across a line and a point A of a triangle and the symmetry across a line of a free hand drawing curve.



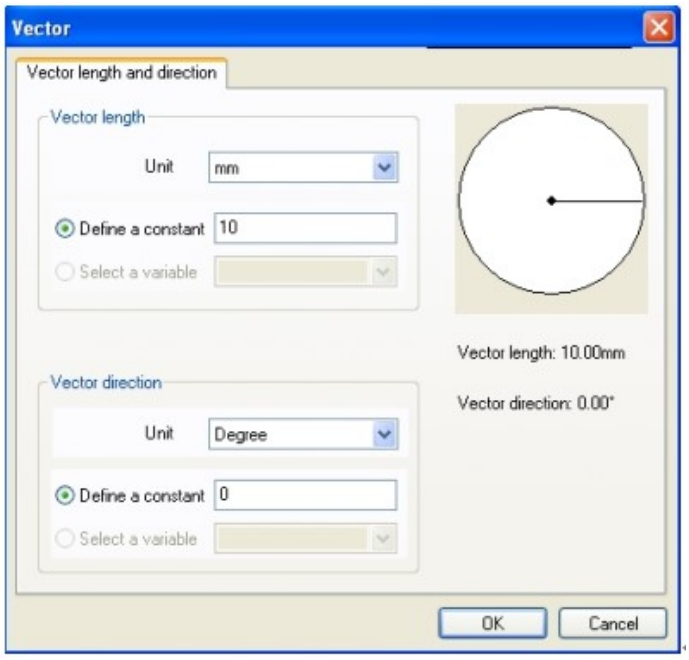
ii) Translation of vector of several objects at once

There is first a need to define a vector:

The first method consist just of selecting two points (the order of selection defines the direction) or a line where the direction is from the start point to the end point of that line. Then click on the tool AB that pops up automatically in geometry toolbar. Then a label is displayed on the screen showing the vector that have been defined.

Next, make sure that the defined vector and the objects to be translated belong to the same drawing region (if not. select them and click on combine tool that pops up automatically in geometry toolbar) . Then click on tranlation vector tool. that pops up automatically to get the translation done.

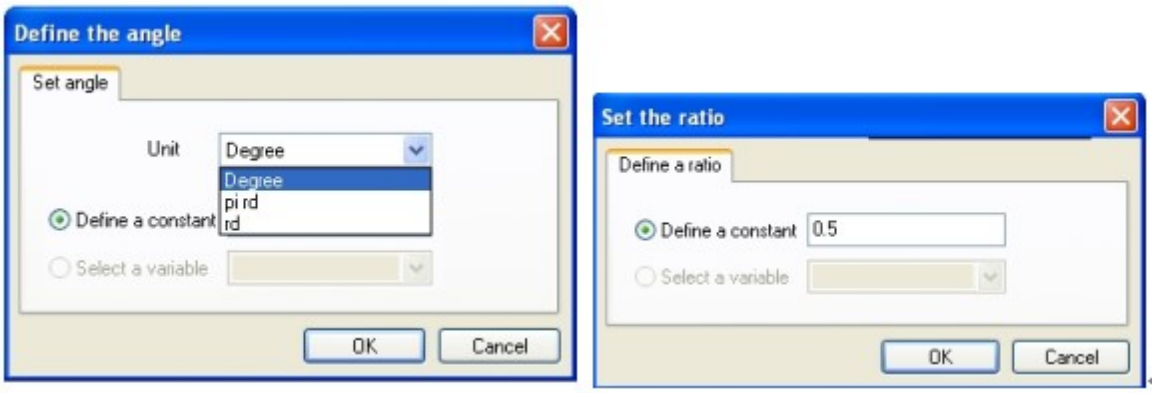
The second method of vector translation definition is based on the use of data (length and angle values) through the " Define a vector length" tool that appears automaticaly in geometry toolbar when an object is selected. Just click on this tool to get the following dialog box for settings.



iii) Rotation and enlargement of several objects

Make sure that the objects and the supposed center of the rotation or the enlargement belong to the same drawing region (If not select them and click on combine tool that pops up automatically in geometry toolbar) . Select them in this order first all the objects and then the supposed center (a point) . Then click on the rotation tool or the enlargement tool.

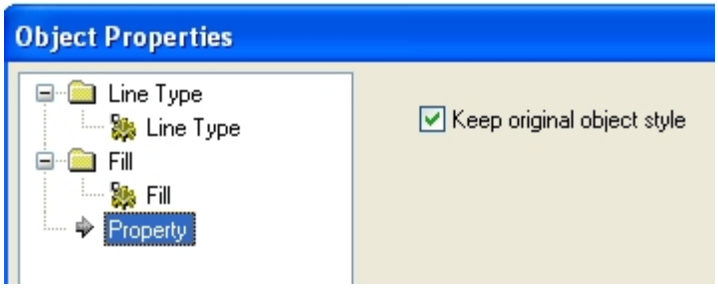
The following shows rotation dialog box and the enlargement dialog box that appear for the appopriate settings



Note: To get the enlargement of a point M, you may use "Define an axis point abscissa " described as subdivision tool below. Only in this case, the order of the selection of the point M and the center changes.

iv) Geometry transforms and object style

When you apply a geometry transformation (rotation, symmetry, translation, enlargement, etc) to an object, the result is a transformed object keeping as default the same style (line color, line style, fill, etc) as the original one The figure below shows a transformed object properties dialog box.



If you want to change the style (line style or fill) of the transformed object independently to the original one, then you have to make sure that in its object properties dialog box, the option "Keep original style" is unchecked. Otherwise any attempt to get different style to the original one will not have any effect.

c) Subdividing points of a line

i) Locating a point C of a segment AB (Using evenly division tool)

We would like to locate a point C the segment [A, B] such that $\overline{AC} = \frac{m}{n}\overline{AB}$ ($m \in \mathbb{N}^*$, $n \in \mathbb{N}^*$ and $m < n$) . In the following example we are consider $m = 2, n = 5$.

Select in this order point A then point B and click on the tool  that pops up automatically in the geometry toolbar. Then the dialog in Fig1 appears as default.

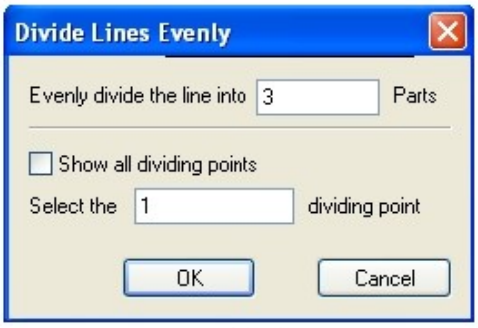


Fig1

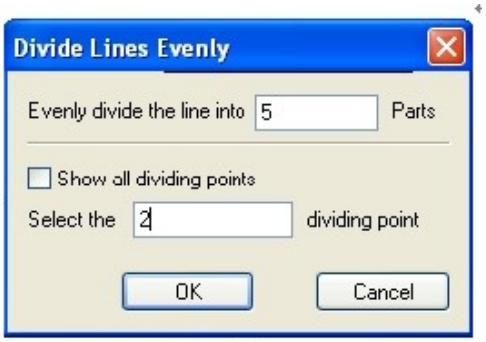


Fig2

Customize the dialog box as shown in Fig2 and click on "OK", see illustration (Fig3) .

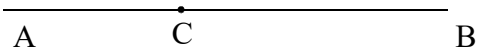


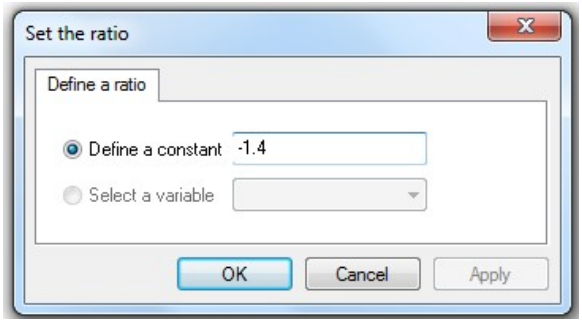
Fig3

Note: If you check "Show all dividing points", then you will get four points that ensure the subdivision of AB segment is in five equal parts.

ii) Locating a point C of a line (AB) (Using the abscissa tool)

We would like to locate a point C of the line (A, B) such that $\overline{AC} = \lambda\ \overline{AB}$ ($\lambda \in \mathbb{R}^*$)

Select in this order point A then point B and click on the tool  that pops up automatically in the geometry toolbar. Then, in the dialog box that appears, type for example -1.4 ($\lambda = -1.4$) in "Define a constant" slot as shown below.



Click on "OK" button to get the result. (see Fig 4)

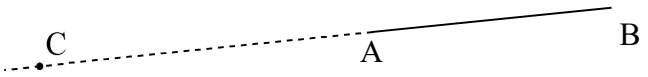


Fig 4

Note:

- This dialog box allows to use variable ratio. When a variable is defined, you can check the box "Select a variable".
- The ratio could just be a complex constant as $\frac{\sqrt{3}+\sqrt{2}\sin(0.3\pi)}{\sqrt{31}-\sqrt{7}}$. In this case it should be very easy to define it as functional variable.
- You can use variable ratio to divide a segment into *n* equal parts. You have just to define a functional variable $\frac{m}{n}$ when *n* is a constant natural number and *m* an independent natural number variable between 1 and *n*. Then using the technique of generating track of target motion (next topic) , you would get the result. This technique could be very useful for the animation of objects linked with the divided points of a segment.

iii) Measure of a point M of a line (OI)

Draw a segment OI and click on the tool " Select a point of a line". Then select a point M on the segment or on the extension of this segment as shown below. Then click on the tool . " Ratio" that becomes automatically available in geometry toolbar. Then a measure is displayed as shown below and here it means: $\overline{OM} = 2.3324\,\overline{OI}$

Measure 18897: Homothety coefficient on the segment of M = 2.3324

d) Track of a target in motion

You can select a point from a segment, a polygon, a circle or an ellipse and through Insert menu get its animation button.
You can define an independant variable and through Insert menu get its animation button.
This kind of variables having an animation button could involve motion of others objects that construction depend on them. Then to see all the positions occupied by these objects, select first the variable (the previously said point or indepenent variable) and then the object. Then click in the geometry toolbar of the the " Display the track of the target

motion". The opposite dialog opens up .

Write the appropriate number and click on "OK" button.

You can, through properties or motion properties dialog box (right click on the result to see properties and motion properties) modify the result obtained

Example

Draw a segment [AB] and select a point M of this segment. Then draw the vector $\overrightarrow{MP}$ perpendicular to [AB] as shown in Fig 5.

Then select the point M and the vector $\overrightarrow{MP}$ in this order and click on "  Display the track of the target motion" tool in geometry toolbar.. In the track dialog box that appears, write 10. Click on OK to get the result in Fig 6

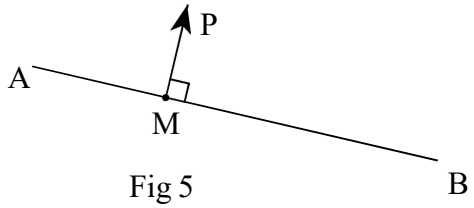


Fig 5

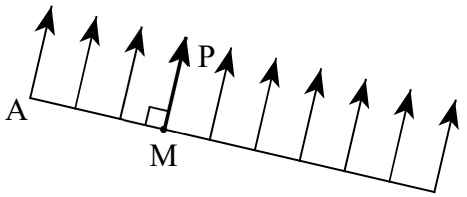
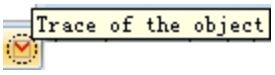
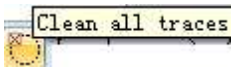


Fig 6

Note: In Class when an object is selected you can click on the trace button 

to show the trace of that object during the object motion.. The button clean 

helps to clean object traces.

e) Color variation

You can make use of any variable value to get a color variation of an object. You just have to select that object and that variable (this selection could be done in any order) . Then click "  Object color in relation with the parameter variation" to set the color parameters. Then you can get the variation of the object color when the variable takes different values.

f) Buttons of animation

There exist four kinds of control animation buttons: Show / hide button, Animation button, Series button and Displace button. You can get them from the sub-menu "Control buttons" of "Insert" menu .

i) Show/hide button

When objects of a same drawing region are selected, this button is automatically activated. It helps to show or hide objects and it proves to be very useful in constructions process and timing.

ii) Animation buttons

When a free object or a displaceable point of an objetc or an independent variable is selected, the animation button is automatically available. It is particularly very useful for the point animation on a segment, on a polygon, on a circle, on an ellipse or on an arc passing three points. It produces motion at a constant speed.

iii) Displace button

This button is activated only when two points of a same drawing region are selected and the second point selected is displaceable. Then you use it to move the first selected point to the level of the second one. it produces motion at a constant speed.

iv) Series button

This button is activated when two of more buttons of animation (Show/Hide, Animation button, Displace button) of a same drawing region are selected. You can customize the series button from its motion properties dialog box for a series of actions to be taken simultaneously or in sequences.

Note

Let remind that two or more objects belong to the same drawing region when under selection they are surrounding by only one grid.

You can merge two or more drawing regions into one drawing region with the " Combine tool".

g) Geometry toolbar "Hide" and "Show" tools

When a drawing is selected or when an object is drawn, the tools " Hide the selected objects" and " Show the hidden objects" are automatically available in geometry toolbar. They are not associated at any particular objects as the previously defined animation buttons are.

The tool helps to hide any object selected.

The tool helps to show all the hidden objects in the drawing zone. As it is said, this object is available only when an object is selected .

h) Measures

i) Types of measures

In the following table we are describing the different tools available for measures.

Measures	
Icons	**Specific tasks**
Length	Used to display a length of a segment
Distance	Used to display the distance between two points or a distance from a point to a line
Ratio	Used to find the abscissa on an axis point or the length ratio of two segments
Perimeter	Used to display the perimeter of a polygon, a circle, an ellipse
Length of arc	Used to display the length of an arc passing three points or an arc defined by two points of a circle or an circle arc ,
Arc measure	Used to display the measure of an arc defined by two points of a circle or an circle arc or the polar angle of a point of a circle or a circle arc
Radius	Used to display the radius of a circle
Angle	Used to display the angle measure defined by three points or two rays
Area	Used to display the area of a triangle or a quadrilateral or domain defined by three or four points or any regular polygon.

ii) Measures Settings

From the units and measurements dialog box, the user can set a measurement display. For example, the unit of angle can be defined in degree (°) , rd or πrd; the unit of length can be defined in mm, cm or inch; the unit of area can be defined in mm^2, cm^2 or $inch^2$; finally the value of a measurement can be defined with a precision of 0 to 5 decimal places. However, for any displayed measurement, a modification on the units or the precision can be done from the parameters of the animation of the said measurement.

iii.) Angle measures

iii-1) <u>Understanding the display of an angle measurement</u>

To display the measure defined by the half-lines **OA** and **OB** in ScienceWord and Class, select in order the points **A**, **O** and **B** or the points **B**, **O** and **A**, then click on the tool "Angle measure" which appears in the drawing bar; These measures are noted respectively $\mathbf{A\widehat{O}B}$ (or $\angle$**AOB**) and $\mathbf{B\widehat{O}A}$ (or $\angle$**BOA**).

✧ When points **A**, **O** and **B** are selected in this order, the display is **AOB**; this measurement is the angle of the angular sector that would be swept by rotating the half line **OA** around point **O** to bring it onto the half line **OB**.

✧ When points **A**, **O** and **B** are selected in this order, the display is **BOA**; this measurement is the angle of the angular sector that would be swept by rotating the half line **OB** around point **O** to bring it onto the half line **OA**.

In either case, the rotation can be in two possible directions: **clockwise** or **counterclockwise**. Below, **Fig 1** illustrates one or the other of the two angular sectors that would have been swept to bring **OA** on **OB**; **Fig 2** illustrates one or the other of the two angular sectors that would have been swept to bring **OB** on **OA.**

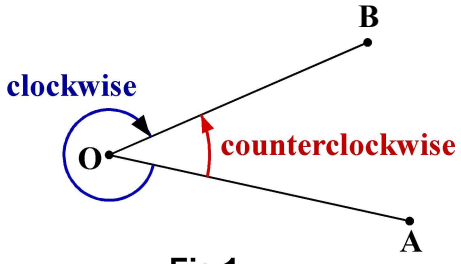


Fig 1

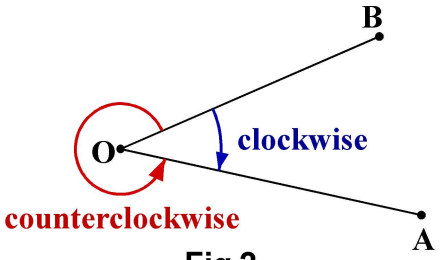
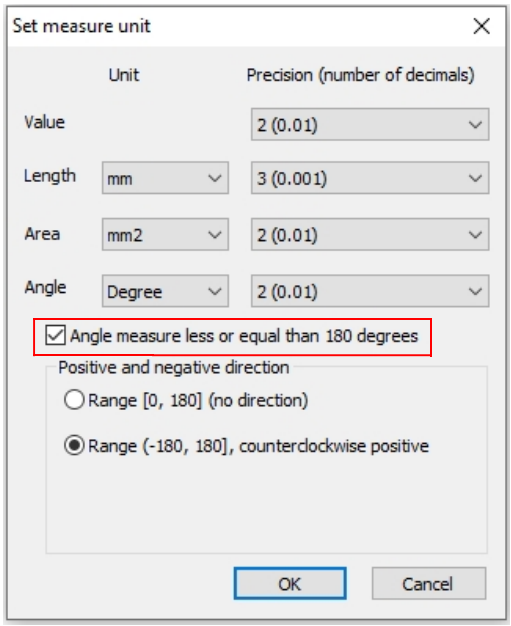


Fig 2

ScienceWord and **Class** offer several options for angle measurements that can be set in a dialog box that is accessed by clicking on "Unit of Measurement" in the "Format" menu.

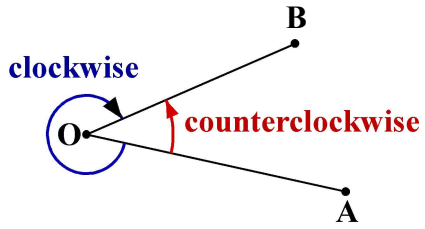
iii-2) Angle measurement option within the interval $[0°; 180°]$

This option allows you to measure the angle of the smaller of the two angular sectors defined by the two half-lines **OA** and **OB**; the measurement is that of the geometric angle of **OA** and **OB** or that of the interior angle at vertex **O** of triangle **AOB**.



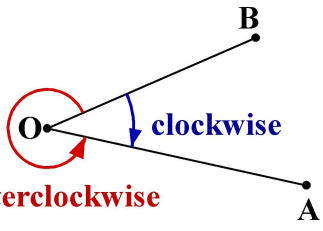
Option 1: Geometric angle measurements for values taken in $[0°; 180°]$

Fig 1



Mesure 563: Angle AOB = 35.90°

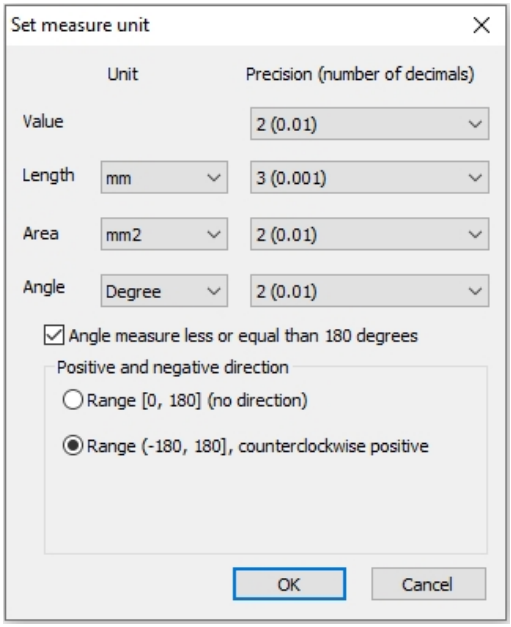
Fig 2



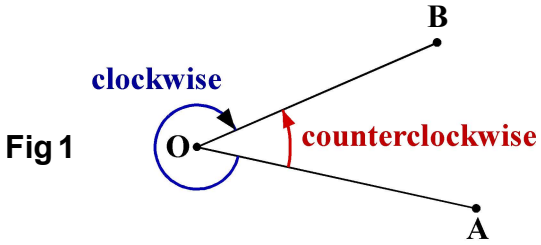
Mesure 564: Angle BOA = 35.90°

iii-3) Positive and negative angles measurement within the interval]-180°; 180°]

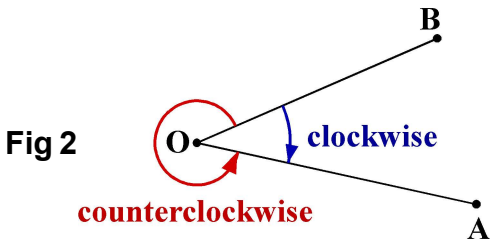
This option provides the measure of the smallest angular sector swept by rotating one of the half-lines OA and OB on the other; it is positive if the rotation is made counterclockwise and negative otherwise



Option 2: Positive and negative angles measurement within]-180° ; 180°]



Mesure 568: Angle AOB = 35.90°

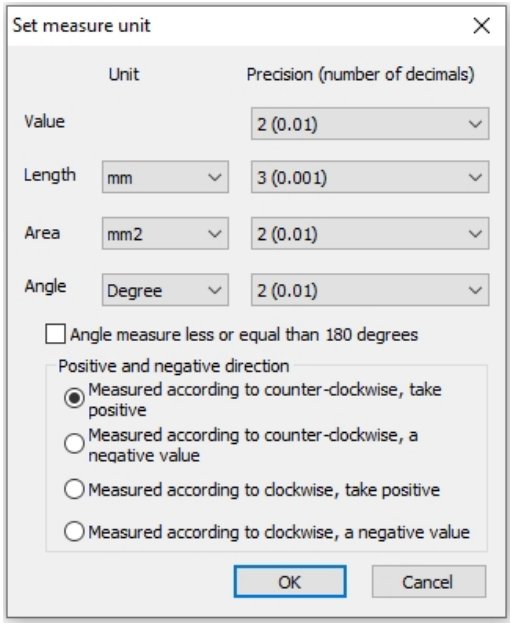


Mesure 570: Angle BOA = -35.90°

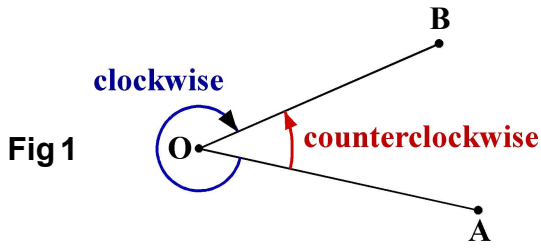
.

iii-4) Measurement option taken positively counterclockwise in [0°; 360°[

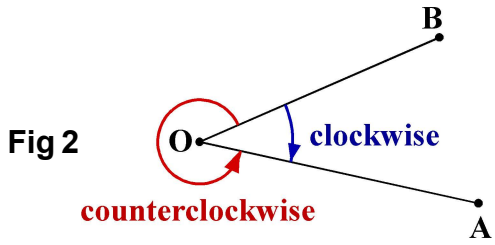
This option allows to express with a value of the interval [0°; 360°[the measure of the angle of the two half-lines **OA** and **OB** .



Option 3: Measurement taken positively counterclockwise in [0° ; 360°[



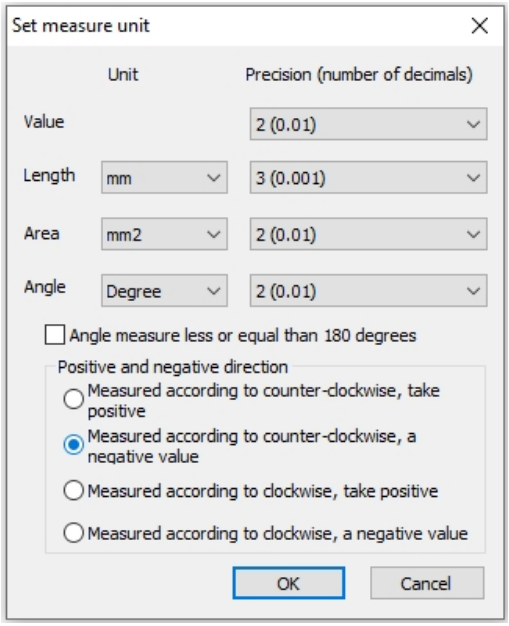
Mesure 156: Angle AOB = 35.90°



Mesure 158: Angle BOA = 324.10°

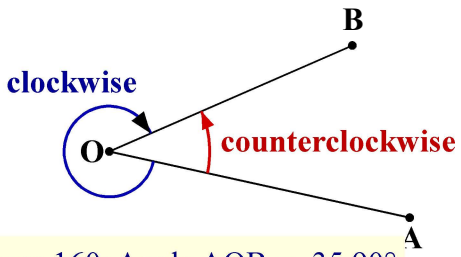
iii-5) Measurement option taken negatively counterclockwise in]-360°; 0°]

This option allows to express with a value of the interval]-360°; 0°] the measure of the angle of the two half-lines **OA** and **OB**.



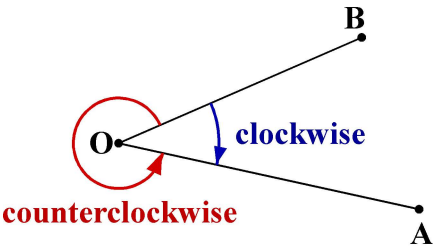
Option 4: Measurement taken negatively counterclockwise in]−360° ; 0°]

Fig 1



Mesure 160: Angle AOB = -35.90°

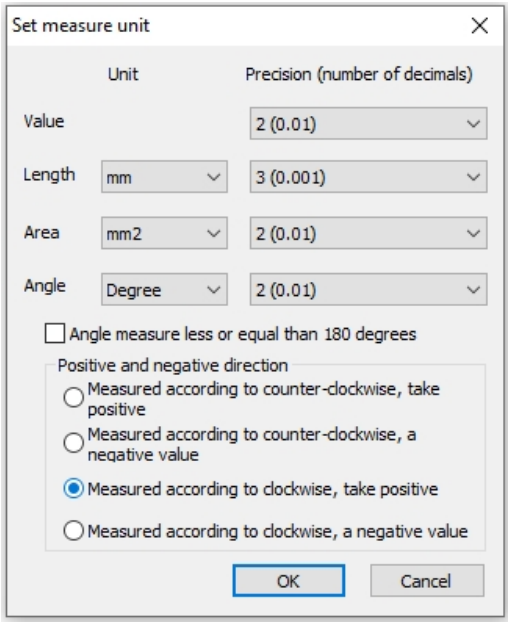
Fig 2



Mesure 162: Angle BOA = -324.10°

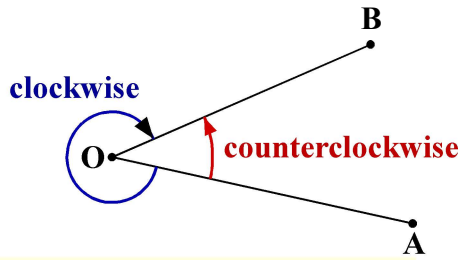
iii-6) Measurement option taken positively clockwise in]0°, 360°]

This option allows to express with a value of the interval]0°; 360°] the measure of the angle of the two half-lines **OA** and **OB**.



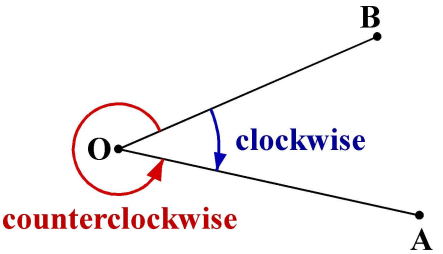
Option 5: Measurement taken positively clockwise in]0° ; 360°]

Fig 1



Mesure 2955: Angle AOB = 324.10°

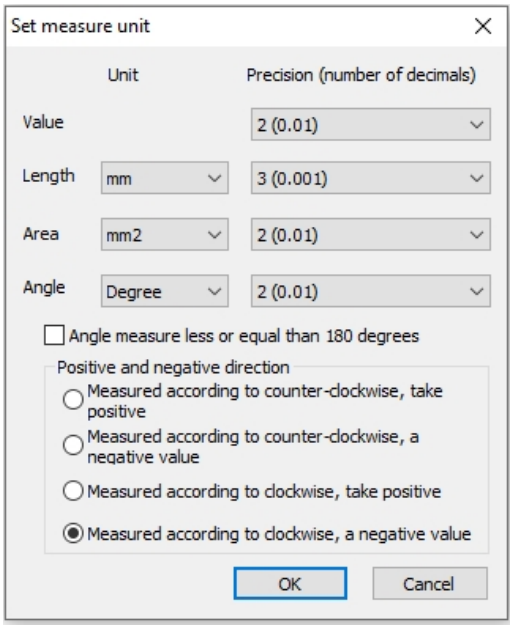
Fig 2



Mesure 2957: Angle BOA = 35.90°

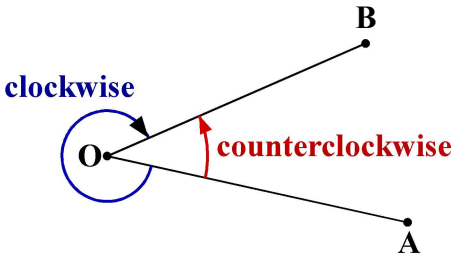
iii-7) Measurement option taken negatively clockwise in [−360°, 0°[

This option allows to express with a value of the interval [−360°, 0°[the measure of the angle of the two half-lines **OA** and **OB**.



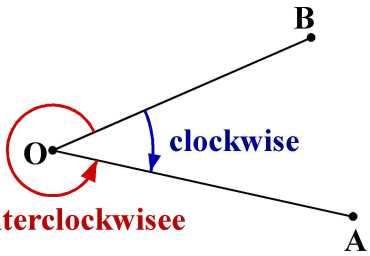
Option 6: Measurement taken negatively clockwise in [-360°; 0°[

Fig 1



Mesure 3130: Angle AOB = -324.10°

Fig 2



Mesure 3132: Angle BOA = -35.90°

iv.) Measurement of the polar angle of a point of the circle

To display the measure of the polar angle of a point M on the circle, simply select the point M, then click on the "Arc Measure" tool that appears in the drawing bar.

The measurement of the polar angle of point M uses the same options for measuring an angle previously studied.

The measure of the polar angle of point **M** in **Fig 3** is that $\widehat{\mathbf{IOM}}$ (or ∠**IOM**) in **Fig 4** of the half-lines **OI** and **OM**, where I is the origin polar point of angle 0°.

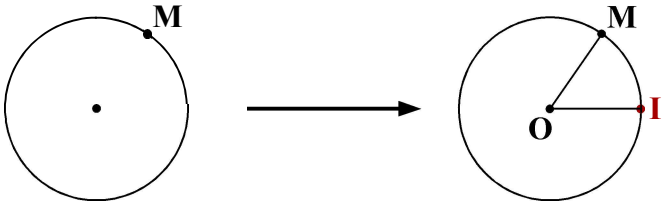


Fig 3 **Fig 4**

Mesure 3401: Measure of the angle I = 0.00°

CONTENTS