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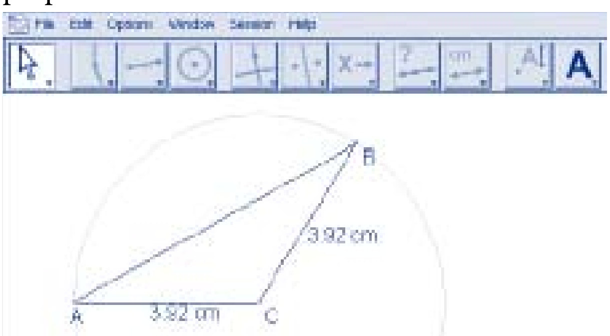
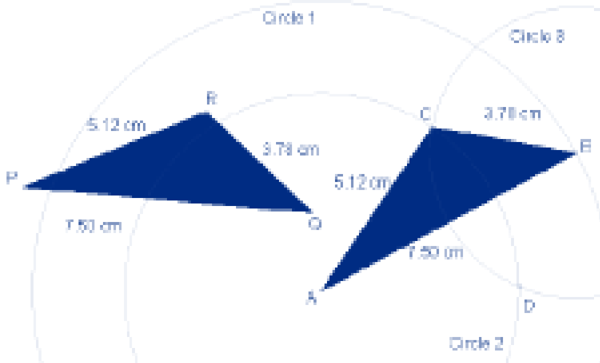
A Cabri Geometry teaching sequence

Cabrilog recently released version *II plus* of their interactive geometry package. It is clearly a much more useful package than the version I reviewed for you in 1995 (*AMT 51* (2)). However, unlike other sophisticated applications packages, the designers have avoided creating so many options that secondary students lose their way among the menu items. This article suggests a geometry teaching sequence for beginners.

The first task is to draw a triangle. *Cabri* enables you to draw a polygon with three sides but you will want to do clever things with lines and angles so you will need to construct the triangle by joining three points with line-segments. Since the lines menu offers lines, rays and line-segments, here is an opportunity to revise these concepts. If we used lines instead of line-segments, would this be a triangle? After you have constructed the three line-segments you may want to overlay the triangle with a three sided polygon so that you can colour it. This forms a flexible triangle that some students appear happy to play with for quite a long time. This is a good time to establish a habit of labelling the points, marking the angles and measuring the angles and lengths of sides. The default colour for lines is a light green — you may wish to change this using the preferences.

The next challenge is to create a triangle which can be flexed but always remains isosceles. Most of my students used the radii of a circle but some used a reflection to form a triangle with line symmetry. I was far happier to define an isosceles triangle as one having two equal sides and eventually deduce the symmetry properties from that.

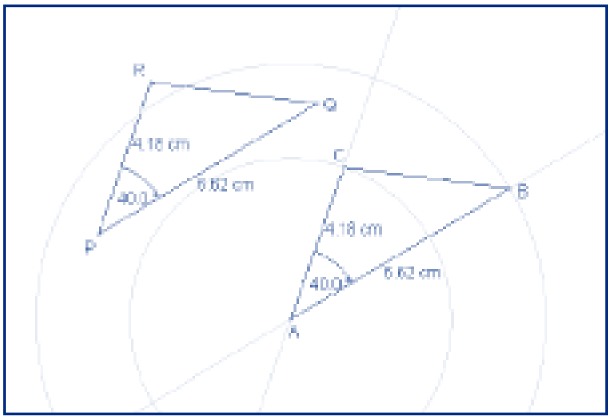




There is an attributes option to hide construction lines, however, I much prefer to reach for the paint pot and colour them using a lighter colour. Separate menu items for Colour (spelled correctly) and Text Colour can be found in the attributes menu.

The figure above illustrates the S.S.S. condition of congruence. A flexible triangle is labelled PQR and the lengths of each side are measured. An arbitrary point A is selected to correspond to point P. From the constructs menu select Compass, click on the measure of the length of PQ (7.50 cm in this case) and then click on the point A. A circle is drawn with centre A and with a radius equal to the length of PQ. Unfortunately we must take the whole circle: I could not find an option to draw a small arc. From the points menu we choose Point on Object and select a point on the circle and label it B. The line-segment AB will now have the same length as PQ.

Choose the compass tool again and first click on the measure of PR and the point A and then the measure of QR and the point B. This will construct two circles. Choose the Intersection Points tool from the Point menu and place points at the intersections of the circles. I teach my students to select each circle well away from the actual intersection points as this avoids confusion in some figures. If we label the intersection points C and D then triangles ABC and ABD are each congruent to PQR and, however triangle PQR is flexed, the new triangles will flex with it. This can be emphasised by colouring the polygons PQR and ABC.

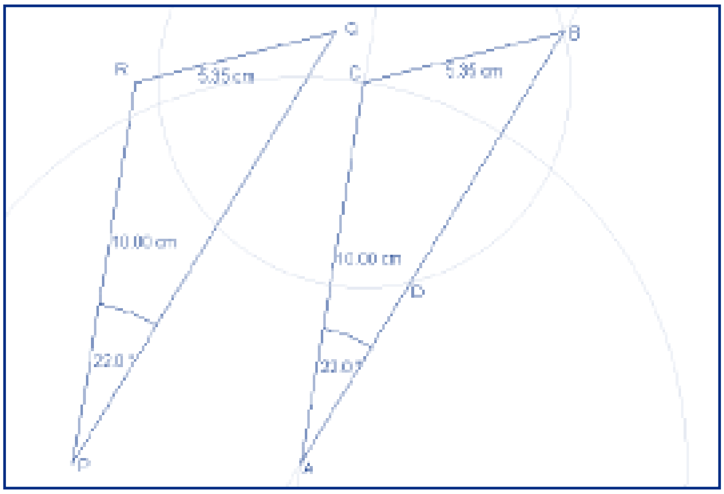


I believe that interactive geometry lessons should always be accompanied by desk work which practices the same skills. This is why I use the compass tool rather than the Measurement Transfer option which is much more mysterious and involves Measurement Transfer onto rays (copying from a point does not work despite what the help menu tells you).

When I started to illustrate the S.A.S. condition of congruency, I used the compass construction for copying an angle but the page full of circles looked far too complicated. It emphasised a need to be able to draw small arcs. In the example shown above, I settled for copying the angle RPQ by drawing lines AB//PQ and AC//PR. The alternative was to introduce the concept of rotation into a beginner's learning sequence. I used the compass tool to draw circles with radii PQ and PR about A. The intersection tool was then used to find points B and C. Clearly there are alternative positions for these points on the other side of each circle.

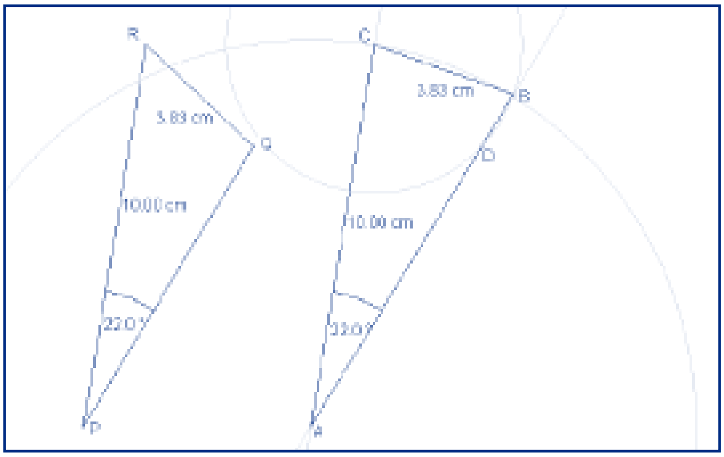
When A, B and C are joined using line-segments we have a triangle which is congruent to triangle PQR. To show this you can measure each line segment. While I was using the length measurement tool I was surprised that when I tried to measure the length of AB I was asked if I wanted to measure the length of the segment AB or the line AB. As I continued to use the package I was continually annoyed by this feature. The ambiguous object sub-routine switches in and asks you to nominate an object irrespective of whether the alternative options make sense in the context of a particular tool.

The next three figures illustrate what can happen if the angle in an S.A.S. configuration is not the included angle. The figure is built in the same way as the previous example except that the side QR is copied instead of the side PQ. Thus the angles at P and A are no longer the included angle.



Using the compass tool I take the length of QR and click on C. The circle cuts the line AB at B and at D giving two possible triangles with sides of 10 and 5.35 cm. Students will need this figure again when they meet the ambiguous case when they solve a triangle using the Sine Rule.

In the figure above, triangle ABC is congruent with triangle PQR but if the point Q is slowly moved toward P the point B moves down and then starts to move up again as shown in the figure below. Triangle ABC is now no longer congruent with triangle PQR. The transition point occurs when angle CBA is a right angle: this is why the right angle in the R.H.S. condition of congruency does not lead to the ambiguous case even though it is not the included angle.



My students found *Cabri Geometry II plus* easy to use and I was pleased with how much work we could accomplish in a short time.

As I write this article, the package is available only for Windows platforms but you can see from the screen dumps that it works well in a *Virtual PC* environment. The package also allows students to transfer their work to their TI-83 plus calculators.

Cabri Geometry II plus is available from AAMT Inc. A Macintosh version will be available mid-2004.