

BACCALAURÉAT GÉNÉRAL ET TECHNOLOGIQUE
ÉPREUVE SPÉCIFIQUE DES SECTIONS EUROPÉENNES
MATHEMATIQUES – ANGLAIS

SUJET 6 – The shape of a 20 p coin

Thème : Geometry

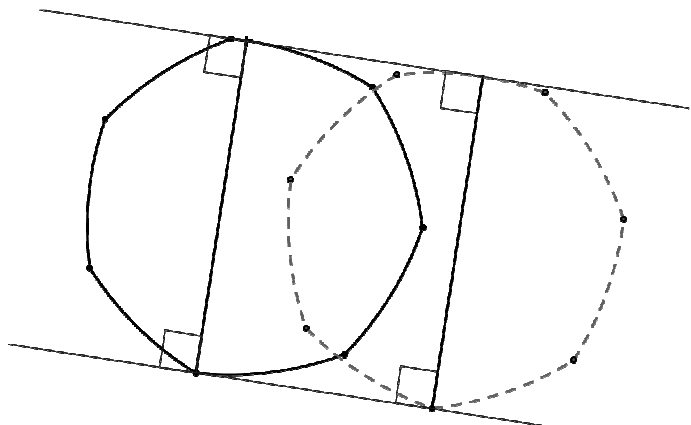
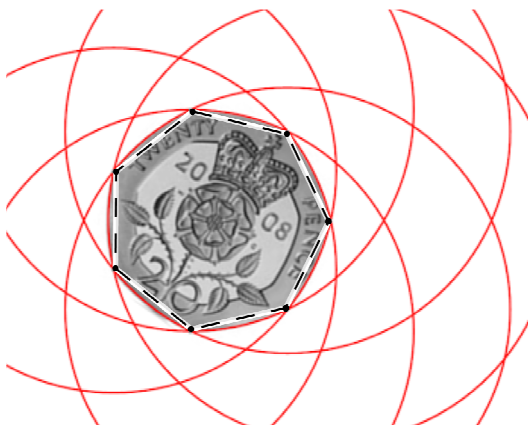
Ce sujet comporte 2 pages. L'usage de la calculatrice est autorisé.

The 20 p piece has seven edges, each of the same length. This would indicate that it might be a regular heptagon. However, these edges are clearly curved so it can't possibly be a straightforward polygon.

5 In order to construct a 20 p shape we begin with a regular heptagon. Choose one of the vertices (corners) of the heptagon and place the point of a pair of compasses on it. Draw a circle through the two opposite vertices. Repeat this step for each of the other six vertices.

10 Why are these shapes chosen for coins though? It's understandable that we might want coins that are not all circles in order that we might tell the difference between them quickly. Other ways of distinguishing them include colour and size but, with eight different coins in circulation, these evidently don't quite go far enough. The reason for the use of this particular family of shapes (the simplest of which is named after German engineer Franz Reuleaux) is that, like a circle, they have constant width; that is the perpendicular distance between two pairs of parallel tangents is the same no matter where on the shape's boundary that tangent is. This is a particularly useful property as it allows the coin to be
15 identified in a vending machine by a width that doesn't vary as it is rolling.

Adapted from Owen ELTON's blog « matheminutes »

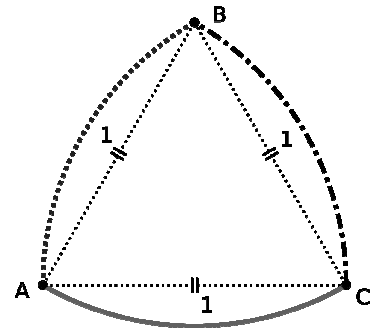


A- Dégager les idées essentielles du texte ci-dessus.

The aim of this exercise is to study the Reuleaux triangle figured on the right and some generalizations.

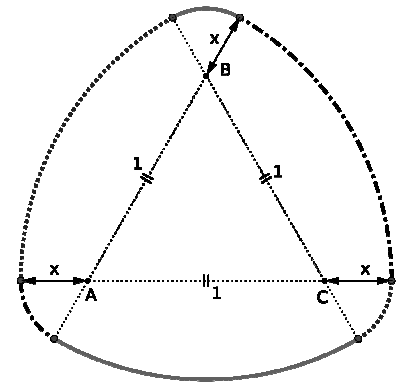
B- Questions :

1. a. Describe how you would construct the Reuleaux triangle starting with such a triangle ABC.
- b. Explain why its width is constant.



2. The previous shape is a bit pointy in A, B and C. Someone had the idea of making it rounder using only circular arcs to make it roll better.

- a. Explain quickly the construction on the right.
- b. Express the width $w(x)$ of this figure as a function of x .
- c. Prove that the perimeter is : $\pi \cdot w(x)$.



3. Can you find the measures x and y of the following Reuleaux shape which still has a constant width and was obtained by extending the sides of ABC where :
 $AB=4$, $BC=5$ and $AC=6$.

