



## Discovery tour of part of Nîmes heritage through its totem animal: the crocodile

On every street corner, on the facades of buildings, on paved roads, and even in the interiors of Nîmes, the crocodile is everywhere!

Much more than a symbol, it embodies the very essence of Nîmes.

### A little history ...

After the Egyptian campaign, some of Augustus' soldiers settled in **Nîmes**. Their victory was symbolized by a **crocodile** chained to a palm tree, a representation then taken up on coins minted in Nîmes and much later (under François I) becoming the arms and then the emblem of the city.

So we are going to walk the streets of Nîmes in the footsteps of these crocodiles, while doing mathematics in english, ready for departure?

### Departure : Dhuoda High School

Let's head towards the arenas, then go to the Charles de Gaulle esplanade

### Step 1: The Pradier fountain



It is a monumental marble fountain inaugurated on the Nîmes esplanade on June 1, 1851 and has been recognized as a historic monument since 1988.

Its creators are Charles Questel (French architect born in 1807 and died in 1888) and James Pradier (French painter and sculptor of Swiss origin).

Its main element is a woman who allegorically represents the city of Nîmes. It is surrounded by 4 seated statues (2 men and 2 women) which represent the four major rivers of Nîmes (the source of Nîmes, the Gardon, the Eure fountain and the Rhône).

### Mathematics :

1) What shape is the outline of the fountain basin?

It's a hexagon

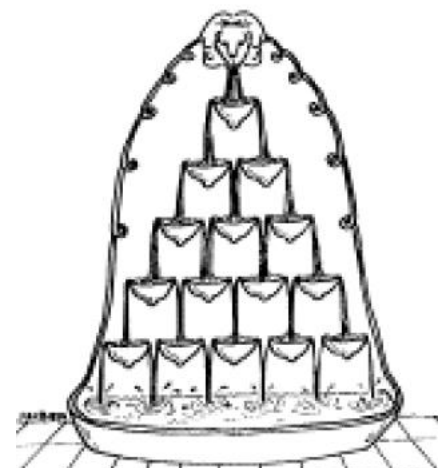
It's a pentagon

It's an octagon

2) A Roman fountain problem:

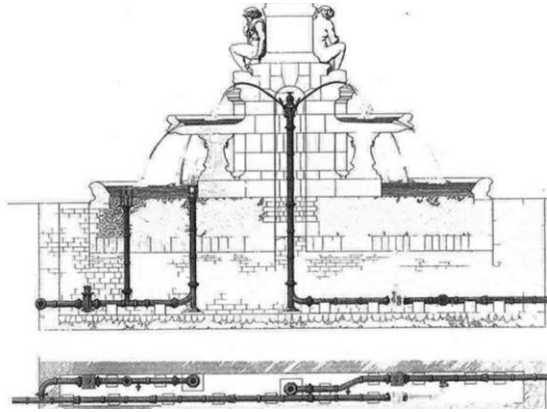
All the basins of the fountain opposite are overflowing. On each floor, half of the volume added to a basin flows into each of the two basins placed below.

During the day, one cubic meter flows into the upper basin.



Express as a fraction of this cubic meter the volume of water flowing into each basin of the fountain.

The water supply diagram for the Pradier fountain is below:



- 3) Pradier's signature is a frog: can you find it? Take a picture.
- 4) Where is the crocodile on the fountain?

## Step 2: Market square, the crocodile fountain



At the request of the city and in collaboration with the Italian sculptor **Vito Tongiani**, the visual artist **Martial Raysse** undertook the creation of a **fountain in Carrara marble**.

This exceptional work revisits, in its own way, **the city's coat of arms**: the crocodile, the central figure of the fountain, contemplates the passers-by in the square. The rope around his neck, his chains are broken. He is therefore no longer attached to his palm tree which is located at the other end of the square



### Mathematics :

How much water can the fountain basin hold at most?  
You will give the answer in  $\text{m}^3$ .

Hint 1 : Measure the inside diameter of the pool

Hint 2 : The volume of a cylinder is obtained by the formula  $V = \pi R^2 h$

Hint 3 : Be careful, remember to remove the volumes of the various elements inside the pool  
The volume of the cube is  $V = c^3$ , and the volume of a rectangular parallelepiped is  $V = L \times l \times h$

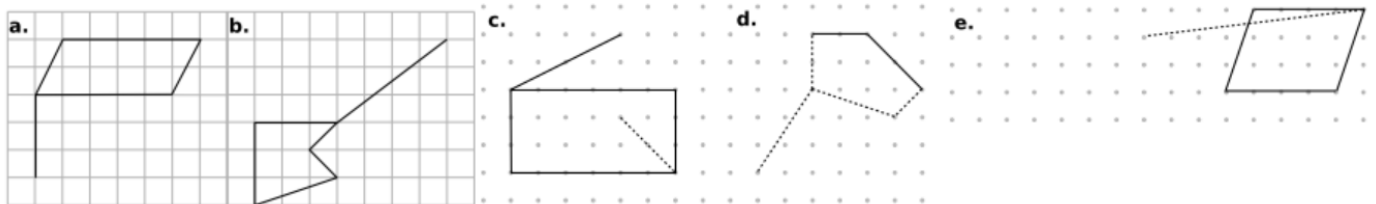
### Step 3 : Optical illusion

Let's leave the market square and head towards **rue de l'Aspic**, one of the most commercial streets in Nîmes. At the corner of this street and **Rue des Broquiers**, look up to see a crocodile posted at a window! This optical illusion, created with precision by the Avignon painter **Dominique Durand**, blends in perfectly with the surrounding architecture.



### Mathematics :

- 1) Remember the rules of cavalier perspective. Does this optical illusion respect them?
- 2) Complete the drawings in order to obtain representations in cavalier perspective of straight prisms.



- 3) Here's how to draw a crocodile tear in a corner  $\widehat{xOy}$  of  $100^\circ$  : draw a segment  $[AB]$  length 12 cm so that  $A$  belongs to the half line  $[Ox)$  and  $B$  belongs to the half line  $[Oy)$ .  $M$  is then the symmetric of  $O$  respect to the line  $(AB)$ .

Construct the curve described by point  $M$  when the ends of segment  $[AB]$  slide along the sides of the angle

*Please note, you will need to draw several segments  $[AB]$  and construct several points  $M$  to visualize the curve.*

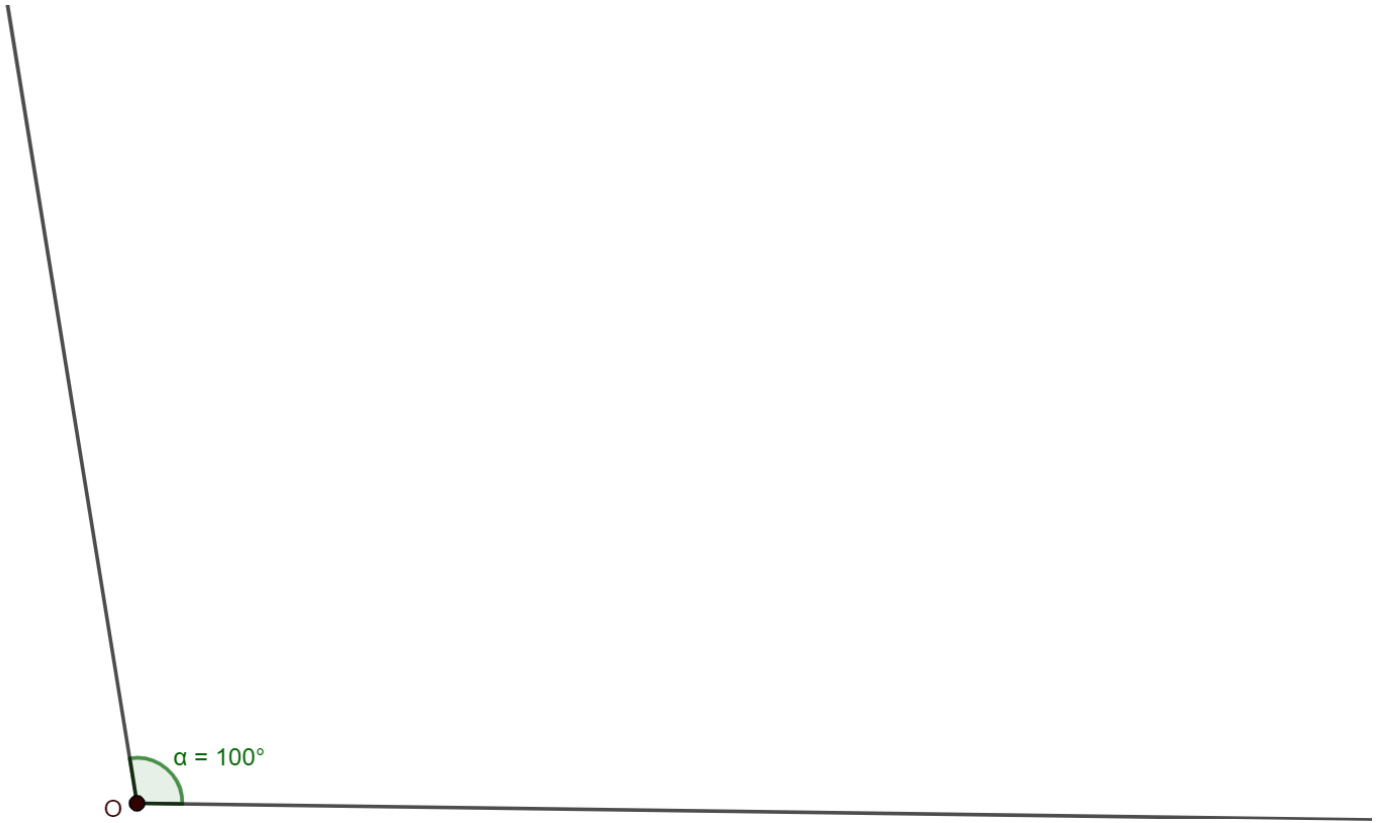
Make your construction on annex sheet 1

- 4) How many teeth do you think a crocodile has ?

50       60       80       100

Hint 1 : observe the optical illusion

Annex sheet 1 : The crocodile's tear



#### Step 4 : City Hall

If you venture within the walls of the Town Hall, don't hesitate to look up. In addition to the artistic installations and historical map of Nîmes, at the top of the grand staircase, majestic and proudly displayed, 4 saurian bellies will ask you a few questions... Finally, you will ask the questions yourself of course.

Might as well try to answer it before the next question !

Why are these 4 crocodiles highlighted in this way? Titles of nobility and Antiquity for the city, protected and classified as historic monuments, they have been here for 164 years and no longer have all their teeth. It must be



said that their history has made them aware of the horrors of time and change. Moreover, the 4 crocs are not one and the same batch but arrived in Nîmes in 4 trips (a fifth, which would have been the oldest, was lost).

An iron plate (almost invisible) placed on their bellies indicates the date of reception of each individual. The first dates from 1597 (62 years after the crocodile appeared on the city's coat of arms), the second arrived in 1671 and was purchased for 165 pounds in Marseille. The third in 1692 and was given against an annual annuity of 15 pounds. Finally, the fourth, the most imposing, was offered in 1703 by Mr. Poussiégue, a rich and nostalgic Nîmes merchant based in Malta and wishing to thank the councilors of his native town.

#### Mathematics :

A strange crocodile was discovered in Africa.

The length of its tail is a third of its total length, its head is 93 centimeters long and this length is a quarter of the length of the crocodile without its tail.

How long is this crocodile in centimeters?

A) 558

B) 496

C) 490

D) 372

E) 186

## Step 5 : The Natural History Museum

Enter the museum garden and observe the magnificent crocodile at the entrance

Do you know the difference between a crocodile, a caiman and a gharial? So, a visit to the zoology gallery of the Nîmes natural history museum is essential. The large family of crocodylians is divided into three branches, crocodiles, gharials and alligators.

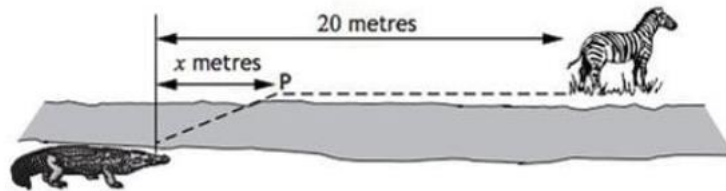
In its ancient display cases housing the stuffed animals, we find Nile crocodiles of different ages, a baby mummified in Egypt, a small one, a large mummified one and eggs. We recognize crocodiles by the fourth tooth of the lower jaw which protrudes, even when the mouth is closed.

### Mathematics :

A crocodile is stalking prey located 20 metres further upstream on the opposite bank of a river.

Crocodiles travel at different speeds on land and in water.

The time taken for the crocodile to reach its prey can be minimised if it swims to a particular point,  $P$ ,  $x$  metres upstream on the other side of the river as shown in the diagram :



The time taken,  $T$ , measured in tenths of a second, is given by :  $T(x) = 5\sqrt{36 + x^2} + 4(20 - x)$

- 1) a) Calculate the time taken if the crocodile does not travel on land.  
b) Calculate the time taken if the crocodile swims the shortest distance possible
- 2) Between these two extremes there is one value of  $x$  which minimises the time taken. Find this value of  $x$  and hence calculate the minimum possible time.



## Step 6 : Mural fresco

Let's venture into the colorful streets of the Gambetta district which are full of **murals, graffiti and stencils**. Let's pass through rue Fléquier and observe the works of the Bordeaux artist Guillaumit which are on the front and back of the building in the square. Let's pass under the arch and turn around to admire the symbols of Nîmes, the crocodile and the palm tree in a baroque 2.0 style.

Let's stop in rue Ranguetil where the artist **Iseckte** is having fun with our emblem!



## Mathématiques :



1) Observe this giant crocodile carefully and spot the many references to the city hidden in this work. So, have found them ?

2) A little geometry... With your compasses and rulers, the following figure is to be made on the next sheet in appendix 2

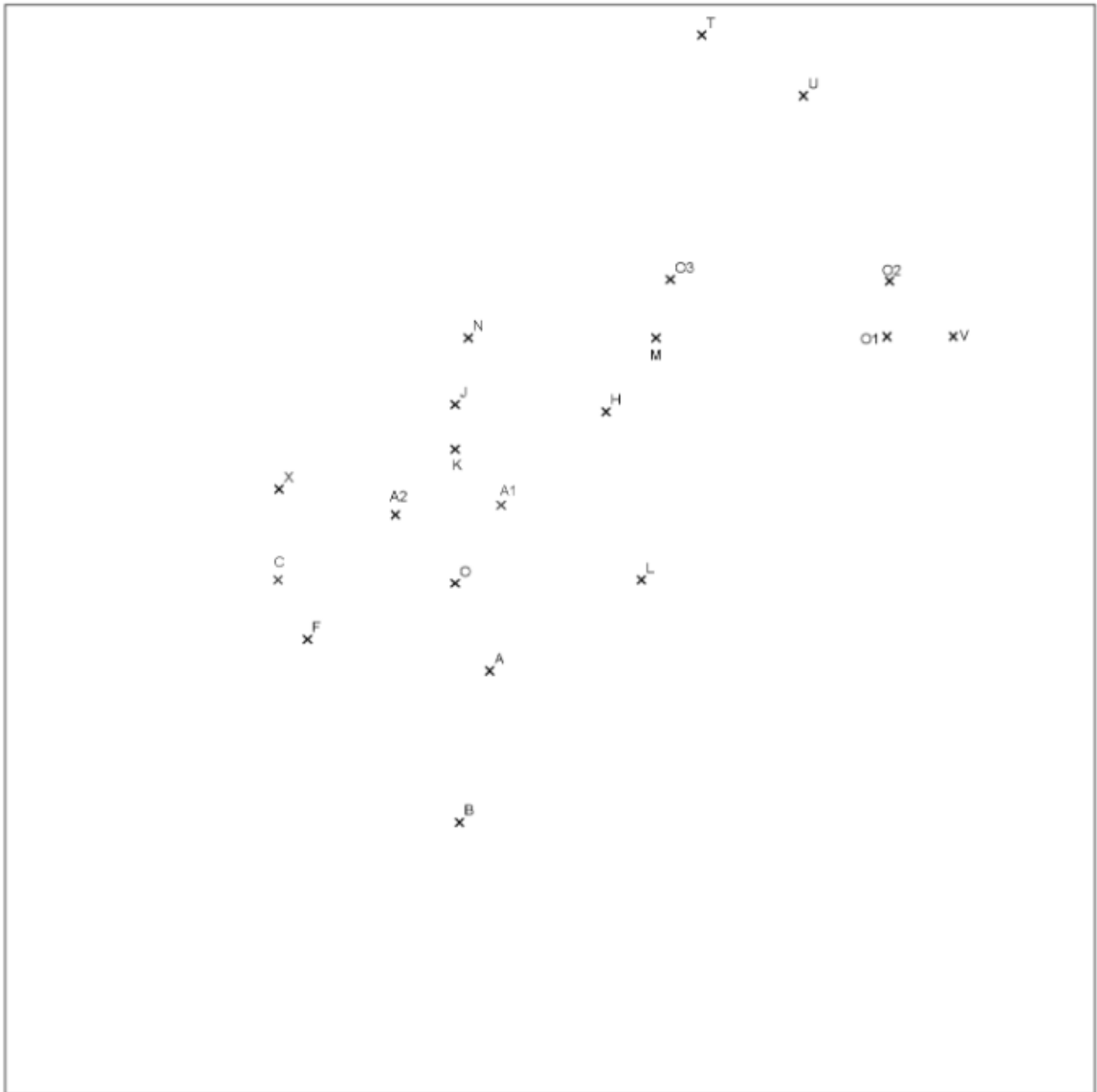
Follow the following construction program carefully:

- Draw the circle  $C_1$  with center A and radius  $[AA_1]$ .
- Draw, with dots, the circle  $C_2$  with center A diameter circle 12 cm.
- Draw the arc of the circle  $\widehat{DE}$  with center B, going through C such as :  $D \in C_1$  et  $E \in C_2$ .
- Draw the small arc of the circle  $\widehat{CG}$  with center F, whose end G is on the circle  $C_1$ .
- Draw the big arc of the circle  $\widehat{CC'}$  with center X, the point  $C'$  being a point of arc  $\widehat{DE}$ .
- Draw the small arc of the circle ends  $A_1$  et  $A_2$  and with center O.
- Draw the semi-circle with center J, having as end K, and located on the same side as L relative to the line  $(KO)$ . Appoint  $K'$  the other end.
- The circle with center L and going through K cuts the arc  $\widehat{A_1A_2}$  into R and the semi-circle traced to g) into S.
- Draw the small arc  $\widehat{RS}$  with center L.
- Draw the arc with center K, ends D et  $K'$ , going through  $A_2$ .
- Draw, with dots, the circle with center M and radius  $[MH]$ .
- Draw the smallest arc with center N, end  $A_1$ , whose second end is on the circle drawn at the step k). Name this end cette P.
- The circle with center P and going through  $K'$  cut the circle  $C_2$  in two points I et I'. Draw this circle with dots. Put I so that the angle  $\widehat{IHK'}$  be acute.
- Draw in solid lines, te small arc  $\widehat{EI}$  with center A. Erase the remaining dotted lines.
- Draw the smallest arc with center H, end I, whose second end is on the circle drawn at the step k). Name this end Q.
- Draw in solid lines, the small arc  $\widehat{QP}$  with center M. Erase the dots.
- Draw the small arc  $\widehat{PV}$  with center T.
- Draw the arc with center U, end V, containing M. His second end is on arc  $\widehat{QP}$ .
- Draw the circles with center  $O_2$ , diameter circle 0,8 cm and 1 cm.
- Draw the small arc with center  $O_1$ , one of whose ends is V, the other one being on the circle with center  $O_2$  and diameter 1 cm.
- Draw the circle with center  $O_3$ , radius 0,7 cm and the one with center  $O_3$  going through Q.
- Draw the small arc with center U, radius  $UO_2$ , being « between the eye and the nose »

And now, go over all the lines in black and give free rein to your imagination to finalize your work.



Annex sheet 2 : Your crocodile



## Step 7 : Crocodiles of all colors



Your math teacher wants to reward you for all your efforts and work during this circuit. But during the journey, he felt a little peckish.

He had planned a box of a famous brand of candy made up of 38% licorice, 23% marshmallow and the rest crocodiles.

When they open the box, the students worry that some of the candy has disappeared.

In fact, 54% of crocodiles have disappeared. But the professor was careful to leave 60% of the licorice.

8% are marshmallows eaten.

The teacher asks a student to draw a candy at random from the box.

The following events will be noted:

R : « the drawn candy is licorice »

C : « the drawn candy is marshmallow »

K : « the drawn candy is crocodile »

M : « the drawn candy has already been eaten »

Part A :

- 1) Represent the situation using a probability tree
- 2) Check that the probability of the event “the candy is licorice that has already been eaten” is 0,152.
- 3) Calculate the probability of the event M.
- 4) Among the candies eaten, what is the probability that it was a marshmallow?

Part B :

There are 250 candies in the box. If you eat 100 candies, you get a stomach ache.

Is it normal for the math teacher to have a stomach ache?