

Level 1

Tintin Buys the Unicorn

Tintin and Snowy arrive in Newto(w)n (a beach town populated by geeky Math enthusiasts called Alge-bros) to meet their old friend Captain Haddock . With some time in his hand, Tintin decides to visit the market to buy a gift for Haddock.

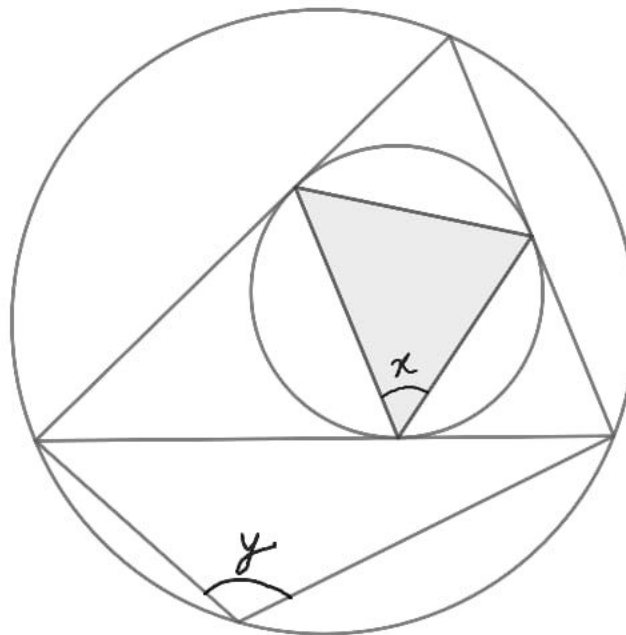
1.1 Problem 1

Tintin looks up the market on the local directory of Newtown and finds the following:

Welcome to Newtown

To reach the Central Market, go along the direction of the tangent to the curve $y = f(x)$ at $x = 42$, where x and y are the angles shown in the figure.

Help Tintin figure out which direction he should go along.



Submission Guideline: Submit the value of the slope of the said tangent.

1.2 Problem 2

On his way to the Central Market, Tintin comes to a fork on the road. With two roads in front of him, he is confused about which one leads to the Central Market. He decides to ask an Algebro (a native of Newtown) the correct way. The Algebro replies:

*Oh young traveler, you seem astray.
But I can show you the right way.
One question is all you've got,
But I might lie, or I might not.*

Help Tintin in framing the one question he can ask the Algebro, such that irrespective of whether the Algebro lies or not, Tintin would know which way to go.

Submission Guideline: Submit the question you want to ask the stranger.

1.3 Problem 3

On reaching the market, Tintin realises that he needs Eulors (currency of Newtown) to buy a gift. So he visits the local bank and requests for a loan. The banker tells him the following:

I have 3 bags here: X , Y and Z . Bag X has 27 one Eulor coins and bags Y and Z are empty. If you tell me the minimum number of steps (if possible) required to get 9 coins in each bag, you can take all the money. But there are two rules:

- In the j^{th} step, you have to shift exactly j coins from one bag to another.
- You cannot transfer any coin directly between Y and Z .

Submission Guideline: Submit 0 if not possible else submit the minimum number of steps required.

1.4 Problem 4

Stocked up with 27 eulors, Tintin starts shopping. He visits the jewellery shop Tu-ring and the mobile shop, Des-Carts, however, finds nothing interesting. Just then, he spots a model of the Unicorn, the 15th century warship captained by Haddock's ancestors. Convinced that he had found just the perfect gift for Haddock, Tintin asks the shopkeeper for the price of the Unicorn model. The shopkeeper tells Tintin the following:

Initially I had 5 boxes of ship-models, consisting of three types of ships: the tanker, the steamer and the cruise. Each box had the same number of ships in them. One day, I sold all of it to 8 traders. Each trader bought the same number of ships, paying 17 Eulors for each cruise, 4 Eulors for each steamer and 2 Eulors for each tanker. In the end, I had 301 Eulors in total.

Then I bought the Unicorn- it cost me all the money I had earned from selling, all the tankers combined. That, will be the price for you as well!

Assume that the shopkeeper had the maximum number of ships possible with the given constraints, and he had at-least 2 model ships of each kind. Find out the price of the Unicorn (i.e. the money earned by sale of all the tankers by the shopkeeper).

Submission Guideline: If the price of the Unicorn is x Eulors, submit x .

1.5 Problem 5

Just as Tintin was exiting the shop with the Unicorn model, a man named Ivanovich approaches Tintin saying that the Unicorn model he had just bought was incredibly important for him and offered Tintin a billion Eulors, for the Unicorn. Tintin denies the offer. After many more trials, desperate Ivanovich says the following:

“ I offer you a deal. There will be 3 heaps of sticks, consisting say x , y and z sticks respectively (x , y and z may or may not be equal). Each one of us will take turns alternatively and in each turn, the person can remove any number of sticks from any one heap. If I pick up the last stick, I lose and I'll give you 100 thousands Eulors. However, if you pick up the last stick, you lose and you give me the Unicorn for free. I have with me 30 sticks in all. You can form the heaps as you want (determine x , y and z such that there sum is 30) however, I will take the first turn. Is that a deal?”

Tintin thinks about it for a moment and then, agrees to the deal since he knows that there exists some set of values (x, y, z) such that he will definitely earn the 100 thousand dollars, irrespective of how Ivanovich plays.

Submit any set of values of x, y and z (the number of sticks in each heap) such that if Ivanovich takes the first chance in the game, Tintin would definitely win, assuming Tintin plays correctly.

Submission Guideline: Submit the ordered set (x, y, z) .