

6. A NAUTICAL ELEMENT

A cargo of sulfur is to be transported from Canada to South Africa where it will be used in the manufacture of fertilisers. The ship, the Antoine Lavoisier, sets off from Halifax and will need to transfer its cargo at sea to the South African ship, the Brimstone, for its onward journey to Cape Town. When they are 50 nautical miles apart the Brimstone, which is sailing at 15 knots, is ESE of the Antoine Lavoisier, which continues to sail due East at 20 knots. The Brimstone sets course to rendezvous with the Antoine Lavoisier.

How long will it take them to meet?



7. LUSTROUS LINKS

A jeweller is commissioned to make a chain to join the two clasps on the ceremonial robe of the Master of the Honourable Company of Metalworkers. The chain is to contain links of eight different metallic elements. There are to be nine links. Eight are circular in shape with two of gold and one each of silver, titanium, cobalt, tungsten, palladium and rhodium. The ninth link in the shape of a figure of eight is made of platinum. The two gold links must not connect together. In how many different ways could the jeweller assemble the chain? (Hint. Consider how you put an asymmetric ring on your finger or link your forefingers and thumbs).

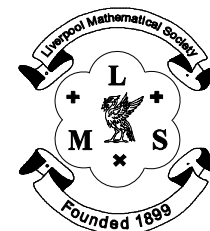


A detailed explanation for your solution is required for full marks.

The competition is promoted by Liverpool Mathematical Society (LMS)

www.maths.liv.ac.uk/lms.html

The Liverpool Mathematical Society incorporates the Liverpool Branch of the Mathematical Association.
The MA is a Registered Charity (No. 313281).



(INCORPORATING THE LIVERPOOL BRANCH OF THE MA AND THE ATM)

Open Challenge '19 For Year 13 or below

Rules

- 1) It should be attempted at home during February half term.
- 2) Your entry must be your own work.
- 3) For individual entries only. You should attempt all questions.
- 4) Entries without any working out at all or written on this sheet will not be marked.
- 5) It is possible to win a prize even if you have not completed all of the questions, so hand in your entry even if it is not quite finished.
- 6) **You must print your name, date of birth and school in neat, legible writing on the front sheet.**
- 7) Pupils under 15 years of age should only attempt this in exceptional circumstances.

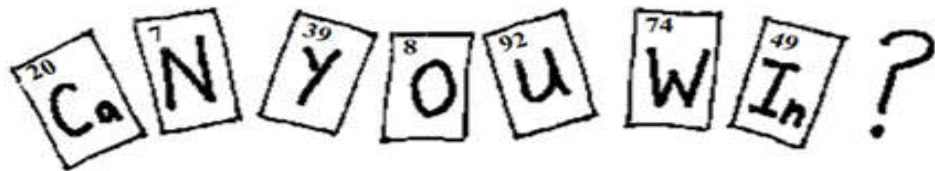
Either you or your maths teacher needs to return your entry by 8 March to this address:

Open Challenge '19 Entries,

Mrs A. Carter,
Danes Court,
Mudhouse Lane,
Burton,
Neston.
CH64 5TS.

All of the prizes and certificates will be awarded at an evening of mathematical recreation at the University of Liverpool on 8 May. Solutions will be posted on www.maths.liv.ac.uk/lms.html shortly afterwards. We hope that you enjoy the questions.

The theme is “The Periodic Table of the Elements”



1. A STARTER FOR “?”

74 1 85, 53 16, 8 10, 15 71 16, 28 10 = “?”

2. “DOUBLE” DILEMMA

$$\frac{(\text{Cadmium} + \text{Vanadium} - \text{Chlorine})}{\text{Lithium}} - \frac{\text{Cadmium}}{\text{Carbon}} = \text{"?"}$$

But what will the “?” be if $4 \times \text{Vanadium}^2 = \text{Carbon}$?

3. ALL THAT GLITTERS



Hiero, King of Syracuse, ordered a solid gold votive crown to be made for a statue of Zeus. The goldsmith was given 10lb of gold and the crown, on completion, also weighed 10lb.

However, suspecting that the goldsmith had used silver instead of some of the gold and kept the extra, he directed Archimedes to ascertain the extent of the fraud.

Archimedes, whilst taking a bath, found that a specimen of gold supplied by the king to the smith for the crown, when weighed in water, lost $52/1000$ of its weight, whilst silver lost $99/1000$ of its weight. The crown itself lost 10 ounces of its weight when weighed in water. Eureka! cried Archimedes.

What did he tell the king about the crown’s composition?

4. RINGING THE CHANGES

During a recent bell ringing practice in our church tower Anne speculated about the composition of the bronze used to cast the bells. Geoffrey posed the following puzzle. Whole pure ingots of three metallic elements, copper, tin and zinc are to be combined to form bronze. The number of zinc ingots is at least half the number of tin ingots and at most one third the number of copper ingots. Given that the total number of tin and zinc ingots exceeds 55, find the minimum number of copper ingots needed.



5. WAR ZONE MEDICINE

During an operation in a field hospital during WW1 it was necessary to have ready two separate 1 fluid ounce measures of iodine at the same time. However the only measures available were for six, ten and fifteen fl oz. Show how this could be done in the fewest number of operations without marking of measures or using any container other than the original sufficiently large flask of iodine. The only operations allowed are filling or emptying a measure or transferring iodine from one measure to another.

