Lesson Element

How many atoms in my signature?

- Teacher Guidance

Instructions for teachers

These instructions are for a classroom activity *which supports OCR A Level Chemistry A.*

The Activity:

This activity is a classroom activity in which the learners calculate the number of atoms in a signature written by a graphite pencil.

Calculations will involve the mole as a unit of substance and will involve exponential values using a calculator.

This activity offers an opportunity for maths skills development.

How many atoms is my signature?

Introduction

Relevant learning outcome

Learners should be able to demonstrate and apply their knowledge and understanding of:

2.1.3 Amount of substance

The mole

(a) explanation and use of the terms:

(i) amount of substance,

(ii) mole (symbol 'mol'), as the unit for amount of substance,

(iii) the Avogadro constant, N_A (the number of particles per mole, 6.02×10^{23} mol^{-1}),

This short activity allows students to be introduced, using a problem-solving approach, to the first three terms in 2.1.3 Amount of substance: amount of substance, mole and the Avogadro constant.
The teacher can then go over the findings formally introducing the three terms.

Task Instructions

Prior relevant knowledge and understanding:

2.1.1 (c): the carbon-12 isotope is the standard for atomic masses.

This activity starts with a question: 'How many atoms are there in your signature?'
Learners will need to know that a pencil 'lead' is graphite, a form of carbon, and that 12 g of carbon contains 6.02×10^{23} carbon atoms.

Use of 6.02×10^{23} (602 sextillion) is likely to be new information for learners.
The learners then try to solve this problem for themselves using paper, a pencil and a balance. They will also need a calculator with powers.

It is useful to have a supply of pencils, real graphite pencils are ideal, but any pencil will do (although of course most 'leads' contain clay also – don't tell them this!, although it can be a useful point for discussions under 'assumptions').

Now, just allow learners to get on with the activity. There are many outcomes including the following.

1. One signature doesn't weigh much.
2. Many signatures are needed just to register any mass. (It can be 50+.)
3. Ratio skills are needed to scale down 12 g and 6.02×10^{23} to the mass of a single signature.
4. Calculator skills are needed, especially how to input powers correctly.

Some learners will need help with inputting powers into the calculator. Others will need help in scaling down 12 g and 6.02×10^{23}. You may even have to tell some that they need more than one signature. But it is good to allow learners to do this themselves. Some learners are capable of working this out for themselves.

When learners have worked out the number of atoms in their signature, the general conclusion is 'That's a big number'. Then is a good time to relate the number to many of the comparisons that can be found by a simple internet search.

The activity links nicely the three terms: amount of substance, mole and Avogadro constant with the statement:

1 mole of carbon-12 has a mass of 12 g and contains 6.02×10^{23} atoms.

Teacher preparation

Each group will need:

- **Apparatus:** Pencils (preferably graphite) and paper
  Access to balance weighing to two decimal places.
- **Calculators**

Each learner will need a copy of the periodic table.