Average Atomic Mass

Unit: Atomic Structure

MA Curriculum Frameworks (2016): N/A

Mastery Objective(s): (Students will be able to…)

- Calculate the average atomic mass of an atom from percent abundance data.

Success Criteria:

- Solutions correctly turn masses into percentages.
- Algebra and rounding to appropriate number of significant figures is correct.

Tier 2 Vocabulary: abundance

Language Objectives:

- Explain the laws of conservation of mass, definite proportions, and multiple proportions.

Notes:

mass number: the mass of *one individual atom* (protons + neutrons). Always a whole number.

abundance: the percentage of atoms of an element that are one specific isotope.

average atomic mass: the estimated weighted *average* of the mass numbers *of all of the atoms* of a particular element on Earth.

Analogy: average atomic mass works the same way as class average on a test.

1. Multiply each score times the number of students who got it.
2. Add up the number for each score to get the total points.
3. Divide the total by the number of students to get class average.

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Problem:

The atomic mass and abundance of the two stable isotopes of carbon are:

Isotope	Atomic Mass (amu)	Relative Abundance
carbon-12	12.000 000	98.93 %
carbon-13	13.003 355	1.07 %

What is the average atomic mass of carbon?

How to solve:

1. Convert percent abundances to fractions (divide by 100).
2. Multiply the fractional abundance times the atomic mass for each isotope.
3. Add up the sub-total from each isotope to get the total atomic mass.
4. Check that your average atomic mass is in between the smallest and largest.

Answer:

1. Convert abundances to fractions

   98.93 % ÷ 100 = 0.9893 1.07 % ÷ 100 = 0.0107

2. Multiply abundance x mass # for each isotope

   0.9893 x 12.000 000 = 11.8716

   0.0107 x 13.003 355 = 0.1391

3. Add up the number from each isotope to get the total

   11.8716 + 0.1391 = 12.0107

4. Check that your answer is in between the mass number of the smallest isotope and the mass number of the largest one.

   Yes, 12.0107 is between 12 and 13.

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Homework Problems

Calculate the average atomic mass of each of the following elements, based on the percent abundance of their isotopes. For each element, your answers should agree with the atomic mass listed on the periodic table.

Because you can look up the answers, you must show how to set up the calculations in order to receive credit.

1. bromine

isotope	atomic mass (amu)	relative abundance
$^{79}_{35}Br$	78.9184	50.69 %
$^{81}_{35}Br$	80.9163	49.31 %

2. boron

isotope	atomic mass (amu)	relative abundance
$^{10}_{5}B$	10.0129	19.9 %
$^{11}_{5}B$	11.0093	80.1 %

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3. chlorine

isotope	atomic mass (amu)	relative abundance
$^{35}_{17}Cl$	34.9689	75.78 %
$^{37}_{17}Cl$	36.9659	24.22 %

4. magnesium

isotope	atomic mass (amu)	relative abundance
$^{24}_{12}Mg$	23.9850	78.99 %
$^{25}_{12}Mg$	24.9858	10.00 %
$^{26}_{12}Mg$	25.9826	11.01 %

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