Academicia Globe:
Inderscience Research

ISSN: 2776-1010 Volume 2, Issue 4, April, 2021

NEW TYPES OF PROBLEMS FOR DETERMINING THE RELATIVE ATOMIC MASS AND PERCENTAGE CONTENT OF ISOTOPES AND THEIR SOLUTIONS

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ABSTRACT
This article aims to increase the knowledge of chemistry students and strengthen their skills in working with problems from chemistry. The article introduces new types of problems in determining the relative atomic mass and percentage content of isotopes and their solutions, which will help to further improve the thinking skills of researchers and a solid study of the subject.

Keywords: Isotope, isobar, isotone, isoelectron, relative atomic mass, mass fraction.

Introduction

Chemistry is one of the natural sciences that studies the evolution of substances, their properties, and various processes. This science is connected with biology, geography, history, geology, physics, mathematics and many other sciences, among which mathematics has a special place. Because there are problems with a lot of chemistry, and math helps us do that.

The literature covers the following types of issues:

1. Natural neon consists of a mixture of two isotopes, ^{20}Ne and ^{22}Ne. If the average relative atomic mass of natural neon is 20.2, find the mass fraction of 20Ne in natural neon.

2. If the molar fraction of natural oxygen is 99,76% ^{16}O, 0,204% ^{18}O and 0,037% ^{17}O, what is the atomic mass of the element?

3. How many protons, neutrons and electrons are in the isotope of $^{40}_{19}K$ potassium?

4. Indicate the line where the isobars are located.

A) ^{12}C, ^{35}Cl, ^{80}Br; B) ^{40}Ar, ^{40}K, ^{40}Ca; C) ^{11}C, ^{12}C, ^{13}C; D) ^{32}S, ^{40}Ar, ^{40}K.

Below, we discuss new types of problems and their solutions on the topic of “Relative Atomic Mass and Percentage of Isotopes”.

1 – Problem.

Ba^{136}, Ba^{137}, Ba^{138}, Ba^{139} isotopes of natural barium are found. The sum of the mass fractions of the isotopes Ba^{137} and Ba^{138} is 3 times greater than the sum of the mass fractions of the isotopes Ba^{136} and Ba^{139}. If the mass fractions of the isotopes Ba^{137} and Ba^{138} are 2 : 1 and the average relative atomic mass of barium is 137.3, find the percentage fraction of the isotopes?

Sollution.

Under the condition of matter, if the sum of the mass fractions of the isotopes Ba^{137} and Ba^{138} is 3 times the sum of the mass fractions of the isotopes Ba^{136} and Ba^{139}, then their mass fractions are 3: 1. Knowing that the total mass fraction will be 100%, the sum of the mass fractions of the isotopes Ba^{137} and Ba^{138} is 75% ((100/4) x3 = 75) and the sum of the mass fractions of the isotopes Ba^{136} and Ba^{139} is 25%((100/4)x1=75).

If the mass fractions of the isotopes Ba^{137} and Ba^{138} are 2: 1, 50% of 75% ((75/3)x2=50) is Ba^{137} and the remaining 25% (75 - 50 = 25) is Ba^{138}. 'ri is coming. Mass fractions of the isotopes Ba^{137} and Ba^{138} were determined.

We now determine the mass fractions of the isotopes Ba^{136} and Ba^{139}. To do this, we subtract the masses corresponding to the isotopes Ba^{137} and Ba^{138} from the average relative atomic mass.

$$\frac{137 \text{ x } 50}{100} = 68{,}5 \qquad \frac{138 \text{ x } 25}{100} = 34{,}5$$

$$137{,}3 - 68{,}5 - 34{,}5 = 34{,}3 \text{ gr}$$

The mass of 34.3 g corresponds to the isotopes Ba^{136} and Ba^{139}. Their mass fractions can be determined by the following methods.

1 - method. Equation method.

If we denote the mass fraction of Ba^{136} by a, then Ba^{139} is (0.25 - a) (the percentage is calculated as the mass fraction). We compute and work out the sum of their masses equal to 34.3 g:

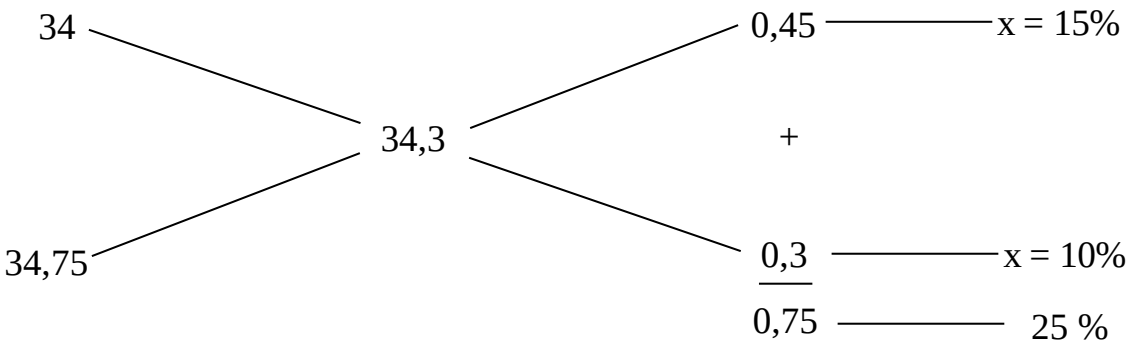
$$136a + 139(0{,}25 - a) = 34{,}3$$
$$136a + 34{,}75 - 139a = 34{,}3$$
$$136a - 139a = 34{,}3 - 34{,}75$$
$$-3a = -0{,}45$$
$$a = 0{,}15 \text{ ya'ni } 15\ \%$$

So if the mass fraction of Ba^{136} is 15%, then Ba^{139} is 10% (25 - 15 = 10).

2 - method. Diagonal method.

We calculate 34.3 in the middle of the diagonal and 25% of the mass of the isotopes at both ends and determine the percentage of the isotopes:

Ba^{136} 136 x 0,25 =34 Ba^{139} 139 x 0,25 = 34,75



Answer: Ba^{136} 15%, Ba^{137} 50 %, Ba^{138} 25 %, Ba^{139} 10 %

2 – Problem.

Cs^{131}, Cs^{132}, Cs^{133}, Cs^{134} isotopes of natural barium are found. The sum of the mass fractions of the isotopes Cs^{132} and Cs^{133} is 3 times the sum of the mass fractions of the isotopes Cs^{131} and Cs^{134}. If the mass fractions of the isotopes Cs^{132} and Cs^{133} are 1: 2 and the average relative atomic mass of barium is 132.7, find the mass fractions of the isotopes as a percentage?

Solution.

According to the problem, if the sum of the mass fractions of the isotopes Cs^{132} and Cs^{133} is 3 times the sum of the mass fractions of the isotopes Cs^{131} and Cs^{134}, then their mass fractions are 3: 1. Knowing that the total mass fraction will be 100%, the sum of the mass fractions of the isotopes Cs^{132} and Cs^{133} is 75% ((100/4) x3 = 75) and the sum of the mass fractions of the isotopes Cs^{131} and Cs^{134} is 25% ((100/4) x1 = 75).

If the mass fractions of the isotopes Cs^{132} and Cs^{133} are in a 1: 2 ratio, 50% of the 75% ((75/3) x2 = 50) is Cs^{133} and the remaining 25% (75 - 50 = 25) is Cs^{132}. Mass fractions of the isotopes Cs^{132} and Cs^{133} were determined.

We now determine the mass fractions of the isotopes Cs^{131} and Cs^{134}. To do this, we subtract the masses corresponding to the isotopes Cs^{132} and Cs^{133} from the average relative atomic mass.

$$\frac{133 \text{ x } 50}{100} = 66{,}5 \qquad \frac{132 \text{ x } 25}{100} = 33$$

$$132{,}7 - 66{,}5 - 33 = 33{,}2 \text{ gr}$$

The mass of 33.2 g corresponds to the isotopes Cs^{131} and Cs^{134}. Their mass fractions can be determined by the following methods.

1 - method. Equation method.

If we denote the mass fraction of Cs^{134} by a, then Cs^{131} is (0.25 - a) (the percentage is calculated as the mass fraction). We compute and work out the sum of their masses equal to 33.2 g:

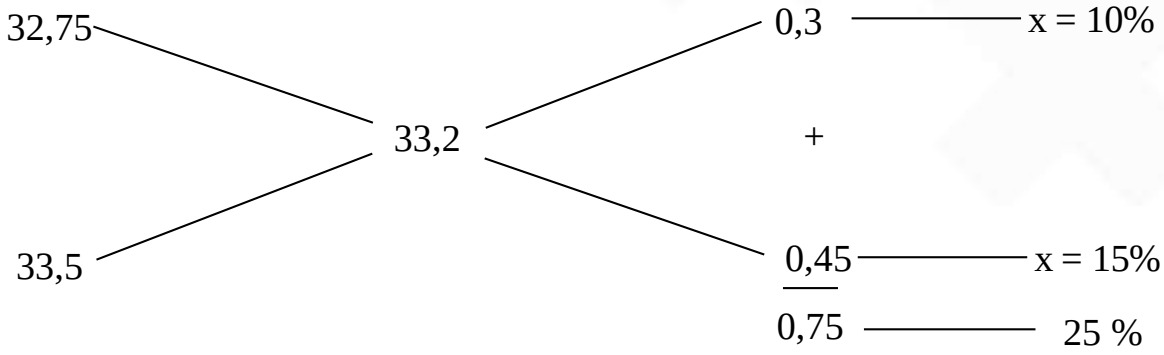
$$134a + 131(0{,}25 - a) = 33{,}2$$
$$134a + 32{,}75 - 131a = 33{,}2$$
$$134a - 131a = 33{,}2 - 32{,}75$$
$$3a = 0{,}45$$
$$a = 0{,}15 \text{ which is } 15\ \%$$

So, if the mass fraction of Cs^{134} is 15%, then Cs^{131} is 10% (25 - 15 = 10).

2 - method. Diagonal method.

We calculate 33.2 in the middle of the diagonal and 25% of the mass of the isotopes at the two ends and determine the percentage of the isotopes:

Cs^{131} 131 x 0,25 =32,75 Cs^{134} 134 x 0,25 = 33,5



Answer: Cs^{131} 10%, Cs^{132} 25 %, Cs^{133} 50 %, Cs^{134} 15 %

The following issues can also be addressed in this way.

1. The isotopes Cl^{34}, Cl^{35}, Cl^{36}, Cl^{37} of natural chlorine are found. The sum of the mass fractions of the isotopes Cl^{35} and Cl^{36} is 1.5 times the sum of the mass fractions of the isotopes Cl^{34} and Cl^{37}. If the mass fractions of the isotopes Cl^{35} and Cl^{36} are 3: 1 and the average relative atomic mass of chlorine is 35.5, what is the mass fraction of the isotopes?

2 Pb^{206}, Pb^{207}, Pb^{208}, Pb^{210} isotopes of natural lead. The sum of the mass fractions of the isotopes Pb^{207} and Pb^{208} is 1: 1 with the sum of the mass fractions of the isotopes Pb^{206} and Pb^{210}. If the mass fractions of the isotopes Pb^{207} and Pb^{208} are 4: 1 and the average relative atomic mass of the lead is 207.2, find the mass fractions of the isotopes as a percentage?

I believe that such issues will help to broaden the horizons of the study of chemistry and to understand the problems of finding isotopes, the average relative atomic mass. This will increase the effectiveness of the subject and improve the quality of education.

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