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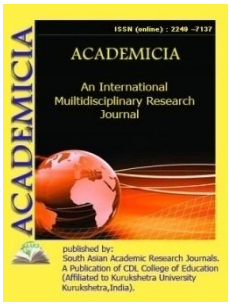

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INTERACTIVE METHODS FOR STUDYING THE STRUCTURE OF THE ATOM

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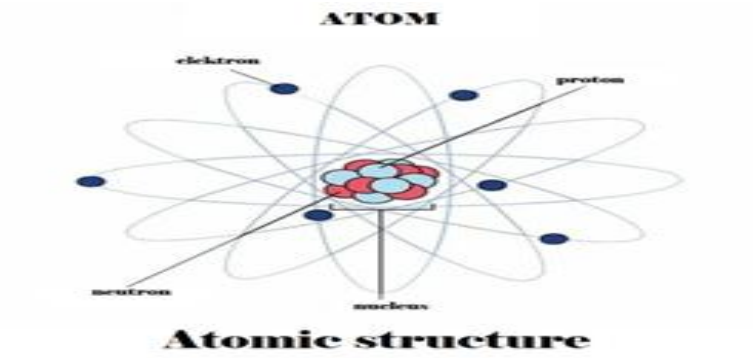
ABSTRACT

The article discusses methods for solving problems and exercises using tables and diagrams in the study of atomic composition. In the tabular form of the problem, the reader must enter the number of protons, neutrons, electrons, the charge of the nucleus and nucleons of the unknown element. In the diagrammatic method, based on the given data, it is necessary to determine the element or determine the number of elementary particles in the element and their percentage. Such methods require the student to have a basic knowledge of atomic structure. To do this, the student must first thoroughly study the theoretical part of the topic. Therefore, first of all, the student is given an atomic model. Depending on this model, the student shows the location of each particle in the atom, the symbol and the charge of the elementary particles.

KEYWORDS: *Atom, Proton, Neutron, Electron, Nucleon, Atomic Charge, Element Serial Number, Relative Atomic Mass.*

INTRODUCTION

An atom is the smallest unit of common substance that makes up a chemical element. Every solid, liquid, gas, and plasma is composed of neutral or ionized atoms. Atoms are extremely small, usually about 100 picometers across. They are so small that , due to quantum effects, it is impossible to accurately predict their behavior using classical physics [1-3].



Each atom consists of a nucleus and one or more electrons associated with the nucleus. The nucleus consists of one or more protons and several neutrons. Only the most common type of hydrogen has no neutrons. More than 99.94% of the mass of an atom is in the nucleus. Protons have a positive electrical charge, electrons have a negative electrical charge, and neutrons have no electrical charge. If the number of protons and electrons is equal, then the atom is electrically neutral. If an atom has more or less electrons than protons, then it has a common negative or positive charge, respectively - such atoms are called ions [4].

The electrons of an atom are attracted to the protons in the atomic nucleus by electromagnetic force. Protons and neutrons in the nucleus are attracted to each other by nuclear force. This force is usually stronger than the electromagnetic force, which pushes positively charged protons away from each other. Under certain circumstances, the repulsive electromagnetic force becomes stronger than the nuclear one. In this case, the core splits and leaves behind a different elements and particle s . This is a form of nuclear fission.

The number of protons in the nucleus is the atomic number, and it determines which chemical element the atom belongs to. For example, any atom containing 29 protons is copper. The number of neutrons determines the isotope of the element. Atoms can attach to one or more other atoms by chemical bonds to form chemical compounds such as molecules or crystals. The ability of atoms to combine and dissociate is responsible for most of the physical changes seen in nature. Chemistry is the discipline that studies these changes.

To give an initial idea of the atomic structure of an unknown element , students are given a drawing that describes a graphical model of the atomic structure of this element (Fig . 2) . According to the picture, the student must find out which particle is included in the structure of the atom and write the name of the elementary particles and their symbols

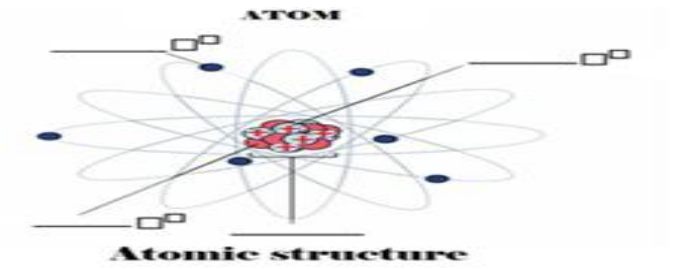


Fig. 2 . Atomic structure of an unknown element

Answers to Figure 3

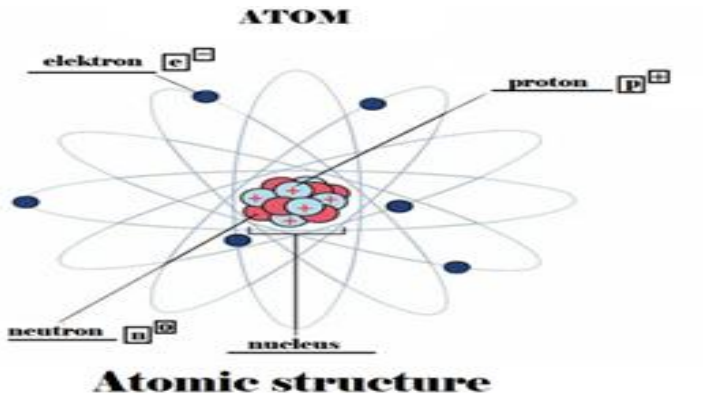


Fig. 3. Student's answer to the atomic structure of an unknown element

Tabular method.

The tabular method is a very convenient method for studying the composition of an atom. Thanks to this method, the reader quickly understands the composition of the nucleus of an element, the equality of the atomic number to the charge of the nucleus, and develops his knowledge on this basis. Below is an example that requires filling in the blanks.

Atom	Number of protons	Number of electrons	Nuclear charge (Z)	Number of neutrons	Number of nucleons
one	one	?	?	?	?

Step 1. Based on the data provided, the student determines the atomic mass of an element from the periodic table of elements and, on this basis, determines the number of neutrons. The next time the reader fills out the spreadsheet, the student automatically switches to determining relative atomic mass and quickly guesses if the number of protons is equal to the number of electrons, or vice versa.

Atom	**Number of protons**	**Number of electrons**	**Nuclear charge (Z)**	**Number of neutrons**	**Number of nucleons**
one	**one**	**one**	**+1**	**0**	**one**

Step 2. The next line will fill in another cell of the element.

Atom	**Number of protons**	**Number of electrons**	**Nuclear charge (Z)**	**Number of neutrons**	**Number of nucleons**
one	one	**one**	**+1**	**0**	**one**
2	**?**	6	**?**	**?**	12
3	**?**	**?**	+12	12	**?**
four	**?**	80	**?**	120	**?**
five	15	**?**	**?**	**?**	31

Step 3. The reader now quickly realizes that the number of nucleons is the relative mass of the atom, that electrons do not take into account the relative mass, or that the charge of the nucleus is equal to the number of protons.

Atom	Number of protons	Number of electrons	Nuclear charge (Z)	Number of neutrons	Number of nucleons
one	one	one	+1	0	one
2	6	6	+6	6	12
3	12	12	+12	12	24
four	80	80	+80	120	200
five	15	15	+15	16	31

Step 4. In this table, you can also add the element symbol or the serial number of the element instead of the main charge.

Element symbol	Number of protons	Number of electrons	Element ordinal number	Number of neutrons	Number of nucleons
N	?	?	?	?	14
P	?	?	?	?	31
O	?	?	?	?	16
Na	?	?	?	?	23

Answers:

Element symbol	Number of protons	Number of electrons	Element ordinal number	Number of neutrons	Number of nucleons
N	7	7	7	7	14
P	15	15	15	16	31
O	8	8	8	8	16
Na	eleven	eleven	eleven	12	23

Or you can enter the name of the item.

Element name	Number of protons	Number of electrons	Element ordinal number	Number of neutrons	Number of nucleons
Nitrogen	?	?	?	?	15
Phosphorus	?	?	?	?	32

answers:

Element name	Number of protons	Number of electrons	Element ordinal number	Number of neutrons	Number of nucleons
Nitrogen	7	7	7	8	15
Phosphorus	15	15	15	17	32

Chart Method

The charting method is very useful when studying atomic composition. Such questions allow the reader to see what the atom as a whole is made of. Below is the composition of the isotope of element 14 - nitrogen (Fig. 4) .

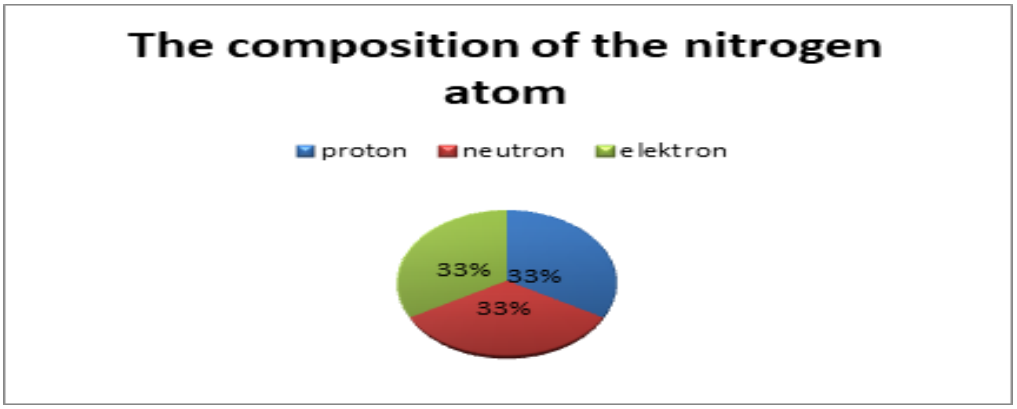
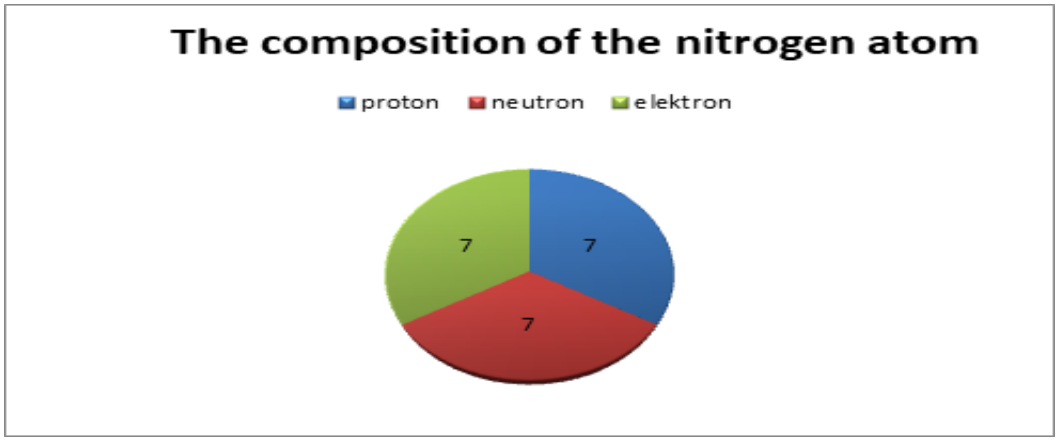


Fig. 4. Nitrogen isotope



Answers to fig. 4

The student must find protons, electrons and neutrons according to the diagram. Another example is the use of diagrams to identify hydrogen isotopes.

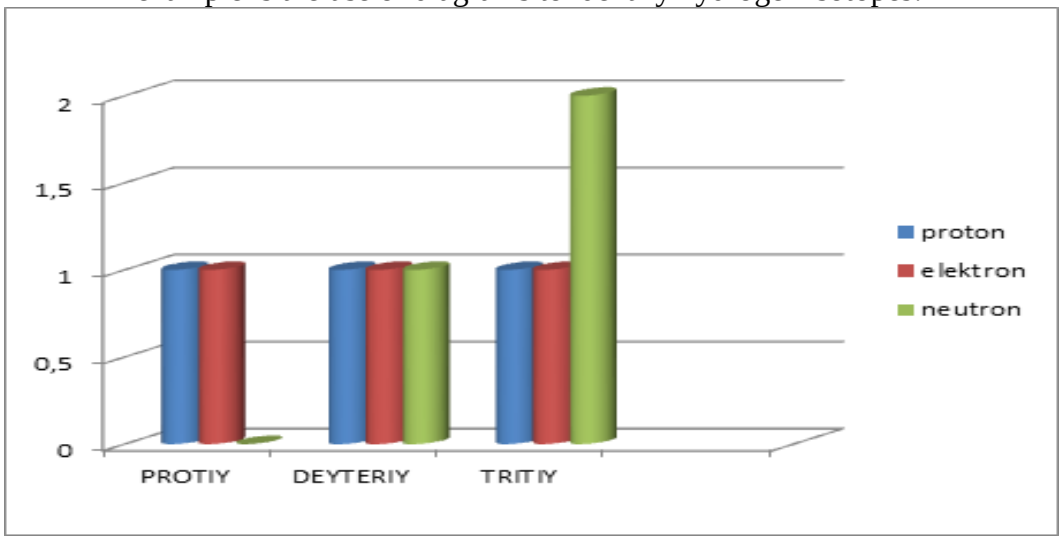


Fig. 5. Isotopes of hydrogen

By looking at the diagram, the reader can guess about each isotope of hydrogen. Depending on the scheme, the student learns the composition of the isotopes of protium 1p, 1e, 0 n, deuterium 1p, 1e, 1n, tritium 1p, 1e, 2n.

The diagram below shows four oxygen isotopes. The student must figure out which oxygen isotope is shown in Fig .

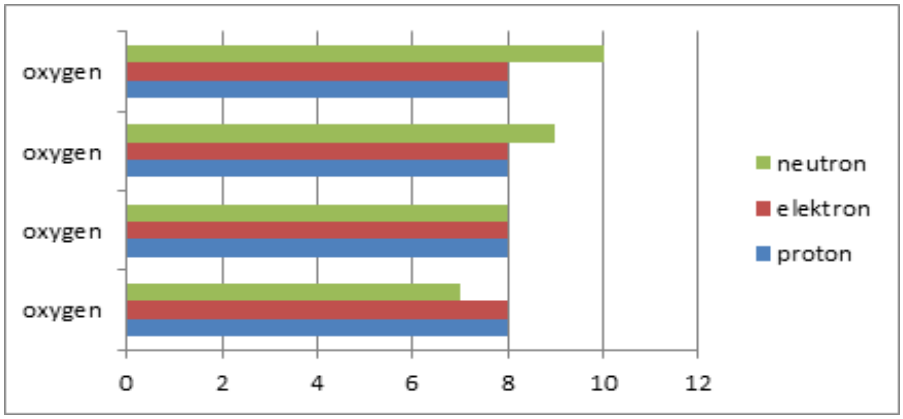


Fig. 6. Oxygen isotopes

According to the diagram, the students calculate that it is given from the isotopes Oxygen-15, Oxygen-16, Oxygen-17, Oxygen-18.

Alternatively, the composition of the isotope can be predicted. The student should write down the percentage of a given isotopic composition based on the data provided [5].

For example, argon contains 18p, 18 e-, 22 n.

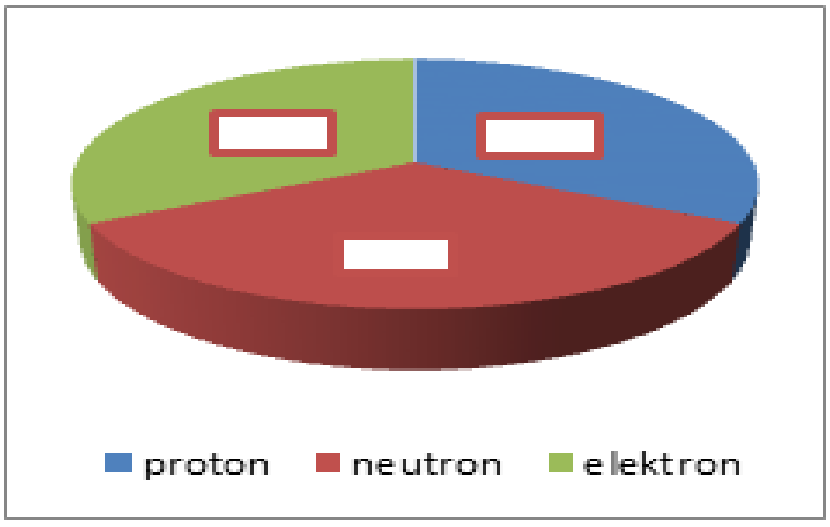
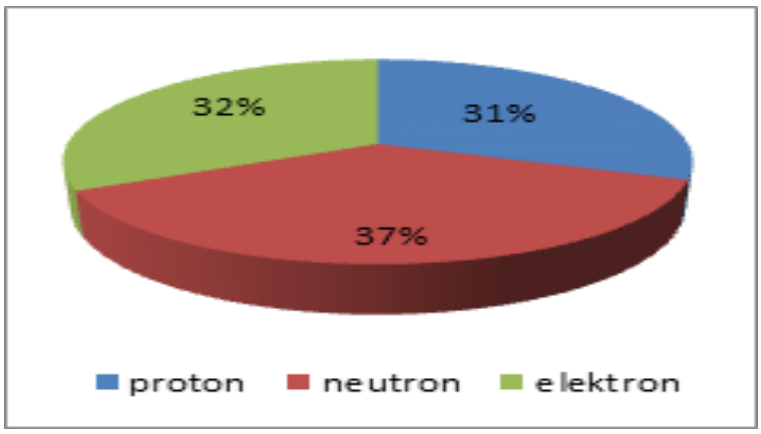


Fig. 7 . Isotope argon-40



Answers Fig. 8. Isotope argon-40

CONCLUSION

The tabular method for solving logical problems was proposed by the Hungarian logicians D. Bizam and J. Herzog. According to this method, tables (matrices) of all possible combinations of terms appearing in the reasoning are built, so that then, on the basis of the information contained in the conditions of the problem, delete impossible combinations. The remaining cells are the final conclusion. Such a tabular form is in a sense a continuation and generalization of Carroll diagrams. In fact, we are talking about Carroll diagrams using exclusively general negative judgments.

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