***Chemistry***

**2: Atoms, Molecules, and Ions**

**2.3: Atomic Structure and Symbolism**

11. Write the symbol for each of the following ions:

(a) the ion with a 1+ charge, atomic number 55, and mass number 133

(b) the ion with 54 electrons, 53 protons, and 74 neutrons

(c) the ion with atomic number 15, mass number 31, and a 3– charge

(d) the ion with 24 electrons, 30 neutrons, and a 3+ charge

Solution

(a) 133Cs+; (b) 127I–; (c) 31P3–; (d) 57Co3+

13. Open the URL: http://phet.colorado.edu/en/simulation/build-an-atom and click on the Atom icon.

(a) Pick any one of the first 10 elements that you would like to build and state its symbol.

(b) Drag protons, neutrons, and electrons onto the atom template to make an atom of your element.

State the numbers of protons, neutrons, and electrons in your atom, as well as the net charge and mass number.

(c) Click on “Net Charge” and “Mass Number,” check your answers to (b), and correct, if needed.

(d) Predict whether your atom will be stable or unstable. State your reasoning.

(e) Check the “Stable/Unstable” box. Was your answer to (d) correct? If not, first predict what you can do to make a stable atom of your element, and then do it and see if it works. Explain your reasoning.

Solution

(a) Carbon-12, 12C; (b) This atom contains six protons and six neutrons. There are six electrons in a neutral 12C atom. The net charge of such a neutral atom is zero, and the mass number is 12. (c) The above answers are correct. (d) The atom will be stable since C-12 is a stable isotope of carbon. (e) The above answer is correct. Other answers for this exercise are possible if a different element of isotope is chosen.

15. Open the URL: http://phet.colorado.edu/en/simulation/build-an-atom and click on the “Atom” icon. Repeat Exercise 13 and Exercise 14 with a different element (also selected from the first 10 elements).

Solution

Nitrogen-14, 14N, contains seven protons and seven neutrons. There are seven electrons in a neutral 14N atom. The net charge of such a neutral atom is zero, and the mass number is 14.

The atom will be stable since Nitrogen-14 is a stable isotope of nitrogen. The isotope symbol for this atom is 14N. Other answers for this exercise are possible if a different element is chosen.

17. The following are properties of isotopes of two elements that are essential in our diet. Determine the number of protons, neutrons and electrons in each and name them.

(a) atomic number 26, mass number 58, charge of 2+

(b) atomic number 53, mass number 127, charge of 1–

Solution

(a) Iron, 26 protons, 24 electrons, and 32 neutrons; (b) iodine, 53 protons, 54 electrons, and 74 neutrons

19. Give the number of protons, electrons, and neutrons in neutral atoms of each of the following isotopes:

(a)

(b)

(c)

(d)

(e)

Solution

(a) 3 protons, 3 electrons, 4 neutrons; (b) 52 protons, 52 electrons, 73 neutrons; (c) 47 protons, 47 electrons, 62 neutrons; (d) 7 protons, 7 electrons, 8 neutrons; (e) 15 protons, 15 electrons, 16 neutrons

21. Repeat Exercise 20 using an element that has three naturally occurring isotopes.

Solution

Let us use neon as an example. Since there are three isotopes, there is no way to be sure to accurately predict the abundances to make the total of 20.18 amu average atomic mass. Let us guess that the abundances are 9% Ne-22, 91% Ne-20, and only a trace of Ne-21. The average mass would be 20.18 amu. Checking the nature’s mix of isotopes shows that the abundances are 90.48% Ne-20, 9.25% Ne-22, and 0.27% Ne-21, so our guessed amounts have to be slightly adjusted.

23. Open the URL: http://phet.colorado.edu/en/simulation/build-an-atom:

(a) Drag protons, neutrons, and electrons onto the atom template to make a neutral atom of Oxygen-16 and give the isotope symbol for this atom.

(b) Now add two more electrons to make and ion and give the symbol for the ion you have created.

Solution

(a) Oxygen-16 contains eight protons, eight neutrons, and eight electrons. The isotope symbol 16O or . (b) or 

25. The average atomic masses of some elements may vary, depending upon the sources of their ores. Naturally occurring boron consists of two isotopes with accurately known masses (10B, 10.0129 amu and 11B, 11.0931 amu). The actual atomic mass of boron can vary from 10.807 to 10.819, depending on whether the mineral source is from Turkey or the United States. Calculate the percent abundances leading to the two values of the average atomic masses of boron from these two countries.

Solution

Two items, the percentage of each isotope, are unknown. As both unknowns are related through an equation that says that the sum of the two fractions is equal to 1, we can write:

Turkey source:



US source:



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