Structure of the Atom

Q6. Summarize the rules for writing of distribution of electrons in various shells for the first eighteen elements.

Answer: The rules for writing of the distribution of electrons in various shells for the first eighteen elements are given below.

→ If n gives the number of orbit or energy level, then $2n^2$ gives the maximum number of electrons possible in a given orbit or energy level. Thus,

First orbit or K-shell will have 2 electrons,

Second orbit or L-shell will have 8 electrons,

Third orbit or M-shell will have 18 electrons.

→ If it is the outermost orbit, then it should have not more than 8 electrons.

→ There should be step-wise filling of electrons in different orbits,

  i.e., electrons are not accompanied in a given orbit if the earlier orbits or shells are incompletely filled.

Q7. Define valency by taking examples of silicon and oxygen.

Answer: The valency of an element is the combining capacity of that element. The valency of an element is determined by the number of valence electrons present in the atom of that element.

→ Valency of Silicon: It has electronic configuration: 2, 8, 4

Thus, the valency of silicon is 4 as these electrons can be shared with others to complete octet.

→ Valency of Oxygen: It has electronic configuration: 2,6

Thus, the valency of oxygen is 2 as it will gain 2 electrons to complete its octet.

Q8. Explain with examples (i) Atomic number, (ii) Mass number, (iii) Isotopes and iv) Isobars. Give any two uses of isotopes.

Answer:

(i) **Atomic number:** The atomic number of an element is the total number of protons present in the atom of that element. For example, nitrogen has 7 protons in its atom. Thus, the atomic number of nitrogen is 7.

(ii) **Mass number:** The mass number of an element is the sum of the number of protons and neutrons present in the atom of that element. For example, the atom of boron has 5 protons and 6 neutrons. So, the mass number of boron is 5 + 6 = 11.

(iii) **Isotopes:** Isotopes are atoms of the same element having the same atomic number, but different mass numbers.

For example, hydrogen has three isotopes.

Protium ($^{1}H_{1}$), deuterium ($^{2}H_{1}$) and tritium ($^{3}H_{1}$).

(iv) **Isobars**

Isobars are atoms having the same mass number, but different atomic numbers i.e., isobars are atoms of different elements having the same mass number.

For example, $^{40}Ca_{20}$ and $^{40}Ar_{18}$ are

Two uses of isotopes are:

(i) One isotope of uranium is used as a fuel in nuclear reactors.

(ii) One isotope of cobalt is used in the treatment of cancer.

Q9. Na$^+$ has completely filled K and L shells. Explain.

Answer: An atom of Na has a total of 11 electrons. Its electronic configuration is 2, 8, 1. But, Na+ ion has one electron less than Na atom i.e., it has 10 electrons. Therefore, 2 electrons go to K-shell and 8 electrons go to L-shell, thereby completely filling K and L shells.

Q10. If bromine atom is available in the form of, say, two isotopes
$^{79}Br_{35}$ (49.7%) and $^{81}Br_{35}$ (50.3%), calculate the average atomic mass of bromine atom.

Answer: **It is given that two isotopes of bromine are $^{79}Br_{35}$ (49.7%) and**
$^{81}Br_{35}$ (50.3%). Then,

The average atomic mass of bromine atom is given by:

$$\frac{79 \times 49.7 + 81 \times 50.3}{100}$$

$$= \frac{3926.3 + 4074.3}{100}$$

$$= \frac{8000.6}{100}$$

=80.006 u (approx)

Q11. The average atomic mass of a sample of an element X is 16.2 u.

What are the percentages of isotopes $^{16}X_8$ and $^{18}X_8$ in the sample?

Answer: It is given that the average atomic mass of the sample of element X is 16.2 u.

Let the percentage of isotope $^{18}X_8$ be y%.

Thus, the percentage of isotope $^{16}X_8$ will be (100 − y) %.

Therefore,

The average atomic mass of X atom = $\dfrac{18 \times y + 16 \times (100 - y)}{100}$

$$\text{or, } 16.2 = \dfrac{18y + 1600 - 16y}{100}$$

$$\text{or, } 1620 = 18y + 1600 - 16y$$

$$\text{or, } 20 = 2y$$

$$y = 10$$

Therefore, the percentage of isotope $^{18}X_8$ is 10%.

And, the percentage of isotope $^{16}X_8$ is $(100 - 10)\% = 90\%$.

Q12. If Z = 3, what would be the valency of the element?

Also, name the element.

Answer: By $Z = 3$, we mean that the atomic number of the element is 3.

Its electronic configuration is 2, 1.

Hence, the valency of the element is 1

(Since the outermost shell has only one electron)

Therefore, the element with $Z = 3$ is lithium.

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