Periodic Classification of Elements

CHAPTER 5

NCERT FOCUS

ANSWERS

Topic 1

1. Yes, Döbereiner's triads are included in the columns of Newlands' octaves. One such triad is Li, K, Na.

2. Döbereiner could classify only three triads from the elements known at that time. It is not found useful because all the elements known at that time could not be arranged in triads.

3. Germanium and Scandium

4. Mendeleev used atomic masses of the elements as the criteria for creating his periodic table. In this table, the elements were arranged in order of increasing atomic masses. The other criteria is the similarity in the formulae of hydrides and oxides of various elements.

5. The modern periodic table removes all the anomalies and drawbacks of the Mendeleev's periodic table based on the increasing atomic mass by changing the basis of classification to atomic number. For example,

(a) All the isotopes of an element are now placed in the same position because they all have the same atomic number.

(b) The anomaly of higher atomic mass element being placed before the lower atomic mass element, is removed when these elements are arranged in the order of increasing atomic number.

6. Metals among the first ten elements are lithium (Li) and beryllium (Be). These are placed towards the left of the table.

7. The electronic configuration of an atom helps us to predict the position of the atom in the periodic table.

(i) The number of the outermost shell corresponds to the period. For example, if the atom has second outermost shell, it belongs to second period and so on.

(ii) The number of electrons in the outermost shell helps in finding the group number in the periodic table. For groups 1–2, the number of valence electrons is equal to the group number but for groups 13–18, the number of valence electrons is equal to the group number minus 10.

8. (a) Neon, Ne (2, 8)

(b) Magnesium, Mg (2, 8, 2) (c) Silicon, Si (2, 8, 4)

(d) Boron, B (2, 3) (e) Carbon, C (2, 4)

9. According to law of triad, the atomic mass of central element was roughly the average of the atomic masses of the other two elements. This arrangement is called Döbereiner's triad. *e.g.*, Li, Na, K

Atomic mass of Na $= \frac{\text{Li}(7) + \text{K}(39)}{2} = 23.0$

10. *Eka*-silicon chloride, $GeCl_4$; *Eka*-aluminium chloride, $GaCl_3$.

Topic 2

1. Magnesium (Mg) belongs to group 2 known as alkaline earth metal family. The two other elements belonging to the same group are calcium (Ca) and strontium (Sr). The basis of choice is the electronic distribution in the valence shell of these elements. All of them have two valence electrons each. For example,

	K	*L*	*M*	*N*	*O*
Mg (Z = 12)	2	8	2	–	–
Ca (Z = 20)	2	8	8	2	–
Sr (Z = 38)	2	8	18	8	2

2. (a) (i) Lithium (ii) Sodium (iii) Potassium

(b) (i) Beryllium (ii) Magnesium

(c) (i) Helium (ii) Neon (iii) Argon

3. Arranging the given elements in different groups and periods in order of their increasing atomic numbers, we have

Periods	1	2	3	4
Group 1	–	–	–	–
Group 2	–	Be	–	–
Group 13	–	–	–	Ga
Group 14	–	–	–	Ge
Group 15	–	–	–	As
Group 16	–	–	–	Se

We know that metallic character decreases from left to right in a period and increases down a group. Therefore, out of the elements listed in the question, Be and Ga are expected to be most metallic. Out of Be and Ga, Ga is bigger in size and hence has greater tendency to lose electrons than Be. Therefore, Ga is more metallic than Be.

4. (a) Group 17 represents halogen family. All the elements included in halogen family are non-metals. Therefore, element *A* is a non-metal.

(b) Reactivity of non-metals is generally due to the electron accepting tendency of their atoms. Down the group, the atomic size increases. Therefore, the attraction of the nucleus for the outside electrons decreases. This means that down the group of non-metals, reactivity decreases. Thus, the element *C* is less reactive than the element *A*.

(c) Atomic size of the elements decreases along a period. The elements *B* and *C* are present in the same period. Since *C* is placed after *B*, the size of the element *C* is less than that of *B*.

(d) The element *A*, as pointed out earlier is a non-metal which belongs to group 17. It has seven valence electrons (2, 8, 7). In order to have the configuration of the nearest noble gas element, it will take up one electron and change to anion *i.e.,* A^- ion.

5. (a) All the elements which lie in the same column as that of boron belong to group 13. Therefore, they have three electrons in their respective valence shells. Except, boron which is a metalloid, all other elements (*i.e.*, aluminium, gallium, indium, thallium and Nihonium) in this group are metals.

(b) The elements which lie in the same column as fluorine are called halogens. They belong to group 17 and thus have seven electrons in the valence shell. Therefore, their valency is 8 – 7 = 1. All these elements (fluorine, chlorine, bromine, iodine and Tennessine) are non-metals, except astatine, which is metalloid.

6. (a) The atomic number of the element is 17, (2 + 8 + 7 = 17).

(b) It will be chemically similar with fluorine (F) which has also 7 electrons in valence shell (2, 7).

7. (a) Lithium, sodium and potassium all react with water to form alkalies, *i.e.,* lithium hydroxide, sodium hydroxide and potassium hydroxide, with the liberation of hydrogen gas.

$$\underset{\text{Lithium}}{2Li} + \underset{\text{Water}}{2H_2O} \rightarrow \underset{\text{Lithium hydroxide}}{2LiOH} + \underset{\text{Hydrogen}}{H_2}$$

$$\underset{\text{Sodium}}{2Na} + \underset{\text{Water}}{2H_2O} \rightarrow \underset{\text{Sodium hydroxide}}{2NaOH} + \underset{\text{Hydrogen}}{H_2}$$

$$\underset{\text{Potassium}}{2K} + \underset{\text{Water}}{2H_2O} \rightarrow \underset{\text{Potassium hydroxide}}{2KOH} + \underset{\text{Hydrogen}}{H_2}$$

All these metals have one electron in their respective outermost shells.

(b) Helium and neon are noble gases and hence, have extremely low chemical reactivity. The common thing in these gases is that they have their valence shells completely filled. Helium has only *K*-shell which is complete, *i.e.*, has 2 electrons. Neon, on the other hand, has two shells, *K* and *L*. Both these shells are complete, *i.e.*, *K* shell has 2 electrons and *L* shell has 8 electrons.