Chapter – 5

Periodic Classification of Elements

In Text Questions-Pg-81

Q. 1 Did Dobereiner's triads also exist in the columns of Newlands' octaves? Compare and find out.

Answer: Yes, Dobereiner's triads also exist in the columns of Newlands' octaves.

According to Newland's law of octaves, every eighth element had properties similar to that of the first.

For example: the elements lithium (Li), sodium (Na) and potassium (K) are present in the second column of Newlands' classification of elements. If we consider lithium as the first element, the 8th element from it will be sodium.

Again, considering sodium as the 1st element, the 8th element from it is potassium.

This means that according to the Newland's law of octaves, lithium, sodium and potassium should have similar properties. We also know that lithium, sodium and potassium form a Dobereiner's triad having similar chemical properties. This shows that Dobereiner's triads also exist in the columns of Newlands' octaves.

Q. 2 What were the limitations of Dobereiner's classification of elements?

Answer: The limitation of Dobereiner's classification of elements:

Dobereiner could identify only three triads from the elements known at that time. So, all the elements could not be arranged in the form of triads on the basis of their similar chemical properties.

Q. 3 What were the limitations of ' law of octaves?

Answer: Newlands' law of octaves for the classification of elements had the following limitations:

(i) This law was applicable to the classification of elements up to calcium only. After calcium, every eighth element did not possess the properties similar to that of the first element.

(ii) Newlands assumed that only 56 elements existed in nature and no more elements would be discovered in the future.

(iii) In order to fit elements into his table, Newlands put even two elements together in one slot and that too in the column of unlike elements having very different properties. For example, the two elements cobalt (Co) and nickel (Ni) were put together in just one slot, and that too in the column of elements like fluorine, chlorine and bromine which have very different properties from these elements.

In Text Questions-Pg-85

Q. 1 Use Mendeleev's periodic table to predict the formulae for the oxides of the following elements: K, C, AI, Si, Ba.

Answer: The general formula for the oxides of group I, II, III and IV are R_2O, RO, R_2O_3 and RO_2. Here R represent the element.

(i) The element K belongs to group I of Mendeleev's periodic table, thus the formula of its oxide will be K_2O.

(ii) The element C belongs to group IV of Mendeleev's periodic table, thus the formula of its oxide will be CO_2.

(iii)The element Al (aluminium) belongs to group III of mendeleev's periodic table, thus the formula of its oxide will be Al_2O_3.

(iv) The element Si (silicon) belongs to group IV of Mendeleev's periodic table, thus the formula of its oxide will be SiO_2 .

(v) The element Ba (barium) belongs to group II of Mendeleev's periodic table thus the formula of its oxide will be BaO.

Q. 2 Besides gallium, which other elements have since been discovered for which gaps were left by Mendeleev in his periodic table? (any two)

Answer: Scandium (Sc) and Germanium (Ge) elements have been discovered for which gaps were left by mendeleev in his periodic table.

Q. 3 What were the criteria used by Mendeleev in creating his periodic table?

Answer: Mendeleev used two criteria in creating his periodic table:

(i) Atomic mass of the elements

(ii) Similar chemical properties of the elements.

He proposed that the chemical properties of elements are the periodic function of their atomic masses. And thus, he arranged the elements in the increasing order of their atomic masses.

Q. 4 Why do you think the noble gases are placed in a separate group?

Answer: Nobel gas are intert elements. They have unique properties compared to other elements, thus they are placed in a separate group in periodic table.

In Text Questions-Pg-90

Q. 1 How could the Modem periodic table remove various anomalies of Mendeleev's periodic table?

Answer: Modern periodic table removes various anomalies of Mendeleev's periodic table as follows:

● In the modern periodic table, elements are arranged in the increasing order of their atomic number.

● In the modern periodic table, there was no problem of the place of isotopes. All isotopes of the same element have different atomic masses, but same atomic number. Hence, they can put at one place in the same group of the periodic table.

● Element having same valence electron are kept in the same group.

● In the modern periodic table, position of hydrogen became clear. It is kept in the group with the elements of same valence electrons.

Q. 2 Name two elements you would expect to show chemical reactions similar to magnesium. What is the basis for your choice?

Answer: Beryllium and Calcium would show chemical reactions similar to magnesium because beryllium, calcium and magnesium belong to same group i.e., group 2nd in the modern periodic table.

Q. 3 Name:

(a) Three elements that have a single electron in their outermost shells.

(b) Two elements that have two electrons in their outermost shells.

(c) Three elements with filled outermost shells.

Answer:

(a) Lithium, Sodium and Potassium.

(b) Magnesium and Calcium.

(c) Helium, Neon and Argon.

Q. 4 (a) Lithium, sodium, potassium are all metals that react with water to liberate hydrogen gas. Is there any similarity in the atoms of these elements?

(b) Helium is an unreactive gas and neon is a gas of extremely low reactivity. What, if anything, do their atoms have in common?

Answer:

(a) Lithium, sodium and potassium have following similarities:

(i) These all are belong to same group (Group I) in the preiodic table.

(ii) They all have 1 electrone in their valene sheel.

(iii) They all are alkali metals.

(iv)They all are highly reactive.

(b) Helium and neaon both are noble gas which belong the zero group in the modern periodic table. The common thing between helium and neon is that both have outermost shell completely filled with electrons. Helium has two electrons in its K shell whereas neon has 8 electrons in its outermost shell.

Q. 5 In the modem periodic table, which are the metals among the first ten elements?

Answer: Among the first ten elements, only 2 elements, Lithium (Li) and Beryllium (Be) are metals.

Q. 6 By considering their position in the periodic table, which one of the following elements would you expect to have maximum metallic character?

Ga, Ge, As, Se, Be

Answer: Metallic character of elements decrease as we move horizontally left to right in the periodic table. Thus, Be will have the maximum metallic character because it is on the extreme left side in the periodic table (in group 2).

Exercise-Pg-91

Q. 1 Which of the following statements is not a correct statement about the trends when going from left to right across the periods of periodic table?

A. The elements become less metallic in nature

B. The number of valence electrons increases

C. The atoms lose their electrons more easily

D. The oxides become more acidic

Answer: On moving from left to right, the number of valence electrons increases. So, the tendency to lose electrons decreases whereas to accept electron increases. Thus, up to the first half, the valency increases in positive and in the next half, valency (in negative) decreases up to zero.

Q. 2 Element X forms a chloride with the formula XCl_2 which is a solid with a high melting point. X would most likely be in the same group of the periodic table as:

A. Na

B. Mg

C. Al

D. Si

Answer: Mg has the valency 2. So, when it combine with chlorine having valency 1, it forms $MgCl_2$. Whereas Na has valency 1, Al has valency 3 and Si has valency 4.

Q. 3 Which element has:

(a) Two shells, both of which are completely filled with electrons?

(b) The electron configuration 2, 8, 2

(c) A total of three shells, with four electrons in its valence shell?

(d) A total of two shells, with three electrons in its valence shell?

(e) Twice as many electrons in its second shell as in its first shell?

Answer: (a) Neon (2, 8) has two shells which are completely filled with electrons.

(b) Magnesium has electron configuration (2, 8, 2).

(c) Silicon (2, 8, 4) has three shells and four electrons in its valence shell.

(d) Boron (2, 3) has two shell and three electrons in its valence shell.

(e) Carbon (2, 4)

Q. 4 A What property do all elements in the same column of the periodic table as boron have in common?

Answer: Boron belongs to group 13 in the periodic table. It has 3 valence electrons, hence its valency is 3. Therefore, all the elements in the same column of the periodic table as boron will have valency of 3.

Q. 4 B What property do all elements in the same column of the periodic table as fluorine have in common?

Answer: Fluorine belongs to group 17 in the periodic table. It has 1 valence electrons, hence its valency is 1. Therefore, all the elements in

the same column of the periodic table as fluorine will have valency of 1.

Q. 5 An atom has electronic configuration 2, 8, 7.

(a) What is the atomic number of this element?

(b) To which of the following elements would it be chemically similar? (Atomic numbers are given in parentheses)

N (7) F (9) P (15) Ar (18)

Answer: (a) The atomic number of this element is 2 + 8 + 7 = 17.

(b) The electronic configuration of given element is 2, 8, 7. Thus, it has 7 valence electrons in its outermost shell. This element will be chemically similar to that element which has 7 valence electrons in its atoms. Now we will check electronic configuration of each element by using their atomic numbers.

(i) The electronic configuration of element N having atomic number 7 is 2, 5. It has 5 valence electrons.

(ii) The electronic configuration of element F having atomic number 9 is 2, 7. It has 7 valence electrons just like that of the given element. Thus, it would be chemically similar to the given element.

(iii) The electronic configuration of element P having atomic number 15 is 2, 8, 5. It has 5 valence electrons.

(iv)The electronic configuration of element Ar having atomic number 18 is 2, 8, 8. It has 8 valence electrons.

Q. 6 The positions of three elements A, B and C in the periodic table are shown below:

Group 16	Group 17
-	-
-	A

-	-
B	C

(a) State whether A is a metal or non-metal.

(b) State whether C is more reactive or less reactive than A.

(c) Will C be larger or smaller in size than B?

(d) Which type of ion, cation or anion, will be formed by element A?

Answer: (a) Metallic character of elements decrease as we move horizontally left to right in the periodic table. The element A belongs to group 17 which is on the right side of the periodic table. Hence, element A does not show metallic character. It is a non-metal.

(b) The chemical reactivity decreases on going down in a group. Thus, element C is less reactive than element A.

(c) The atomic size decrease on going from left to right in a period. Hence, the atom of C will be smaller in size than an atom of B.

(d) Element A belongs to group 17 which has 7 valence electrons. It needs one electron to get noble gas configuration. So, it will accept 1 electron and form a negatively charged ion, A-. The negatively charged ion is called an anion. Thus, element A will form an anion.

Q. 7 Nitrogen (atomic number 7) and phosphorus (atomic number 15) belong to group 15 of the periodic table. Write the electronic configurations of these two elements. Which of these will be more electronegative? Why?

Answer: Electronic configuration of Nitrogen is 2, 5.

Electronic configuration of Phosphorus is 2, 8, 5.

Nitrogen will be more electronegative than Phosphorus because its atom has small size due to which the attraction of its nucleus for the incoming electron is more.

Q. 8 How does the electronic configuration of an element relate to its position in the modem periodic table?

Answer: The electronic configuration of an element gives the information of valence electrons and number of shell present in the element. The modern periodic table has 18 verticle columns called groups and 7 horizontal raws called periods. In the modern periodic table, atoms with similar electronic configurations are placed in the same column, hence, the number of valence electrons remains the same in the group. We get the information of group number after knowing valence electrons. Number of shells present in an element is equal to period number. Thus, by knowing electronic configuration we know the group number and period number of an element, which is the position of element in periodic table.

Q. 9 In the modem periodic table, calcium (atomic number 20) is surrounded by elements with atomic numbers 12, 19, 21 and 38. Which of these have physical and chemical properties resembling calcium?

Answer: The elctronic configuration of calcium having atomic number 20 is 2, 8, 8, 2. Thus, calcium has 2 valence electrons in its outermost shell. Now, that element which has 2 valence electrons will have physical and chemical properties resembling that of calcium.

The electronic configuration of element having atomic number 12 is 2, 8, 2. It has 2 valence electrons just like calcium. So, the element having atomic number 12 will have physical and chemical properties resembling that of calcium.

Q. 10 Compare and contrast the arrangement of elements in Mendeleev's periodic table and the Modem periodic table.

Answer: Comparison of Mendeleev's periodic table and the Modem periodic table

Mendeleev's periodic table	Modem periodic table
Elements have been arranged in increasing oder of atomic mass.	Elements have been arranged in increasing of atomic numbrer.
There are only 8 verticle columns called groups.	There are 18 verticle columns called groups.
The noble gases were not known at the time of Mendeleev.	The noble gases have been placed at the end of table in the separte group (group 18).
There was no place for isotopes.	This problem has bee reactified as slots are determined according to atomic number.