Chapter – 5 Periodic Classification of Elements

Class 10 Science NCERT Textbook – Page No. 81

Q1. Did Dobereiner's triads also exist in the columns of Newland's octaves? Compare and find out.

Answer:

Dobereiner's triads exist in the columns of Newland's classification of elements based on the law of octaves.

lithium (Li), sodium (Na) and potassium (K) which are present in the second column of Newland's classification of elements. the lithium is 1^{st} element, then the 8^{th} element from it is sodium and according to Newland's law of octaves, the properties of 8^{th} element sodium is similar to first element lithium. If sodium is 1^{st} element, then the 8^{th} element is potassium, and according to Newland's law of octaves, the properties of 8^{th} element potassium is similar to 1^{st} element sodium, which means that according to Newland's law of octaves, the elements lithium, sodium and potassium should have similar chemical properties. lithium, sodium and potassium from a Dobereiner's triad have similar chemical properties. Dobereiner's triads exist in the columns of Newland's octaves.

Q2. What were the limitations of Dobereiner's classification of elements?

Answer:

The limitation of Dobereiner's classification of elements was that it failed to arrange all elements in the form of triads having similar chemical properties. Dobereiner's c identified only three triads from the elements known at that time. So, his classification of elements was not successful. Another limitation was that Dobereiner failed to explain the relation between atomic masses of elements and their chemical properties.

Q3. What were the limitations of Newland's law of octaves?

Answer:

The limitations of Newland's law of octaves are:

i) Newland's law of octaves was applicable to the classification of elements up to calcium only. After calcium, every eight element did not possess the properties similar to that of the first element, hence Newland's law of octaves worked well with lighter elements only.

ii) Newland's supposed only 56 elements existed in nature. But later on, several new elements were discovered whose properties did not fit into Newland's law of octaves.

iii) In order to fit elements in his table, Newlands arranged two elements together in one slot and in the column of unlike elements with different properties. Example: the two elements cobalt (Co) and nickel (Ni) were together in one slot and in the column of elements like fluorine, chlorine and bromine which have different properties from these elements.

Class 10 Science NCERT Textbook – Page No. 85

Q1. Use Mendeleev's periodic table to predict the formulae for the oxides of the following elements:

$$\boldsymbol{K, C, Al, Si, Ba}$$

Answer:

i) The element K (potassium) is in group I of Mendeleev's periodic table in which the general formula of the oxides of elements is R_2O. So, the formula of oxide of K will be K_2O.

ii) The element C (carbon) is in group IV of Mendeleev's periodic table in which the general formula of the oxides of elements is RO_2. So, the formula of oxide of C will be CO_2.

iii) The element Al (Aluminium) is in group III of Mendeleev's periodic table in which the general formula of the oxides of element is R_2O_3. So, the formula of oxide of Al will be Al_2O_3.

iv) The elements Si (silicon) is in group IV of Mendeleev's periodic table in which the general formula for the oxide

v) s of element is RO_2. So, the formula of the oxide of Si will be SiO_2.

vi) The element Ba (barium) is in group II of Mendeleev's periodic table in which the general formula for the oxides of element is RO. So, the formula of oxide of Ba will be BaO.

Q2. 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) are the elements which have been discovered for which gaps were left by Mendeleev in his periodic table.

Q3. What were the criteria used by Mendeleev in creating his periodic table?

Answer:

Mendeleev used two criteria in his periodic table:

i) Increasing atomic masses, and
ii) Grouping elements having similar chemical properties.

Mendeleev's took the formula of the oxides and hydrides formed by the elements are chemical properties of elements for their classification.

Q4. Why do you think the noble gases are placed in a separate group?

Answer:

The noble gases are in a separate group as are inert or unreactive with completely filled outermost electron shells.

Class 10 Science NCERT Textbook – Page No. 90

Q1. How could the Modern periodic table remove various anomalies of Mendeleev's periodic table?

Answer:

When the elements are arranged on the basis of atomic numbers following modern periodic law, then irregularities of Mendeleev's classification vanish.

i) Position of Isotopes. All the isotopes of an element have the same number of protons and atomic number , isotopes of an element have the same atomic number, so are placed in the same group of the periodic table. Example, isotopes of chlorine. $Cl-35\ and\ Cl-37$, have the same atomic number 17, so both are at one place in the same group of the periodic table.
ii) Position of Cobalt and Nickel. The atomic number of cobalt is 27 and nickel is 28. according to modern periodic law, the element are arranged in the order of increasing atomic numbers. So, cobalt with lower atomic number (27) come first and nickel with atomic number (28) come later.
iii) Position of Hydrogen. Hydrogen element is placed in group 1, above the alkali metals because the electronic configuration of hydrogen is similar to alkali metals. Both, hydrogen and alkali metals have 1 valence electron each.

Q2. Name two elements you would except to show chemical reactions similar to magnesium. What is the basis for your choice?

Answer:

The two which will show chemical reaction similar to magnesium are beryllium (Be) and calcium (Ca), because beryllium and calcium belong to the same group of periodic table as magnesium (group 2). All of them have similar electronic configuration with 2 valence electrons each.

Q3. Name:

a) Three elements that have a single electron in their outermost shell.
b) Two elements that have two electrons in their outermost shells.
c) Three elements with filled outermost shells.

Answer:

a) Three elements have a single electron in their outermost shell are: Lithium, Sodium and Potassium.
b) Two elements have two electrons in their outermost shells are: Magnesium and Calcium.
c) Three elements with completely filled outermost shells are: Neon and Argon.

Q4. $\boldsymbol{a}$) **Lithium, sodium, potassium are all metals that reacts with water to liberate hydrogen gas. Is there any similarity in the atoms of these elements?**

$\boldsymbol{b}$) **Helium is an unreactive gas and neon is a gas of extremely low reactive. What, if anything, do their atoms have in common?**

Answer:

a) there is a similarity in the atoms of lithium, sodium and potassium elements. All these elements have similar electronic configuration having 1 electron each in their valence shells. The electronic configurations of lithium, sodium and potassium are :

$Lithium \quad : \quad 2, 1$
$Sodium \quad : \quad 2, 8, 1$
$Potassium \quad : \quad 2, 8, 8, 1$

b) Helium and neon are noble gases. The helium and neon have valence shells completely filled with electrons. Helium has 2 electrons in its K valence shell, whereas neon has 8 electrons in its valence shell.

Q5. In the modern periodic table, which are the metals among the first ten elements?

Answer:

In the modern periodic table, the first ten elements are:

$$H, He, Li, Be, B, C, N, O, F, Ne$$

Out of these 10 elements only 2 elements, Lithium (Li) and Beryllium (Be) are metals.

Q6. By considering their position in the periodic table, which one of the following elements would you except to have maximum metallic character?

$$Ga, Ge, As, Se, Be$$

Answer:

The maximum metallic character is found in elements on the extreme left side of the periodic table. Out of the above given elements, Be (Beryllium) will have the maximum metallic character because it is on the left side in the periodic table in group 2.

Class 10 Science NCERT Textbook – Page No. 91 and 92

Q1. 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: Option c)

On moving from left to right across the periods of the periodic table, the non-metallic character increases so tendency to lose electrons decreases.

Q2. 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: Option b)

Since element X forms a chloride XCl_2, so the valency of X is 2. Now, out of $Na, Mg, Al\ and\ Si$, the element of valency 2 is Mg. So, X would be in the same group as that of Mg because all the elements of the same group have equal valency.

Q3. 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 shell in its valence shell?**
e) **Twice as many electrons in its second shell as in its first shell?**

Answer:

a) Neon (2, 8)
b) Magnesium (2, 8, 2)
c) Silicon (2, 8, 4)
d) Boron (2, 3)
e) Carbon (2, 4)

Q4. $\boldsymbol{a}$) **What property do all elements in the same column of the periodic table as boron have in common?**

$\boldsymbol{b}$) **What property do all elements in the same column of the periodic table as fluorine have in common?**

Answer:

a) The element boron is in column (or group) 13 of the periodic table and has a valency of 3. So, all the element in the same column of periodic table as boron will have valency of 3.
b) The element fluorine is in column (or group) 17 of the periodic table and has a valency of 1. So, all the elements in the same column of periodic table as fluorine will have a valency of 1.

Q5. 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)**

$\boldsymbol{N\ (7)}$ $\boldsymbol{F\ (9)}$ $\boldsymbol{P\ (15)}$ $\boldsymbol{Ar\ (18)}$

Answer:

a) The atomic number of this element can be obtained by adding all the electrons present in its electronic configuration. So, the atomic number of the given element having electronic configuration 2, 8, 7 is 2 + 8 + 7 = 17.
b) the number of valence electrons in N, F, P and Ar we have to write their electronic configuration on the basis of atomic numbers.

   i) The atomic number of N is 7, so its electronic configuration is 2, 5 with 5 valence electrons.
   ii) The atomic number of F is 9, so its electronic configuration is 2, 7. It has 7 valence electrons So, element of atomic number 17 is chemically similar to the element fluorine (F) of atomic number 9 as both of them have similar electronic configurations with 7 valence electrons.

Q6. The position of three elements A, B and C in the periodic table are shown below:

$\boldsymbol{Group\ 16}$	$\boldsymbol{Group\ 17}$
–	–
–	$\boldsymbol{A}$
–	–
$\boldsymbol{B}$	$\boldsymbol{C}$

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) Element A of group 17, is on the right side of the periodic table where non-metals called halogens are placed. So, element A is a non-metal and a halogen.
b) In group 17 of halogens, the chemical reactivity decreases on going down in a group so element C is less reactive than A.
c) On-going from left to right in a period, the size of atoms decreases. So, the atom of C is smaller in size than B.
d) Element A of group 17 has 7 valence electrons. So, it accepts 1 electron to form a negatively charged ion, A^- called an anion. Thus, element A form an anion.

Q7. Nitrogen (atomic number 7) and phosphorous (atomic number 15) belong to group 15 of the periodic table. Write the electronic configuration of these two elements. Which of these will be more electronegative? Why?

Answer:

The atomic number of nitrogen's is 7 so its electronic configuration is 2, 5. The atomic number of phosphorous is 5 so its electronic configuration is 2, 8, 5. nitrogen has two electron shells and phosphorous atom has three electron shells. Due to the presence of two electron shell in it, a nitrogen atom is smaller than a phosphorus atom. Nitrogen is more electronegative as its atom has a small size due to which the attraction of its nucleus for the incoming electron is more.

Q8. How does the electronic configuration of an element relate to its position in the modern periodic table?

Answer:

The electronic configuration of an element tells us: the number of electron shells and the number of valence electrons in one atom of the element.

i) The number of electron shells in an atom of the element gives us the period number of the element in the periodic table – if an element has 2 electron shells in its atom, it belongs to 2^{nd} period, if an element has 3 electron shells, it belongs to 3^{rd} period, and so on. Example, the electronic configuration of carbon element is 2, 4. Since the carbon atom has two electron shells (K and L), therefore, it belongs to 2^{nd} period of the periodic table.

ii) The group number of an element in the periodic table with two valence electrons is equal to the number of valence electrons – if an element has 1 valence electron, it is in group 1 and if the element has 2 valence electrons, then it is in group 2 of the periodic table. Example, the electronic configuration of sodium element is 2, 8, 1.As sodium has 1 valence electron, so it belongs to group 1 of the periodic table.

iii) The group number of an element with more than 2 valence electrons is equal to the number of valence electrons plus 10 – if an element has 3 valence electrons, its group number is 3 + 10 = 13, if the element has 4 valence electrons, then its group number is 4 + 10 = 14, and so on. Example, the electronic configuration of aluminum is 2, 8, 3. Since aluminum has 3 valence electrons in the M shell, so it belongs to group number 3 + 10 = 13 of the periodic table.

Q9. In the modern 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 atomic number of calcium is 20, so its electronic configuration is 2, 8, 8, 2. So, calcium has 2 valence electrons in its outermost shell, element which has 2 valence electrons have physical and chemical properties resembling that of calcium. The electronic configuration of element having atomic number 12 is 2, 8, 2. has 2 valence electrons like calcium. So, the element having atomic number 12 have physical and chemical properties resembling that of calcium.

Q10. Compare and contrast the arrangement of elements in Mendeleev's periodic table and the Modern periodic table.

Answer:

S/No.	Mendeleev's periodic table	Modern periodic table
1.	Mendeleev's periodic table is based on atomic masses of elements.	Modern periodic table is based on atomic numbers of elements.
2.	Mendeleev's periodic table does not tell us why elements in a group have similar chemical properties but the elements in a period have different properties.	It tells us that the elements in a group have similar chemical properties because they have similar electronic configurations.
3.	Mendeleev's periodic table does not explain the reason for the periodicity (repetition) in the properties of elements.	It says that since the electronic configuration of elements are repeated at regular, intervals, so, the properties of elements are also repeated at regular intervals.
4.	Mendeleev's periodic table does not tell us why the properties of elements are repeated after 2, 8, 18 and 32 elements.	It tells us since the electronic configurations of element are repeated after 2, 8, 18 and 32 elements, so the, properties of elements are also repeated after 2, 8, 18 and 32 elements.
5.	Mendeleev's periodic table had a number of anomalies.	There are no anomalies in the modern periodic table.