Class 10 Chapter 5 Periodic Classification of Elements Important Questions with Answers

Short Answer Type Questions

Q1. The three elements A, B and C with similar properties have atomic masses X, Y and Z, respectively. The mass of Y is approximately equal to the average mass of X and Z. What is such an arrangement of elements called? Give one example of such a set of elements.

Answer:

Dobereiner proposed a Triad of elements. He arranged elements in triads. In it, the atomic mass of the middle element is equal to the average atomic mass of the other two elements. Such an arrangement of elements is called a triad.
For example, the Atomic mass of Lithium, Sodium and Potassium are 6.9, 23.0 and 39.0, respectively. The average mass of Li and K is approximately 23.0, equal to the atomic mass of Na. Thus, Lithium, Sodium and Potassium make a triad.

Q2. Elements have been arranged in the following sequence based on their increasing atomic masses.
F, Na, Mg, Al, Si, P, S, Cl, Ar, K.
(a) Pick two sets of elements with similar properties.
(b) The given sequence represents which law of classification of elements?

Answer:

(a) (i) F and Cl (ii) Na and K have similar properties.
(b) It represents Newland's law of octaves.

Q3. Can the following groups of elements be classified as Dobereiner's triad?
(a) Na, Si, Cl
(b) Be, Mg, Ca
Atomic mass of Be 9; Na 23; Mg 24; Si 28; C| 35; Ca 40
Explain by giving a suitable reason.

Answer:

(a) Na, Si, and Cl are not a Dobereiner's triad. Although the atomic mass of silicon (Si) is the average of atomic masses of sodium (Na) and chlorine (Cl), but these elements do not possess similar properties. Hence, it can't be classified as a Dobereiner's triad.

23 (Na) + 35 (Cl) / 2 = 29 (Si)

(b) Be, Mg, and Ca is a Dobereiner's triad. They have similar properties, and the atomic masses of magnesium (Mg) is approximately the average of the atomic mass of Be and Ca.

9 (Be) + 40 (Ca) / 2 = 24.5 (Si)

Q4. In Mendeleev's Periodic Table, the eler\ents were arranged in the increasing order of their atomic masses. However, cobalt with an atomic mass of 58.93 amu was placed before nickel, having an atomic mass of 58.71 amu. Give a reason for the same.

Answer:

In Mendeleev's Periodic Table, the elements were arranged in the increasing order of their atomic masses. However, cobalt with an atomic mass of 58.93 amu was placed before nickel, having an atomic mass of 58.71 amu. We did this to ensure that the same group has elements with similar properties. Hence cobalt was placed before nickel despite the higher atomic number of Cobalt than Nickel.

Q5. Hydrogen occupies a unique position in Modern Periodic Table". Justify the statement.

Answer:

Hydrogen has an electron configuration of 1s1. It can either accept one electron to get a stable configuration or donate one electron to become stable. Hence the position of hydrogen isn't evident. We can place it either in the metals group as it donates or in the nonmetal group as it accepts an electron. Hence it occupies a unique position in the periodic table.

Q6. Write the formulae of chlorides of Eka-silicon and Eka-aluminium, the elements predicted by Mendeleev.

Answer:

The formulae of chlorides of Eka-silicon and Eka-aluminium are XC_4 and XCl_3, respectively.

Q7. Three elements A, B and C have 3, 4 and 2 electrons, respectively, in their outermost shell. Give the group number to which they belong in the Modern Periodic Table. Also, give their valencies.

Answer:

A belongs to Group 13, B belongs to Group 14, and C belongs to Group 2. A valency is 3, B valency is 4, and C valency is 2.

Q8. If an element X is placed in group 14, what will be the formula and the nature of bonding of its chloride?

Answer:

If an element is placed in group 14, it has 4 electrons in its outermost orbit. Hence, the formula of its chloride is XCl_4 . It makes compounds by sharing electrons, so its compound will have a covalent bond.

Q9. Compare the radii of two species, X and Y. Give reasons for your answer.
(a) X has 12 protons and 12 electrons
(b) Y has 12 protons and 10 electrons

Answer:

As both X and Y had 12 protons, their atomic number is 12, i.e., magnesium. Y has only 10 electrons, due to which the effect of nuclear charge on the electrons would be more than that of 12 electrons. Hence, the radii of Y would be smaller than that of X.

Q10. Arrange the following elements in increasing order of their atomic radii.
(a) Li, Be, F, N
(b) CI, At, Br, I

Answer:

(a) Li, Be, N, and F are in the same period, and atomic radii decrease from left to right. Thus, the order will be: F < N < Be < Li.
(b) CI, Br, I, and At are in the same group, and the atomic radii increase from top to bottom. Thus, the order will be: CI < Br < I < At.

Q11. Identify and name the metals from the following elements whose electronic configurations are given below.
(a) 2, 8, 2
(b) 2, 8, 1
(c) 2, 8,7
(d) 2, 1

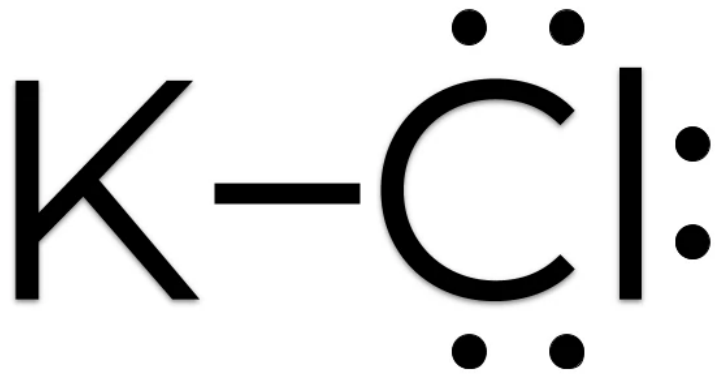
Answer:

(a) Magnesium; It is a metal.
(b) Sodium; It is a metal.
(c) Chlorine; It is a nonmetal.
(d) Lithium; It is a metal.

Q12. Write the formula of the product formed when element A (atomic number 19) combines with element B (atomic number 17). Draw its electronic dot structure. What is the nature of the bond formed?

Answer:

The product's formula when element A (atomic number 19) combines with element B (atomic number 17) is KCl.
The nature of the bond between KCl is ionic.
Electron Dot Structure of KCl:



Q13. Arrange the following elements in the increasing order of their metallic character: Mg, Ca, K, Ge, Ga

Answer:

Metallic character increases as we move down the group because there is an increase in atomic size. Thus, the order will be: Ge< Ga < Mg < Ca < K.

Q14. Identify the elements with the following property and arrange them in increasing order of their reactivity
(a) An element which is a soft and reactive metal
(b) The metal which is an important constituent of limestone
(c) The metal which exists in a liquid state at room temperature

Answer:

(a) Sodium is soft and reactive.
(b) Calcium is an important constituent of limestone.
(c) Mercury exists in a liquid state at room temperature.
The increasing order of reactivity will be: Hg < Ca < Na.

Q15. Properties of the elements are given below. Where would you locate the following elements in the periodic table?
(a) A soft metal stored under kerosene.
(b) An element with variable (more than one) valency stored underwater.
(c) An element which is tetravalent and forms the basis of organic chemistry.
(d) An element which is an inert gas with atomic number 2.
(e) An element whose thin oxide layer is used to make other elements corrosion-resistant by anodising.

Answer:

(a) Sodium is soft metal stored under kerosene.
(b) Phosphorous shows variable (more than one) valency and is stored underwater.
(c) Carbon is a tetravalent element and forms the basis of organic chemistry.
(d) Helium is an element which is an inert gas with atomic number 2.
(e) Aluminium is an element whose thin oxide layer is used to make other elements corrosion-resistant by anodising.

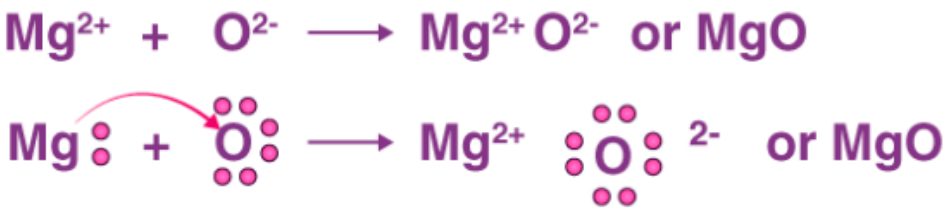
Long Answer Type Questions

Q1. An element is placed in the 2nd Group and 3rd Period of the Periodic Table. It burns in the presence of oxygen to form a basic oxide.
(a) Identify the element
(b) Write the electronic configuration
(c) Write the balanced equation when it burns in the presence of air
(d) Write a balanced equation when this oxide is dissolved in water
(e) Draw the electron dot structure for the formation of this oxide

Answer:

(a) Magnesium
(b) The electronic configuration of magnesium is 2, 8, 2.
(c) $2\ Mg + O_2 \rightarrow 2\ MgO$
(d) $MgO + H_2O \rightarrow Mg(OH)_2$

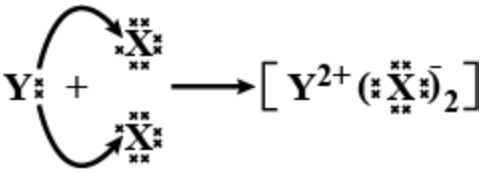
(e) Electron Dot Structure of magnesium oxide:



Q2. An element X (atomic number 17) reacts with an element Y (atomic number 20) to form a divalent halide.
(a) Where in the periodic table are elements X and Y placed?
(b) Classify X and Y as metal (s), non-metal (s) or metalloid (s).
(c) What will be the nature of the oxide of element Y? Identify the nature of bonding in the compound formed.
(d) Draw the electron dot structure of the divalent halide.

Answer:

(a) X belongs to Group 17 and 3rd periods, while Y belongs to Group 2 and 4th.
(b) X is a Nonmetal, while Y is a metal.
(c) Y will form a basic oxide, and it will have an ionic bonding.
(d) Electron dot structure of the divalent halide.



Q3. The atomic number of a few elements are given below
10, 20, 7, 14
(a) Identify the elements
(b) Identify the Group number of these elements in the Periodic Table
(c) Identify the Periods of these elements in the Periodic Table
(d) What would be the electronic configuration for each of these elements?
(e) Determine the valency of these elements

Answer:

(a) 10 is the atomic number of neon.
20 is the atomic number of calcium.
7 is the atomic number of nitrogen.
14 is the atomic number of silicon.
(b) Neon belongs to group 18.
Calcium belongs to group 2.
Nitrogen belongs to group 15.
Silicon belongs to group 14.
(c) Neon belongs to period 2.
Calcium belongs to period 4.
Nitrogen belongs to period 2.
Silicon belongs to period 3.
(d) The electronic configuration of neon is 2, 8.
The electronic configuration of calcium is 2, 8, 8, 2.
The electronic configuration of nitrogen is 2, 5.
The electronic configuration of silicon is 2, 8, 4.
(e) The valency of neon is equivalent to 8 - no of valence electrons, i.e. 8 - 8 = 0.
The valency of calcium is equivalent to the no of valence electrons, i.e. equal to 2.
The valency of nitrogen is equivalent to 8 - no of valence electrons, i.e. 8 - 5 = 3.

The valency of silicon is equivalent to 8 - no of valence electrons, i.e. 8 - 4 = 4.

Q4. Complete the following crossword puzzle (Figure 5.1)

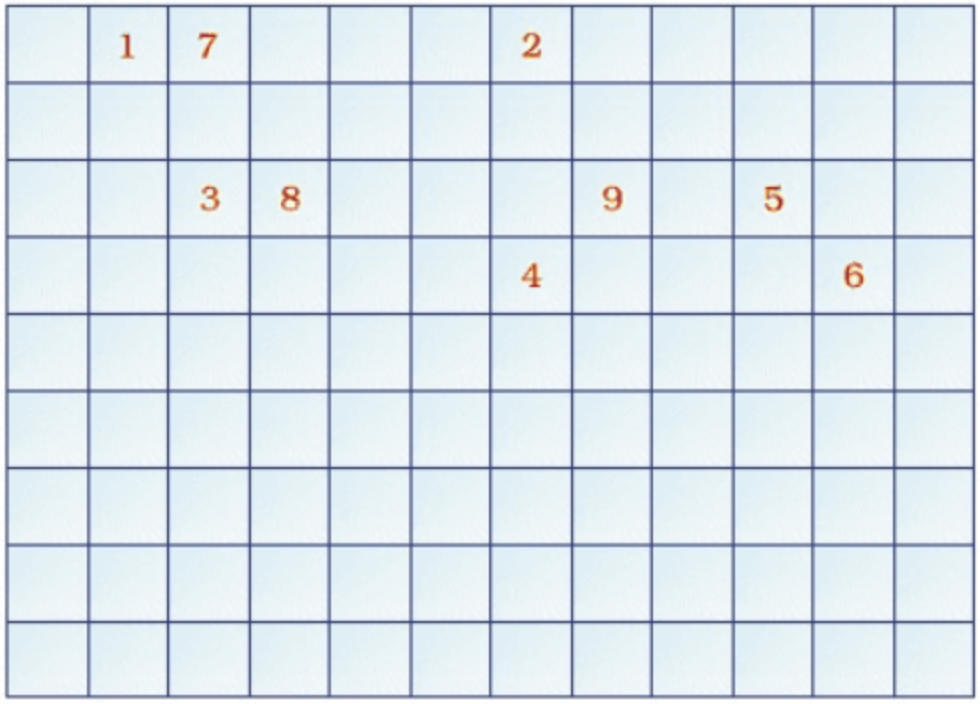


Fig. 5.1

Across:
(1) An element with atomic number 12.
(3) Metal used in making cans and member of Group 14.
(4) A lustrous non-metal with 7 electrons in its outermost shell.
Down:
(2) Highly reactive and soft metal which imparts yellow colour when subjected to flame and is kept in kerosene.
(5) The first element of the second Period
(6) An element which is used in making fluorescent bulbs and is the second member of Group 18 in the Modem Periodic Table
(7) A radioactive element which is the last member of the halogen family.
(8) Metal is an important constituent of steel and forms rust when exposed to moist air.
(9) The first metalloid in Modem Periodic Table whose fibres are used to make bullet-proof vests

Answer:

(1) Magnesium has 12 atomic numbers.

(2) Sodium is a highly reactive and soft metal which imparts yellow colour when subjected to flame and is kept in kerosene.
(3) Tin is used in making cans and is a member of Group 14.
(4) Iodine is a lustrous non-metal with 7 electrons in its outermost shell.
(5) Lithium is the first element of the second Period.
(6) Neon is used in making fluorescent bulbs and is the second member of Group 18 in the Modem Periodic Table.
(7) Astatine is a radioactive element which is the last member of the halogen family.
(8) Iron is an important constituent of steel and forms rust when exposed to moist air.
(9) Boron is the first metalloid in Modem Periodic Table whose fibres are used to make bullet-proof vests.

Q5. (a) In this ladder (Figure 5.2), symbols of elements are jumbled up. Rearrange these symbols of elements in the increasing order of their atomic number in the Periodic Table.
(b) Arrange them in the order of their group also.

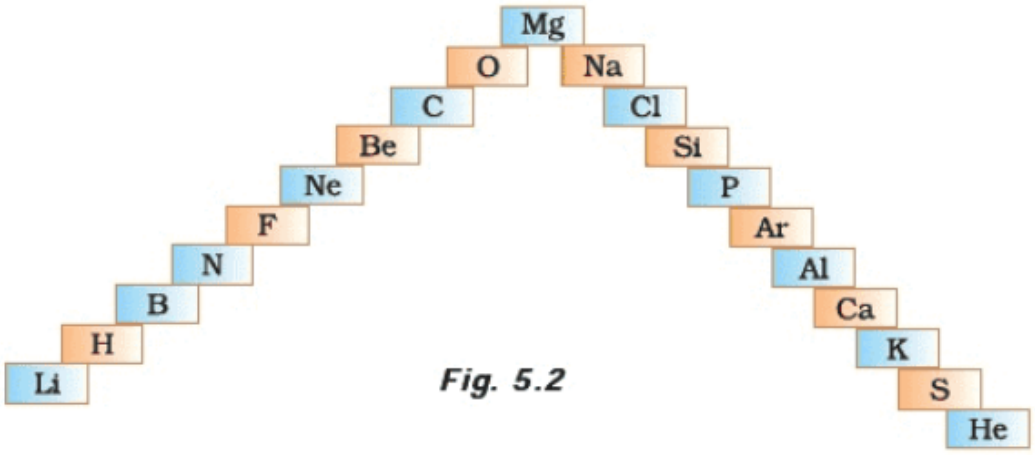


Fig. 5.2

Answer:

(a) The arrangement of elements in the increasing order of their atomic number in the Periodic Table.
H, He, Li, Be, B, C, N, O, F, Ne, Na, Mg, Al, Si, P, S, Cl, Ar, K, Ca.
(b) The arrangement of elements in groups.
Group 1: H, Li, Na, K
Group 2: Be, Mg, Ca
Group 13: B, Al
Group 14: C, Si
Group 15: N, P
Group 16: O, S

Group 17: F. Cl
Group 18: He, Ne, Ar

Q6. Mendeleev predicted the existence of certain elements not known at that time and named two of them Eka-silicon and Eka-aluminium.
(a) Name the elements which have taken the place of these elements.
(b) Mention the group and the period of these elements in the Modern Periodic Table.
(c) Classify these elements as metals, non-metals or metalloids.
(d) How many valence electrons are present in each of them?

Answer:

(a) Eka-silicon was replaced by Germanium, while Gallium replaced Eka-aluminium.
(b) Gallium belongs to Group 13 and Period 5 of the periodic table, while Germanium belongs to Group 14 and Period 4.
(c) Gallium is metal, while Germanium is metalloid.
(d) Gallium has three valence electrons, while Germanium has 4.

Q7. a) Electropositive nature of the element(s) increases down the group and decreases across the period.
(b) Electronegativity of the element decreases down the group and increases across the period.
(c) Atomic size increases down the group and decreases across a period (left to right).
(d) Metallic character increases down the group and decreases across a period.
Based on the above trends of the Periodic Table, answer the following about the elements with atomic numbers 3 to 9.
(a) Name the most electropositive element among them.
(b) Name the most electronegative element among them.
(c) Name the element with the smallest atomic size
(d) Name the element which is a metalloid
(e) Name the element that shows maximum valency.

Answer:

(a) The most electropositive element among them is Lithium.
(b) The most electronegative element among them is Fluorine.
(c) The element with the smallest atomic size is Fluorine.
(d) Boron (5) is a metalloid.
(e) Carbon shows maximum valency.

Q8. An element X, a yellow solid at room temperature, shows catenation and allotropy. X forms two oxides formed during the thermal decomposition of ferrous sulphate crystals and are the major air pollutants.
(a) Identify the element X
(b) Write the electronic configuration of X
(c) Write the balanced chemical equation for the thermal decomposition of ferrous sulphate crystals?
(d) What would be the nature (acidic/ basic) of oxides formed?
(e) Locate the position of the element in the Modem Periodic Table.

Answer:

(a) The element X is Sulphur.
(b) The electronic configuration of X is 2, 8, 6.
(c) Thermal decomposition of ferrous sulphate:
$2\ FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$
(d) Oxides of Sulphur are acidic.
(e) Sulphur belongs to Group 16 and the third period of the periodic table.

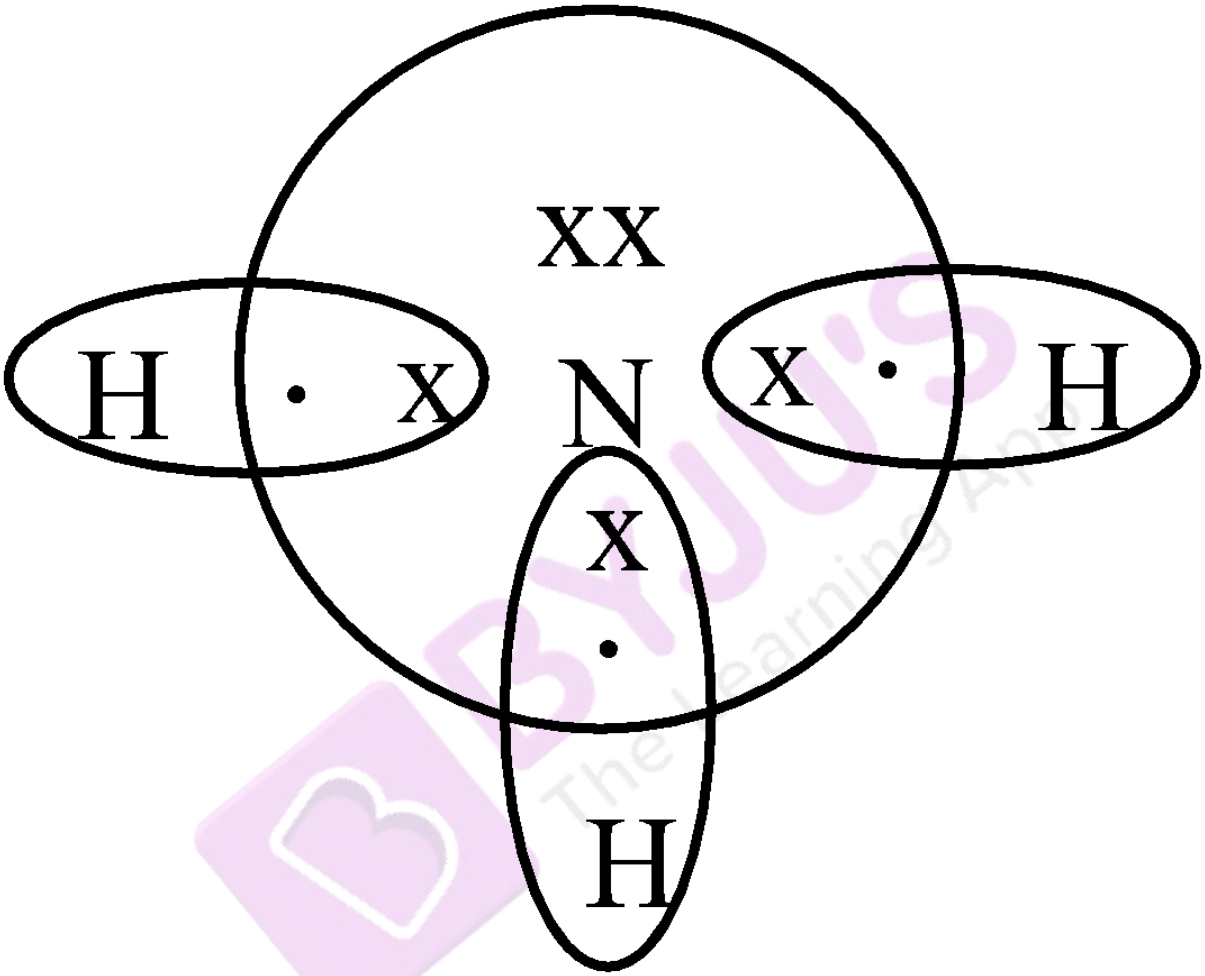
Q9. An element X of group 15 exists as a diatomic molecule and combines with hydrogen at 773 K in the presence of the catalyst to form a compound, ammonia, which has a characteristic pungent smell.
(a) Identify the element X. How many valence electrons does it have?
(b) Draw the electron dot structure of the diatomic molecule of X. What type of bond is formed in it?
(c) Draw the electron dot structure for ammonia, and what type of bond is formed in it?

Answer:

(a) The element X is Nitrogen. It has five valence electrons.
(b) The electron dot structure of the diatomic molecule of X.

Dinitrogen forms a covalent bond.

(c) The electron dot structure of the ammonia.



Ammonia forms a covalent bond.

Q10. Which group of elements could be placed in Mendeleev's Table without disturbing the original order? Give reason.

Answer:

Noble gases could be placed in Mendeleev.s periodic table without disturbing the original order. Noble gases are inert due to a wholly filled valence electron shell. They are present in low concentrations in our atmosphere and do not form any compound with other elements. During the evolution of the periodic table by Mendeleev, these gases were not known. After their discovery, they were placed in a separate group as their properties did not resemble that of any other group in the periodic table. So, their existence did not affect the existing order of Mendeleev's periodic table.

Q11. Give an account of the process adopted by Mendeleev for the classification of elements. How did he arrive at Periodic Law?

Answer:

Mendeleev tried to classify the elements based on their chemical properties to ease the study of elements. He wrote the properties of each element on a separate card and arranged them in diverse ways. He put all 63 elements in the order of their increasing atomic masses in horizontal rows called periods. Elements with similar properties were placed below the other in the same vertical column called groups. There was a total of seven periods and eight groups. The classification was based on resemblances in physical and chemical properties and the compounds formed by elements with hydrogen and oxygen. He noticed that elements of similar properties would repeat at regular intervals (8th, 18th, or 32nd position). Then, he stated it as the periodic law, i.e. The properties of elements are a periodic function of their atomic masses.