Periodic Classification Of Elements

Multiple Choice Questions

Question 1.
Upto which element, the Law of Octaves was found to be applicable.
A. Oxygen

B. Calcium

C. Cobalt

D. Potassium

Answer:
John Alexander Reina Newland was the first to discover the Periodic Table. He made a table of all known elements and arranged them on the basis of their atomic weight. Lithium is the first element and sodium is the eighth element. Similarly, the eighth element after sodium is potassium. Law of octaves says that the elements Li, Na and K must have similar chemical and physical properties. For example, if we start from Lithium (atomic mass = 6) and arrange elements in increasing order of their atomic masses, the eighth element will be sodium (atomic mass = 23). Both elements show the same physical and chemical properties.
This classification was not applicable to all elements. It was only valid for elements having atomic masses lower than Ca.

Question 2.
According to Mendeleev's Periodic Law, the elements were arranged in the periodic table in the order of
A. Increasing atomic number

B. Decreasing atomic number

C. Increasing atomic masses

D. Decreasing atomic masses

Answer:
Dmitri Ivanovich Mendeleev was a Russian scientist. He arranged the elements in increasing order of their relative atomic masses. This law states that the properties of elements are the periodic function of their relative atomic masses.

Question 3.
In Mendeleev's Periodic Table, gaps were left for the elements to be discovered later. Which of the following elements found a place in the periodic table later?
A. Germanium

B. Chlorine

C. Oxygen

D. Silicon

Answer:
In 1869, after Newlands Octave Law was rejected, Mendeleev Periodic table was introduced. In this periodic table, elements were arranged on the basis of their atomic masses. A few gaps were left for the elements to be discovered later. Later, Gallium (Ga) and Germanium (Ge) were found that had same properties as eka–aluminum and eka–silicon, respectively.

Question 4.
Which of the following statement(s) about the Modern Periodic Table are incorrect?

(i) The elements in the Modern Periodic Table are arranged on the basis of their decreasing atomic number.

(ii) The elements in the Modern Periodic Table are arranged on the basis of their increasing atomic masses.

(iii) Isotopes are placed in adjoining group (s) in the Periodic Table.

(iv) The elements in the Modern Periodic Table are arranged on the basis of their increasing atomic number.
A. (i) only

B. (i), (ii) and (iii)

C. (i), (ii) and (iv)

D. (iv) only

Answer:
Henry Moseley removed defects in earlier periodic tables and stated the modern periodic table. The modern periodic table stated that the properties of elements are periodic functions of their atomic number. The elements are arranged on the basis of their increasing atomic number.

Question 5.
Which of the given elements A, B, C, D and E with atomic number 2, 3, 7, 10 and 30 respectively belong to the same period?
A. A, B, C

B. B, C, D

C. A, D, E

D. B, D, E

Answer:
This period contains the elements beryllium, boron, carbon, oxygen and fluorine.

Question 6.
The elements A, B, C, D and E have atomic number 9, 11, 17, 12 and 13 respectively. Which pair of elements belongs to the same group?
A. A and B

B. B and D

C. A and C

D. D and E

Answer:
Elements A is fluorine (atomic number 9) and C is chlorine (atomic number 17) belong to the same group. These two elements belong to group 17 of the periodic table.

Question 7.
Where would you locate the element with electronic configuration 2, 8 in the Modern Periodic Table?
A. Group 8

B. Group 2

C. Group 18

D. Group 10

Answer:
Group 18 in the modern periodic table has noble gases (inert gases). Helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe) and radon (Rn) are present in group 18. The members of the group have eight electrons in their outermost orbit (except helium which has two electrons). Thus, they have a stable electronic configuration. These gases are chemically unreactive, that is, they don't react with other elements to form compounds.

Question 8.
An element which is an essential constituent of all organic compounds belongs to
A. Group 1

B. Group 14

C. Group 15

D. Group 16

Answer:
Group 14 is known as the carbon family. It contains elements such as carbon (C), silicon (Si), germanium (Ge), tin (Sn), lead (Pb) and flerovium (Fl). Carbon is one of the most common and abundant elements on earth. It is an essential constituent of all organic compounds. Carbon dioxide (CO_2) and methane (CH_4) are a few common compounds containing carbon.

Question 9.
Which of the following statements about the Modern Periodic Table is correct?
A. It has 18 horizontal rows known as Periods.

B. It has 7 vertical columns known as Periods.

C. It has 18 vertical columns known as Groups.

D. It has 7 horizontal rows known as Groups.

Answer:
The periodic table has seven rows called periods. It has 18 columns called groups or families. Elements of the same group have similar properties. For example, group 18 consists of the noble or insert gases. These elements (helium, neon, argon, krypton, xenon, radon) have 8 valence electrons.

Question 10.

Which of the following is the outermost shell for elements of period 2?
A. K shell

B. L shell

C. M shell

D. N shell

Answer:
Periods show the number of outermost shell of any element. Since period 2 has two shells (2s and 2p orbitals), the outermost shell is L shell. The second period contains the elements such as lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine, and neon.

Question 11.
Which one of the following elements exhibit maximum number of valence electrons?
A. Na

B. Al

C. Si

D. P

Answer:
Among the given elements, phosphorus (P) has maximum number of valence electrons i.e., 5. Na (group 1) has one, Al (group 13) has three, Si (group 14) has four and P (group 15) has five valence electrons.

Question 12.
Which of the following gives the correct increasing order of the atomic radii of O, F and N?
A. O, F, N

B. N, F, O

C. O, N, F

D. F, O, N

Answer:

Atomic radius of fluorine (F) 42. Atomic radius of oxygen (O) 48. Atomic radius of nitrogen (N) is 56. Generally, atomic radius increases down a Group, from top to bottom. Thus, atomic radius will decrease from N to F.

Question 13.
Which among the following elements has the largest atomic radii?
A. Na

B. Mg

C. K

D. Ca

Answer:
Na and Mg belong to same period whereas Na and K are in the same group. Atomic radius increases in a group and decreases in a period. Potassium (K) has the largest atomic radii (243 pm). Sodium (Na) has 190 pm. Magnesium (Mg) has 145 pm. Calcium (Ca) has 194 pm.

Question 14.
Which of the following elements would lose an electron easily?
A. Mg

B. Na

C. K

D. Ca

Answer:
Potassium (K) is more electropositive and hence ionizes easily than sodium (Na) due to bigger size and less electronic attraction. As we move down a group in periodic table, the size of the atom increases and the ionization potential decreases. So, potassium releases electrons easily than Na, Mg and Ca.

Question 15.
Which of the following elements does not lose an electron easily?
A. Na

B. F

C. Mg

D. Al

Answer:
Flourine has 7 electrons in the outermost orbit. Its atom size is smallest too. Since it is the most electronegative element, thus does not lose an electron easily.
Sodium has one valence electron, Magnesium has 2 valence electrons, and Aluminum has 3 valence electrons. These are all metals that lose electrons easily.

Question 16.
Which of the following are the characteristics of isotopes of an element?

(i) Isotopes of an element have same atomic masses.

(ii) Isotopes of an element have same atomic number.

(iii) Isotopes of an element show same physical properties.

(iv) Isotopes of an element show same chemical properties.
A. (i), (iii) and (iv)

B. (ii), (iii) and (iv)

C. (ii) and (iii)

D. (ii) and (iv)

Answer:
Isotopes are two or more forms of an element in which the atoms have the same number of protons. Also different isotopes of an element have different mass numbers, hence the number of neutrons in the nuclei of isotopes of an element are different. All isotopes have similar chemical properties.

For example, hydrogen (H) has three isotopes having mass numbers 1, 2 and 3, but all having atomic number equal to 1.

Question 17.
Arrange the following elements in the order of their decreasing metallic character: Na, Si, Cl, Mg, Al
A. Cl > Si >Al > Mg > Na

B. Na >Mg >Al >Si > Cl

C. Na > Al > Mg > Cl > Si

D. Al > Na> Si > Ca > Mg

Answer:
Metallic character decreases on going from left to right in a period. This is due to decreased atomic size which increases the tendency of an element to gain electrons. The metallic character increases on going down in a group due to tendency to lose electrons.

Question 18.
Arrange the following elements in the order of their increasing nonmetallic character: Li, O, C, Be, F
A. F < O < C < Be < Li

B. Li < Be < C < O< F

C. F < O < C < Be < Li

D. F < O < Be < C < Li

Answer:
Non-metallic character increases on going from left to right in a period. This is due to decreased atomic size which increases the tendency of an element to gain electrons. Non-metallic character decreases on moving down a group.

Question 19.
What type of oxide would Eka–aluminium form?
A. EO3

B. E3 O2

C. E2O3

D. EO

Answer:
Aluminum (Al) has the oxidation state: +3. It can form Al3+ as it has valency of +3. So it will form $Al_2 O_3$.

Question 20.

Three elements B, Si and Ge are
A. metals

B. non-metals

C. metalloids

D. metal, non-metal and metalloid respectively

Answer:
Boron (B), silicon (Si), germanium (Ge) are metalloids. A few others are arsenic (As), antimony (Sb), tellurium (Te), polonium (Po) and astatine (At). These elements are found between metals and non-metals of the periodic table. They have properties of both metals and non-metals.

Question 21.
Which of the following elements will form an acidic oxide?
A. An element with atomic number 7

B. An element with atomic number 3

C. An element with atomic number 12

D. An element with atomic number 19

Answer:
Non-metals form acidic oxides. The element with atomic number 7 is a non-metal (nitrogen). All others are metals.

Question 22.
The element with atomic number 14 is hard and forms acidic oxide and a covalent halide. To which of the following categories does the element belong?
A. Metal

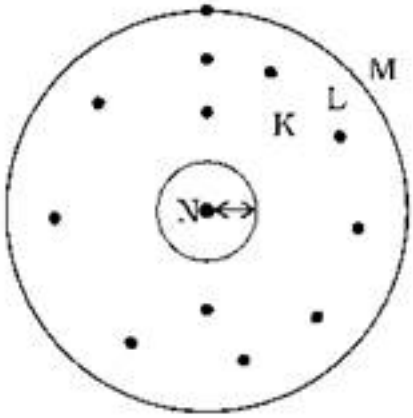
B. Metalloid

C. Non-metal

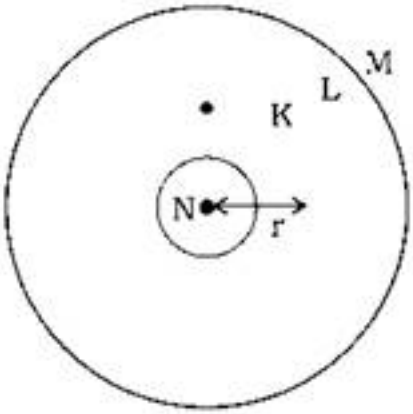
D. Left-hand side element

Answer:
Non-metal silicon has atomic number 14. It possess properties of both metals and non-metals. It forms acidic oxides like other non-metals.

Question 23.
Which one of the following depict the correct representation of atomic radius(r) of an atom?



(i)



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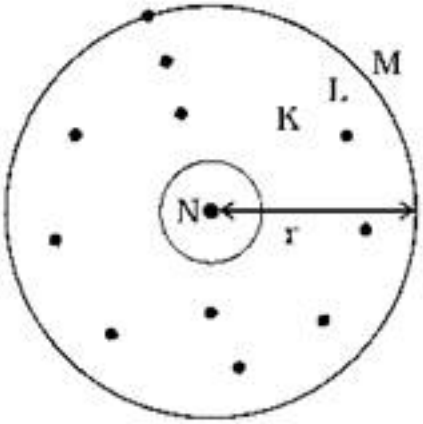

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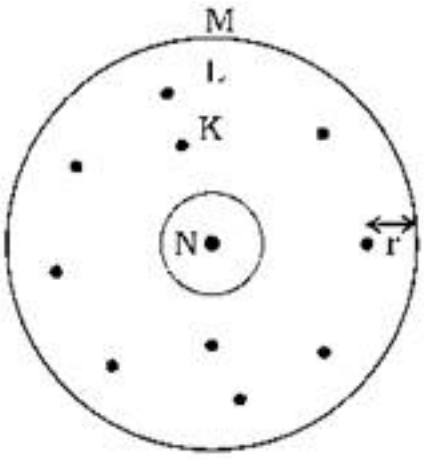


(iv)

A. (i) and (ii)

B. (ii) and (iii)

C. (iii) and (iv)

D. (i) and (iv)

Answer:
Atomic radius is the distance between centre of the nuclei and the outermost shell.

Question 24.
Which one of the following does not increase while moving down the group of the periodic table?
A. Atomic radius

B. Metallic character

C. Valence

D. Number of shells in an element

Answer:
Elements that belong to the same group has same number of valence electrons. Thus the valency of elements remains the same.

Question 25.
On moving from left to right in a period in the periodic table, the size of the atom.
A. increases

B. decreases

C. does not change appreciably

D. first decreases and then increases

Answer:
As we move from left to right in a period, the atomic number increases but the number of shell remains same. Thus electronic attraction increases thus reducing the size.

Question 26.
Which of the following set of elements is written in order of their increasing metallic character?
A. Be Mg Ca

B. Na Li K

C. Mg Al Si

D. C O N

Answer:
As we move down in a group the metallic nature of elements increases. Be Mg Ca are present in the same group (group 2 of modern periodic table). Thus, Ca has the highest metallic character.

Short Answer Questions

Question 1.
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 as? Give one example of such a set of elements.

Answer:
The arrangement of these elements is known as Dobereiner triad. This triad is a group of three elements.

In 1817, Dobereiner suggested relationship between properties of elements and their atomic weights. The atomic weight of the middle element is approximately equal to the average weights of other two elements.

One example of such as set of elements is lithium, sodium and potassium.

Here, atomic weight of sodium is average weights of the lithium and potassium.

7 (lithium) + 39 (potassium)/2 = 23 (sodium)

Question 2.
Elements have been arranged in the following sequence on the basis of their increasing atomic masses.

F, Na, Mg, Al, Si, P, S, Cl, Ar, K

(a) Pick two sets of elements which have similar properties.

(b) The given sequence represents which law of classification of elements?

Answer:
(i) F and Cl have similar properties. (ii) Na and K have similar properties..

(b) The given sequence represents Newland’s law of octaves. Newland’s law of octaves states that every eighth element will show similar properties as that of the first element. Therefore, above two sets will have similar properties.

Question 3.
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; Cl 35; Ca 40

Explain by giving reason.

Answer:
No. Na, Si, Cl cannot be classified as Dobereiner's triad. Although the atomic mass of silicon (Si) is average of atomic masses of sodium (Na) and chlorine (Cl), all these elements do not have similar properties.

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

(b) Yes. Be, Mg, Ca cannot be classified as Dobereiner's triad. They have similar properties and the atomic weights of magnesium (Mg) is roughly the average of the atomic weights of Be and Ca.

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

Dobereiner's triad suggested relationship between properties of elements and their atomic weights. The atomic weight of the middle element is approximately equal to the average weights of other two elements.

Question 4.
In Mendeleev's Periodic Table the elements were arranged in the increasing order of their atomic masses. However, cobalt with atomic mass of 58.93 amu was placed before nickel having an atomic mass of 58.71 amu. Give reason for the same.

Answer:
In Mendeleev's Periodic Table, elements with similar properties can be grouped together.

Cobalt was placed in the group of rhodium (Rh) and iridium (Ir) because cobalt has properties similar to these elements.

Likewise, nickel was placed with elements such as pallidium (Pd) and platinum (Pt) because nickel has properties similar to these elements.

Question 5.
"Hydrogen occupies a unique position in Modern Periodic Table". Justify the statement.

Answer:

Hydrogen occupies a unique position in Modern Periodic Table because of the following reasons:

a. The valence shell configuration of hydrogen and alkali metals is same. Both have only one electron. Thus some of the properties of hydrogen and alkali metals are similar and hence they are placed in group 1.

b. Both hydrogen and halogens need just one electron to complete their valence configuration. Thus they shows similar properties and are placed in group 17.

c. Apart from these properties, hydrogen shows some other unique properties such as they form oxides that are neutral in nature. Metals form basic oxides and halogen form acidic oxides.

Question 6.
Write the formulae of chlorides of Eka-silicon and Eka-aluminium, the elements predicted by Mendeleev.

Answer:
$GeCl_4$, $GaCl_3$

'Eka-element' term was introduced by D. I. Mendeleev in 1871. The elements were arranged in the periodic table. But all the eka-elements were discovered later. Eka-silicon discovered in 1886 was called germanium (Ge). Eka-aluminum discovered in 1875 was called gallium (Ga). Eka-boron discovered in 1879 was called scandium. The prefix 'eka' means 'beyond' on his table.

The valency of germanium is 4 so the chemical formula of its chloride is $GeCl_4$.

The valency of gallium is 3 so the chemical formula of its chloride is $GaCl_3$.

Question 7.
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:

Element	Group No.	Valency
A	Group-13	3
B	Group-14	4
C	Group-2	2

Element A has 3 valence electrons. Thus it has valency 3. It should be in group 13 that contains elements such as B, Al, Ga, In and Tl.

Element A has 4 valence electrons. Thus it has valency 4. It should be in group 14 that contains elements such as C, Si, Ge, Sn and Pb.

Element A has 2 valence electrons. Thus it has valency 2. It should be in group 2 that contains elements such as Be, Mg, Ca, Sr and Ba.

Question 8.
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 X is placed in group 14, its chemical formula is XCl_4.

The nature of bonding of its chloride is covalent bonding.

Element X has 4 valence electrons. Thus, it has valency 4. This element must show covalent bonding in order to complete octet configuration. So the chemical formula would be XCl_4.

Since this compound is form by sharing of electrons, the bond is covalent in nature.

Question 9.
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:

Radii of Y is less than X.

Here, X has 12 electrons and 12 protons, therefore it is a neutral atom. Y contains 12 protons and 10 electrons so there are 2 more protons that gives Y a charge of +2. The electronic configurations of the two species is as follows:

X	Y
K L M	K L
2 8 2	2 8

The atomic size of a positive ion (cation) is always smaller than a neutral atom. This is because cation has less number of electrons and hence more nuclear attractions on electrons in cation. Thus the size of a cation is smaller than that of the neutral atom. Hence, atomic radius of Y is smaller than that of X.

Question 10.
Arrange the following elements in increasing order of their atomic radii.

(a) Li, Be, F, N

(b) Cl, At, Br, I

Answer:
F < N < Be < Li (Li, Be, F and N belong to same period of modern periodic table. As we move from left to right in a group, the atomic radii of elements decreases due to high atomic charge but the number of shell remain constant).

(b) Cl < Br < I < At (Cl, At, Br and I belong to same group of periodic table that is group 17. As we move down in a group, the atomic radii of elements increase due to increase in the number of shell of an element).

Question 11.
Identify and name the metals out of 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:
Elements with 1 to 3 valence electrons are usually metals. Elements with 4 or more valence electrons are usually non-metals or metalloids.

(a) 2, 8, 2 – Magnesium (12)

(b) 2, 8, 1 – Sodium (11)

(d) 2, 1 – Lithium (3)

Question 12.
Write the formula of the product formed when the element A (atomic number 19) combines with the element B (atomic number 17). Draw its electronic dot structure. What is the nature of the bond formed?

Answer:
Element A is K (Potassium).

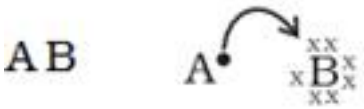
The electronic configuration of element A (atomic number 19) would be 2, 8, 8, 1. As it has only one valence electron therefore it must be a metal. Thus it is potassium.

Element B is Cl (Chlorine).

The electronic configuration of element B (atomic number 17) would be 2, 8, 7. As it has 7 valence electrons therefore it must be a non-metal. Thus it is chlorine.

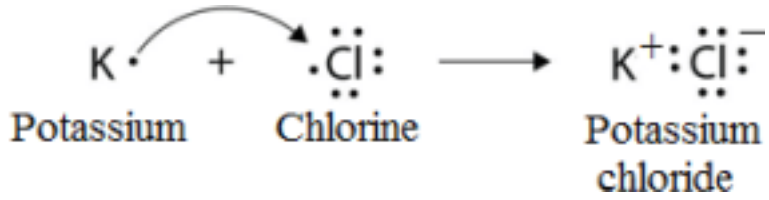
A metal and a non-metal usually combine with an ionic bond. Metals have tendency to lose electrons and form cations whereas non-metals can accept electrons to form anions.

Dot structure:



Potassium and chlorine will combine with an ionic bond to form potassium chloride (KCl).

The electron dot structure of KCl is as given below:



Question 13.
Arrange the following elements in the increasing order of their metallic character Mg, Ca, K, Ge, Ga

Answer:
Ge < Ga < Mg < Ca < K

The metallic character decreases from left to right in a period. All the above elements, except Mg, are placed in the same period so the metallic character will decrease from K to Ge and order of metallic character would be Ge < Ga < Ca < K

As we move down in a group, metallic nature of elements increases. So, Ca is more metallic than Mg. Similarly, Mg will be less metallic than K because in period, metallic nature decreases from left to right. Hence the increasing order of metallic character would be

Ge < Ga < Mg < Ca < K

The arrangement of some of these elements in the Modern Periodic table is shown as below.

Group /Period	1	2	13
3		Mg	
4	K	Ca	Ga

Question 14.
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 liquid state at room temperature.

Answer:
Sodium (Na) or Potassium (K) [Alkali metals such as sodium (Na) and potassium (K) are soft and reactive.] (b) Calcium (Ca) [The chemical formula of limestone is $CaCO_3$. Hence calcium (Ca) would be an important constituent of limestone.] (c) Mercury (Hg) [Mercury (Hg) is the only metal that exists in liquid state at room temperature.]

Increasing order of their reactivity: Since reactivity of metals decreases from left to right in a period therefore increasing order of reactivity would be Hg < Ca < Na/K.

Question 15.
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 under water.

(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 the process of “anodising”.

Answer:
(a) Sodium (Na) – Group 1 and Period 3 or Potassium (K) – Group 1 and Period 4. Sodium and potassium are alkali metals. Such metals have high reactivity, hence they are usually kept under kerosene. Alkali metals are placed in group 1 and starts from period 2 to 7.

(b) Phosphorus (P) Group 15 and Period 3. It has a variable valency of 3 and 5. It reacts with air and not water. Thus, it is stored in water. It is placed in group 15 and period 3 of periodic table.

(c) Carbon (C) Group 14 and Period 2. Carbon forms the basis of all organic compounds. It is tetravalent because it has 4 valence electrons. It is placed in group 14 and period 2 of Periodic table.

(d) Helium (He) – Group 18 and Period 1. Helium is the lightest inert gas. It has atomic number 2. It is placed in group 18 and period 1 of periodic table.

(e) Aluminium (Al) – Group 13 and Period 3. Aluminium is used to make other elements corrosion resistant by the process of “anodising”. The oxide layer formed is that of Al_2O_3. . The atomic number of aluminum is 13 and it is placed in group 13 and period 3 of periodic table.

Long Answer Questions

Question 1.
An element is placed in 2nd Group and 3rd Period of the Periodic Table, burns in 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) The element placed in 2nd Group and 3rd Period of the Periodic Table is Magnesium (Mg).

(b) Electronic configuration: 1s2, 2s2 2p6 3s2

K, L, M

2, 8, 2

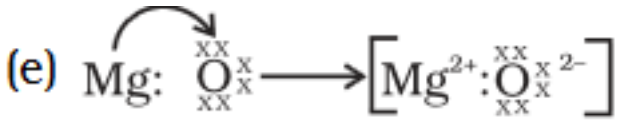
(c) When the magnesium metal burns in oxygen, it produces magnesium oxide.

$2Mg(s) + O2(g) \rightarrow 2MgO(s)$

When magnesium oxide is heated with water, magnesium hydroxide is formed.

(d) $MgO(s) + H2O(l) \rightarrow Mg(OH)2(aq)$

Electron dot structure:

(e) 

Magnesium loses two electrons and oxygen gains two electrons to complete the octet structure.

Question 2.
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 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) Element X belongs to Group 17 and 3rd period. X is Cl (chloride).

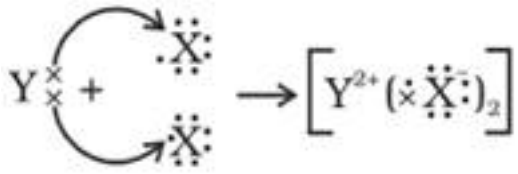
Element Y belongs to Group 2 and 4th period. Y is Ca (calcium).

(b) X is a non-metal and Y is a metal.

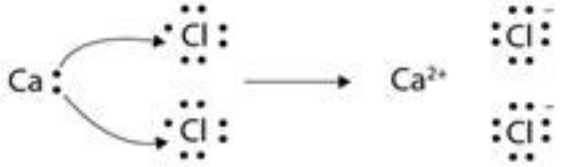
(c) Metals always combine with oxygen to form basic oxides. Basic oxides react with acids to form salt and water.

In a reaction, meals lose electrons and non-metals gain electrons. Thus positive and negative ions are formed. This creates a strong electrostatic force between these ions. These strong electrostatic forces form the ionic bonds.

(d) Electron dot structure



Electron dot structure for calcium chloride



Question 3.
Atomic numbers 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:
The elements are neon (Ne), calcium (Ca), nitrogen (N) and silicon (Si)

(b) Group no.: neon (Ne) - 18, calcium (Ca) - 2, nitrogen (N) -15 and silicon (Si) - 14

(c) Period: neon (Ne) – 2nd period, calcium (Ca) – 4th period, nitrogen (N) - 2nd period and silicon (Si) – 3rd period

(d) Electron configuration: neon (Ne) - (2, 8), calcium (Ca) - (2, 8, 8, 2), nitrogen (N) - (2, 5) and silicon (Si) - (2, 8, 4)
(e) Valency: neon (Ne) - 0, calcium (Ca) - 2, nitrogen (N) - 3 and silicon (Si) - 4

Question 4.
Complete the following cross word puzzle (Figure 5.1)

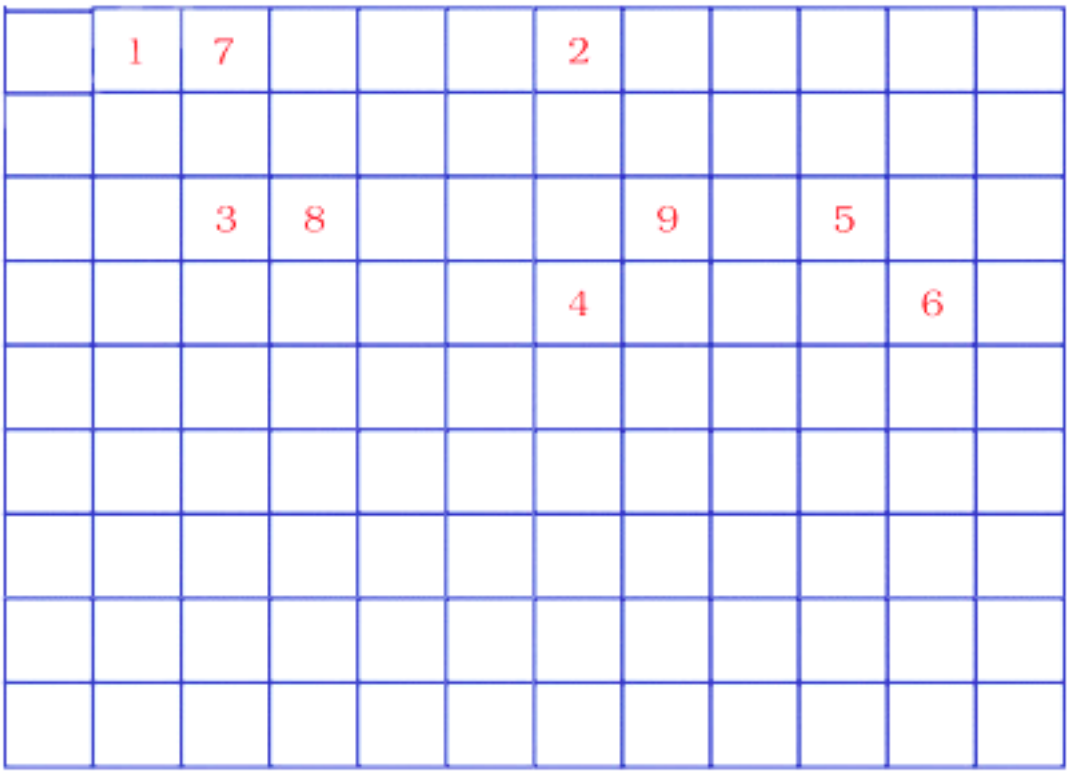


Fig. 5.1

Across:

(1) An element with atomic number 12.

(3) Metal used in making cans and member of Group 14.

(4) A lustrous non-metal which has 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 second Period

(6) An element which is used in making fluorescent bulbs and is second member of Group 18 in the Modern Periodic Table

(7) A radioactive element which is the last member of halogen family.

(8) Metal which is an important constituent of steel and forms rust when exposed to moist air.

(9) The first metalloid in Modern Periodic Table whose fibres are used in making bullet-proof vests

Answer:

	M [1]	A [7]	G	N	E	S [2]	I	U	M		
		S				O					
		T [3]	I [8]	N		D	B [9]		L [5]		
		A	R			I [4]	O	D	I	N [6]	E
		T	O			U	R		T	E	
		I	N			M	O		H	O	
		N					N		I	N	
		E							U		
									M		

Question 5.
(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.

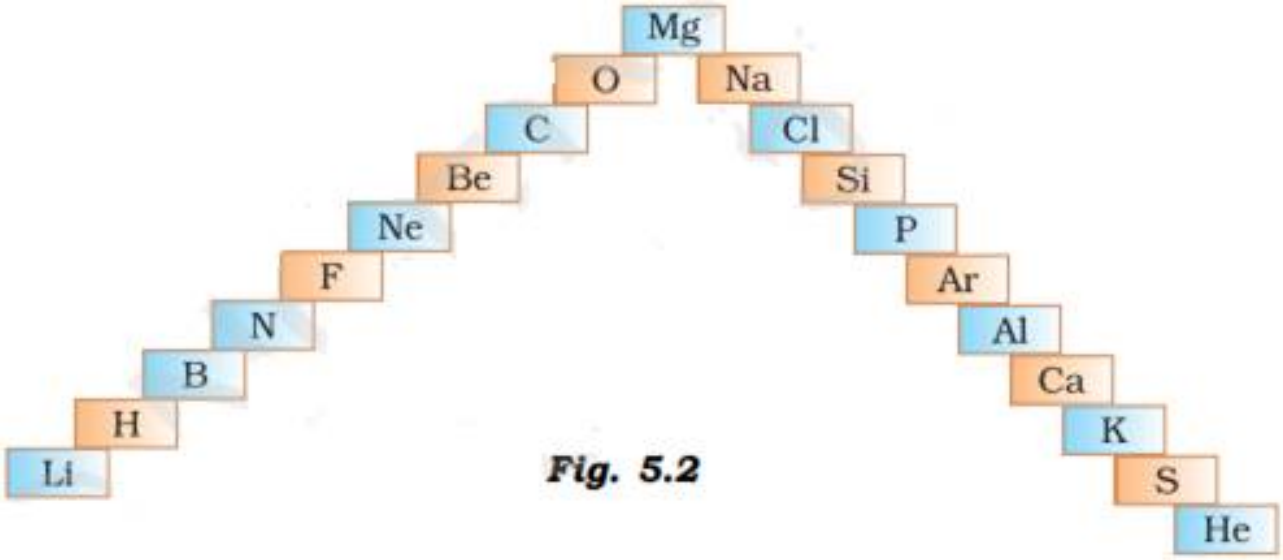


Fig. 5.2

Answer:
(a) H, He, Li, Be, B, C, N, O, F, Ne, Na, Mg, Al, Si, P, S, Cl, Ar, K, Ca

(b) 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

Question 6.
Mendeleev predicted the existence of certain elements not known at that time and named two of them as 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 one of them?

Answer:
(a) The two elements that have taken the place of Eka-silicon and Eka-aluminium are Germanium (Ge) and Gallium (Ga), respectively.

(b) Germanium is placed in Group 14 and Period 4 in the Modern Periodic Table.

Gallium is placed in Group 13 and Period 4 in the Modern Periodic Table.

(c) Germanium (Ge) is metalloid. Gallium (Ga) is a metal.

(d) Valence electrons in Germanium (Ge) are 4. Valence electrons in Gallium (Ga) are 3.

Question 7.
(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.

On the basis of 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.

(c) Name the element with smallest atomic size.

(d) Name the element which is a metalloid.

(e) Name the element which shows maximum valency.

Answer:
(a) The most electropositive element among them is lithium.

(b) The most electronegative element is fluorine.

(c) The element with smallest atomic size is fluorine.

(d) The element which is a metalloid is boron.

(e) The element which shows maximum valency is carbon. Its valency is 4.

Question 8.
An element X which is a yellow solid at room temperature shows catenation and allotropy. X forms two oxides which are also 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 Modern Periodic Table.

Answer:
(a) Element X is sulphur (atomic no. 16).

(b) Electronic configuration of 'X' is

K, L, M

2, 8, 6

(c) $2FeSO_4$ (s) Heat $\rightarrow$ Fe_2O_3(s) + SO_2 (g) + SO_3(g)

(d) SO_2 and SO_3 are acidic oxides.

(e) It belongs to group 16 and 3rd period.

Question 9.
An element X of group 15 exists as diatomic molecule and combines with hydrogen at 773 K in 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?

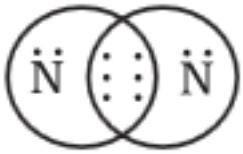
(b) Draw the electron dot structure of the diatomic molecule of X. What type of bond is formed in it?

(c) Draw the electron dot structure for ammonia and what type of bond is formed in it?

Answer:
The element X is nitrogen (atomic no. 7) with electronic configuration as 2, 5.

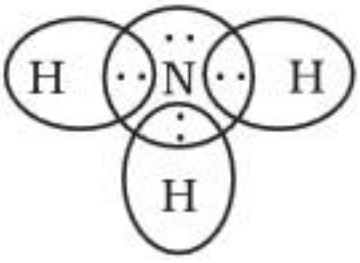
It has 5 valence electrons.

(b) Electron dot structure of diatomic molecule of nitrogen



It has triple covalent bonds.

(c) Electron dot structure of ammonia



It has 3 single covalent bonds.

Question 10.
Which group of elements could be placed in Mendeleev's Periodic Table without disturbing the original order? Give reason.

Answer:
Noble gases could be placed in Mendeleev's Periodic Table without disturbing the original order.

According to Mendeleev's classification, the properties of elements are the periodic function of their atomic masses and there is a periodic recurrence of elements with similar physical and chemical properties.

Noble gases were discovered much later after Mendeleev Periodic Table was discovered. Noble gases were placed in a separate group called Zero Group, after the 8th group. The placement of noble gases did not disturb the arrangement of any elements in the Mendeleev's Periodic Table. Noble gases are present in very low concentration in the atmosphere and are chemically almost unreactive.

Question 11.
Give an account of the process adopted by Mendeleev for the classification of elements. How did he arrive at "Periodic Law"?

Answer:
In the Mendeleev's classification of elements, he arranged all 63 elements in the order of their increasing relative atomic masses in the form of a table. It is known as Mendeleev's Periodic Table. This table was divided into 8 columns and 7 rows. The columns are known as groups and rows are known as periods. Groups from 1 to 7 comprise normal elements and group 8 comprised a few transition elements. Elements with similar properties had been kept in the same group. For example; lithium, potassium, rubidium are kept in 1st group. These elements usually formed compounds such as oxides and hydrides. Such properties formed the basis of classification of these elements. For example, hydrogen, sodium, and potassium belong to the first group. The general formula of oxides for the elements of 1st group is R_2O (H_2O, Na_2O, K_2O).
He arranged all the known elements in increasing order of their atomic masses. Elements with similar properties fall in same group. However, Mendeleev placed many elements in wrong order of their increasing atomic masses. For example, the atomic mass of nickel is less than that of cobalt but still cobalt was placed before nickel.
Mendeleev left some blank spaces intentionally in his periodic table in order to place the elements having similar properties in the same group in future. For example, titanium has been placed in 4th group, leaving a blank space adjacent to it in 3rd group. Similarly, arsenic has been placed in 5th group; leaving two adjacent spaces blank. These spaces have been occupied by scandium, gallium and germanium after their subsequent discoveries.
Mendeleev discovered some elements and named them as eka-boron, eka-aluminium and eka-silicon. Scandium, Gallium and Germanium were discovered later and took the place of eka-boron, eka-aluminium and eka-silicon, respectively in the gap left in the Mendeleev's Periodic table. Their properties were exactly similar to the corresponding predicted elements.

Thus, Mendeleev's Periodic Law states that the properties of elements are the periodic function of their relative atomic masses. Noble gases, being inert, could be placed in a separate group without disturbing the original order in the Mendeleev's Periodic Table.