Periodic Classification of Elements

Definitions

1. **Element:** A substance that cannot be separated into simpler substances and that singly or in combination constitute all matter.
2. **Periods:** It is a horizontal row of periodic table.
3. **Groups:** It is a vertical column of the periodic table.
4. **Atomic mass:** Atomic mass of an element is the sum of protons and neutrons.
5. **Atomic radius:** It is defined as the distance from the centre of nucleus to the outermost shell of the atom. It is generally expressed in Picometer (pm).
6. **Periodicity:** The recurrence of similar physical and chemical properties of elements when arranged in a particular order.
7. **Valency:** It is defined as the combining capacity of an atom of an element to acquire the next inert gas configuration.
8. **Electronegativity:** The relative tendency of an atom to attract shared pair of electrons towards itself.
9. **Electron affinity:** The amount of energy released when an

electron is added to an isolated gaseous atom.

10. **Ionisation energy:** The amount of energy required to remove most loosely bonded electron from an isolated gaseous atom.

11. **Isotopes:** Atoms of same element having similar atomic number but different atomic mass.

12. **Isobars:** Atoms of different elements having different atomic number but same atomic mass.

Multiple Choice Questions

13. The Law of Octaves was applicable upto which element in the Periodic table:

(a) Oxygen

(b) Calcium

(c) Cobalt

(d) Potassium

Ans. (b) Calcium.

Explanation :

Newland's law of octaves was applicable only to lighter elements having atomic masses up to 40 u i.e., up to calcium. After calcium, every eighth element did not possess properties similar to that of the first element.

14. According to Mendeleev's Periodic Law, the elements were arranged in the periodic table in the order of:

[NCERT, Exemplar]

(a) Increasing atomic number

(b) Decreasing atomic number

(c) Increasing atomic masses

(d) Decreasing atomic masses

Ans. (c) Increasing atomic masses.

Explanation :

According to Mendeleev's periodic law, the elements were arranged in the periodic table in the order of increasing atomic masses.

15. 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 perioidc table later.[NCERT, Exemplar]

(a) Germanium

(b) Chlorine

(c) Oxygen

(d) Silicon

Ans. (a) Germanium.

Explanation :

Chlorine, oxygen and silicon were included in Mendeleev's periodic table. Germanium was discovered later which fit into the empty spaces left by Mendeleev and matched to the expected properties.

16. How many elements were arranged by Mendeleev in his periodic

table ?

(a) 98

(b) 63

(c) 42

(d) 21

Ans. (b) 63.

Explanation :

Mendeleev included 63 known elements arranged it according to increasing atomic weight; Mendeleev also left spaces for as yet undiscovered elements for which he predicted according to the atomic weights.

17. What type of oxide would Eka– aluminium form ?

[NCERT, Exemplar]

(a) EO_3

(b) E_3O_2

(c) E_2O_3

(d) EO

Ans. (c) E_2O_3

Explanation :

Aluminium is Al having the oxidation state: +3, it can form Al^{3+} and it has valency = +3. So it will form Al_2O_3. Gallium and aluminium belong to the identical group and hence their valency is also going to the same which is 3. Eka Aluminium comes after

Aluminium, and it is called Gallium. E_2O_3 is the type of oxide Eka – aluminium would form.

18. Which element was not known when Mendeleev proposed his classification ?

(a) Hydrogen

(b) Sodium

(c) Calcium

(d) Germanium

Ans. (c) Germanium

Explanation :

The elements which were unknown when Mendeleev gave his classification were geranium, gallium and scandium. He left gaps for the unknown elements and predicted correctly the properties of some of the unknown elements.

19. According to Mendeleev's Periodic Law, the elements were arranged in the periodic table in order of their:

(a) increasing atomic number

(b) decreasing atomic number

(c) increasing atomic mass

(d) decreasing atomic mass

Ans. (c) increasing atomic mass

Explanation :

Mendeleev realized that the chemical and physical properties of

elements were related to their atomic mass in a 'periodic' way, and arranged them so that groups of elements with similar properties fell into vertical columns in his table. So, according to Mendeleev's periodic table elements were arranged according to their atomic mass.

20. Which of the following statements about Newland' slaw of octaves is correct?

(a) It was applicable to all elements.

(b) It was applicable to elements up to calcium only.

(c) Every first and seventh element had similar properties.

(d) Noble gases werediscovered that time

Ans. (b) It was applicable to elements up to calcium only.

Explanation :

Out of the total 56 known elements, Newland could arrange elements only up to calcium.

Every eighth element did not show properties similar to that of the first after calcium.

21. 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) Chlorine

(b) . Silicon

(c) Oxygen

(d) Germanium

Ans. (d) Germanium

Explanation :

Chlorine, oxygen and silicon were included in Mendeleev's periodic table. Germanium was discovered later which fit into the empty spaces left by Mendeleev and matched to the expected properties.

22. The law of octaves was given by ___.

(a) Mendeleev

(b) Newlands

(c) Bohr

(d) Moseley

Ans. (b) Newlands

Explanation :

The law of octaves was given by Newlands.

23. The position of element in the periodic table is generally determined by its:

(a) no of valence electrons

(b) no of shells

(c) both (a) and (b)

(d) none of the above

Ans. (c) both (a) and (b)

Explanation :

Electronic configuration is the arrangement of electrons in the shells. Outer electrons tells us about thegroup number and the number of shells tells us about period number.

24. Vertical columns in a periodic table are called:

(a) rows

(b) periods

(c) groups

(d) patters

Ans. (c) groups

Explanation :

Horizontal rows in the periodic table are called periods and vertical columns are called groups.

25. The elements having seven valence electrons in their outermost shell are known as:

(a) alkalis

(b) halogens

(c) alkaline earth metals

(d) noble gases

Ans. (b) halogens

Explanation :

The family of elements having seven electrons in the valence shell is halogens, i.e., chlorine, fluorine, bromine, iodine, astatine. Halogens are the most electronegative elements in the periodic

table.

26. Non metals usually forms :

(a) acidic oxides

(b) basic oxides

(c) neutral oxides

(d) amphoteric oxides

Ans. (a) acidic oxides

Explanation :

Non-metals react with oxygen to form acidic compounds of oxides which are held together by covalent bonds. These compounds can also be called as acid anhydrides.

27. The number of shells in elements of the third period is:

(a) three

(b) two

(c) four

(d) one

Ans. (a) three

Explanation :

Number of shells= Period number

28. Which of the following group has the maximum radii in a group when considered in the same period?

(a) Halogens

(b) Alkaline earth metals

(c) Alkali metals

(d) Noble gases

Ans. (c) Alkali metals

Explanation :

Atomic radii decreases on moving across a period from left to right ,so moving from group 1 to 18 atomic radii decreases and group 1 has the largest atomic radii as compared to the other groups of the same period.

29. An element X has 4 shells and 3 valence electrons.What is its period number?

(a) 3

(b) 5

(c) 6

(d) 4

Ans. (d) 4

Explanation :

Number of shells= Period number

30. The electronic configuration of an element M is 2, 8, 4. In modern periodic table, the element M must be placed in:

(a) 4th group

(b) 2nd group

(c) 14th group

(d) 18th group

Ans. (c) 14th group

Explanation :

In the periodic table, elements having 4 valence electrons are placed in group 14.

31. Which group elements are called transition metals?

(a) Group number 1 to 2

(b) Group number 13 to 18

(c) Group number 3 to 12

(d) Group number 1 to 8

Ans. (c) Group number 3 to 12

Explanation :

The elements occurring in group 3 to 12 are named as transition metals because they are metallic elements that form a transition between the main group elements, which occur in groups 1 and 2 on the left side, and groups 13–18 on the right side of the periodic table.

Transition elements have following properties:

(a) They are good conductors of heat and electricity.

(b) They can be hammered or bent into shape easily.

(c) They have high melting points (but mercury is liquid at room temperature).

(d) They are usually hard and tough.

(e) They have high densities.

32. Elements of which group has only 2 shells and both are completely filled?

(a) Helium

(b) Neon

(c) Calcium

(d) Boron

Ans. (b) Neon

Explanation :

Neon with the atomic number 10, has the electronic configuration as 2,8. Hence, both its K and L shells are completely filled.

33. The elements A, B and C belong to group 2, 14 and 16 respectively, of the periodic table. Which two elements of these will form covalent bonds?

(a) A and B

(b) B and C

(c) C and A

(d) None of these

Ans. (b) B and C

Explanation :

The covalent bond is formed by the sharing of electrons between

two atoms. As the element B (which belongs to group 14) has 4 valence electrons which it can share with two atoms of the elements of C (from group 16 each having 6 valence shell electrons) to complete the octet of each included atom, B and C will form covalent bond with each other.

34. An element M is in group 13th of the periodic table. The formula for its oxide is:

(a) MO

(b) M_2O_3

(c) M_3O_2

(d) None of these

Ans. (b) M_2O_3

Explanation :

As the element M belongs to group 13th of the periodic table so it has 3 valence electrons, *i.e.*, it can have +3 oxidation state while oxygen atom (with 2 valency) has −2 oxidation state. So the formula for the corresponding oxide is M_2O_3.

35. Which of these belong to the same period?

Element A B C

Atomic number 2 10 5

(a) A, B

(b) B, C

(c) C, A

(d) A, B and C

Ans. (b) B, C

Explanation :

B= 10 (2, 8), C = 5 (2, 3) Both have 2 shell, so they both belong to same period.

36. Carbon belongs to the second period and group 14 while silicon belongs to the third period and group 14 of the periodic table. If atomic number of carbon is 6, the atomic number of silicon should be:

(a) 7

(b) 14

(c) 24

(d) 16

Ans. (b) 14

Explanation :

Silicon and carbon belong to the same group. They have same number of valence electron in their outermost shell i.e. 4. Hence, they will differ in atomic numbers by 8. So, 6 + 8 = 14.

37. Consider the following elements

20Ca, 8O 18Ar, 16S, 4Be, 2He

Which of the above elements would you expect to be in group 16 of the Periodic Table?

(a) 20Ca and 16S

(b) 20Ca and 8O

(c) 18Ar and 16S

(d) 8O and 16S

Ans. (d) 8O and 16S

Explanation :

The electronic configuration of oxygen and sulphur is 2,6 and 2,8,6 respectively. Both of them have 6 electrons in their outermost shell. To know the group number 10 is added. The output is 16.Therefore both of them belong to group 16.

38. The atom of an element has electronic configuration 2, 8, 7. To which of the following elements would it be chemically similar?

(a) N(7)

(b) P(15)

(c) Na(11)

(d) F (9)

Ans. (d) F (9)

Explanation :

Electronic configuration of chlorine and the given element is 2,7, and 2,8,7. Both are having same number of valence electron. Hence they would be similar in their chemical property.

39. How many groups are there in the periodic table?

(a) 18

(b) 8

(c) 28

(d) 17

Ans. (a) 18

Explanation :

Vertical columns of the periodic table are known as groups. There are 18 groups in the periodic table.

40. Atomic mass number is equal to the:-

(a) total number of p and n

(b) total number of p and e

(c) number of Protons

(d) number of neutrons

Ans. (a) total number of p and n

Explanation :

Mass number is the sum of the number of protons and the number of neutrons in an atom.

41. Five elements A, B,C,D and E have atomic numbers 2,3,7,10and 18 respectively. The elements which belong to the same period of the periodic table are:

(a) A,B,C

(b) B, C,D

(c) A,D, E

(d) B,D,E

Ans. (b) B, C,D

Explanation :

B,C and D ,with atomic number 3,7,10 respectively, belong to the same period of periodic table .This is because the elements B,C and D have the same valence shell (L).

42. The alkaline earth metal present in group 2 and period 3 of the periodic table is:

(a) sodium

(b) magnesium

(c) calcium

(d) potassium

Ans. (b) magnesium

Explanation :

The alkaline earth metal present in group 2 and period 3 of the periodic table is magnesium.

43. The position of three elements A, B and C in the Periodic Table are shown below:

Group 16	**Group 17**
–	–
–	A

–	–
B	C

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

(a) cation

(b) anion

(c) both (a) and (b)

(d) none of these

Ans. (b) anion

Explanation :

A will form an anion as it accepts an electron to complete its octet, and achieve the nearest gas configuration.

44. Given below is the electronic configuration of two elements. Which of these will be more electronegative?

A = 2,3

B = 2,3,5

(a) A

(b) B

(c) Both (a) and (b)

(d) None of these

Ans. (a) A

Explanation :

Nitrogen is more electronegative than phosphorus, because on

moving down a group, the number of shell increases and electronegativity also decreases.

45. Where would you locate the element with electronic configuration 2,7 in the Modern Periodic Table?

(a) Group 8

(b) Group 9

(c) Group 18

(d) Group 10

Ans. (b) Group 9

Explanation :

It is the electronic configuration of Fluorine with atomic number 9. It is the hologen and is most electronegative elements.

46. The atomic number of element of second period and sixth group is ?

(a) 20

(b) 56

(c) 38

(d) 55

Ans. (b) 56

Explanation :

The element of second period and sixth group is Barium.

47. Which of the following elements do not belong to same group?

(a) P, As

(b) Tc, Re

(c) Ag, Hg

(d) Ne, Xe

Ans. (c) Ag, Hg

Explanation :

Ag and Hg do not belong to same group. Ag belongs to group 11 and Hg belongs to group 12 of the periodic table.

48. Given below is the elements of group 14 of periodic table,

6 C Carbon 12.0
14 Si Silicon 28.1
32 Ge Germanium 73.6
50 Sn Tin 118.7
82 Pb Lead 207.2
114 Fl Flerovium (289)

(i) How many metals are there in the group?

(a) 1

(b) 2

(c) 3

(d) 0

Ans. (c) 3

Explanation :

Sn, Pb and Fl are metals.

(ii) Which type of bond is formed by elements if this group?

(a) Ionic

(b) Covalent

(c) Coordinate

(d) Metallic bond

Ans. (b) Covalent

Explanation :

The group is having valence of 4. So, covalent bond is formed.

49. In the following set of elements, which one of the following element does not belong to the set.

Calcium, Magnesium, Sodium, Beryllium

(a) Calcium

(b) Magnesium

(c) sodium

(d) Beryllium

Ans. (c) Sodium

Explanation :

Sodium does not belong to the set. This is because all other elements belong to group 2 but sodium belongs to group 1 of the periodic table.

50. Which of the period in periodic table has only gaseous elements?

(a) 1

(b) 2

(c) 3

(d) 4

Ans. (a) 1

Explanation :

It contains two elements H and He, both are gases.

51. Which amongst the given below elements does not belong to the same period.

$_{6}P_{12}$, $_{7}Q_{14}$, $_{8}R_{16}$, $_{11}S_{23}$,

(a) P, Q and R

(b) P and R

(c) P ,Q, R and S

(d) Q and R

Ans. (a) P, Q and R

Explanation :

The electronic configuration of the elements is given as:

Element	Atomic number	Electronic configuration
P	6	2, 4
Q	7	2, 5
R	8	2, 6
S	11	2, 8, 1

Element P, Q and R have only two electrons shells and hence, they belong to the same period i.e, 2nd period.

52. Identify the nature of the element:

Period = 3

Valency = 4

Physical property = hard

Nature of compounds : Oxide- acidic halide - covalent.

(a) Metal

(b) Non-metal

(c) Metalloid

(d) Inner Transition elements

Ans. (c) Metalloid

Explanation :

The element is silicon with atomic number 14. It belongs to 3rd period and its valency is 4. It is a metalloid and exhibit properties of both metals and non-metals. It forms covalent halides as its outermost shell has 4 electrons.

53. Where would you locate the element with electronic configuration 2, 8 in the Modern Periodic Table?[NCERT, Exemplar]

(a) Group 8

(b) Group 2

(c) Group 18

(d) Group 10

Ans. (c) Group 18.

Explanation :

Element with the electronic configuration of 2, 8 is Neon having the atomic number 10. In the modern periodic table, noble gas elements are present in the group 18. Hence, the element with electronic configuration 2, 8 will be in the 18th group of the Modern Periodic Table.

54. The outermost shell for elements of period 2 will be:

(a) K shell

(b) L shell

(c) M shell

(d) N shell

Ans. (b) L shell.

Explanation :

The elements having two valence shells are placed in the second period. Thus, the outermost shell of these elements is L-shell.

55. An element 'X' is forming an acidic oxide. Its position in modern periodic table will be:*

(a) Group 1 and Period 3

(b) Group 2 and Period 3

(c) Group 13 and Period 3

(d) Group 16 and Period 3

Ans. (d) Group 16 and Period 3

Explanation :

An element 'X' is forming an acidic oxide. Its position in modern periodic table will be placed in the group 16 and 3rd period of the periodic table since the elements of the group 16 forms the acidic oxides.

56. The number of electrons in the valence shell is equal to its ……

(a) atomic mass

(b) group number

(c) period number

(d) atomic volume

Ans. (b) group number.

Explanation :

The number of electrons in the valence shell is equal to its group number. For example: Valence electrons in P is 5 and its group number is also 5.

57. Consider the following statements about an element 'X' with number of protons 13.*

(A) It forms amphoteric oxide.

(B) Its valency is three.

(C) The formula of its chloride is XC_3.

The correct statements (s) is/are.

(a) only (A)

(b) only (B)

(c) (A) and (C)

(d) (A), (B) and (C)

Ans. (d) (A), (B) and (C)

Explanation :

An element having the protons 13 has the atomic number 13 and the element having the atomic number 13 is Aluminium, it forms the amphoteric oxide which are both acidic and basic in nature and it has the valency 3 and its oxide is of the formula XC_3 such as Al_2O_3.

58. 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 ?

[NCERT, Exemplar]

(a) Metal

(b) Metalloid

(c) Non-metal

(d) Left-hand side element

Ans. (b) Metalloid

Explanation :

The element will be a metalloid since the elements present in the group 14 have the characteristics of both metals and the non-metals also they have the valence shell electrons as 4 thus, they form the covalent molecules with the other atoms.

59. The modern periodic law is given by……

(a) Mendeleev

(b) Einstein

(c) Bohr

(d) Mosley

Ans. (d) Mosley

Explanation :

The modern periodic law was given by Henry Mosley and his periodic table was based on the fact that “The physical and chemical properties of the elements are periodic functions of their atomic numbers”. The atomic number is equal to the number of electrons or protons in a neutral atom.”

60. Which one of the following property does not increase while moving down the group in the periodic table ?

(a) Atomic radius

(b) Metallic character

(c) Valence electrons

(d) Number of shells in an element

Ans. (c) Valence electrons

Explanation :

The number of valence electrons does not increase while moving down the group in the periodic table.

61. On moving from left to right in a period in the periodic table, the size of the atom:

[NCERT, Exemplar]

(a) increases

(b) decreases

(c) does not change appreciably

(d) first decreases and then increases

Ans. (b) decreases

Explanation :

On moving from left to right in a period, the atomic size decreases as the atomic number (i.e., the number of protons and electrons) increases but the number of shells remain the same. Therefore, the force of attraction between the nucleus and the outermost

shell of electrons (effective nuclear charge) increases, thus leading to a decrease in the size.

62. A liquid non-metal is ……

(a) phosphorous

(b) mercury

(c) bromine

(d) nitrogen

Ans. (c) bromine

Explanation :

Bromine is the liquid non- metal present in the group 17 of the Periodic table.

63. The period that contains only gaseous elements are:

(a) 1

(b) 2

(c) 3

(d) 4

Ans. (a) 1

Explanation :

Period 1 has only gaseous elements namely hydrogen and helium.

64. The pairs of elements with the following atomic numbers have the same chemical properties:

(a) 13 and 12

(b) 3 and 11

(c) 4 and 24

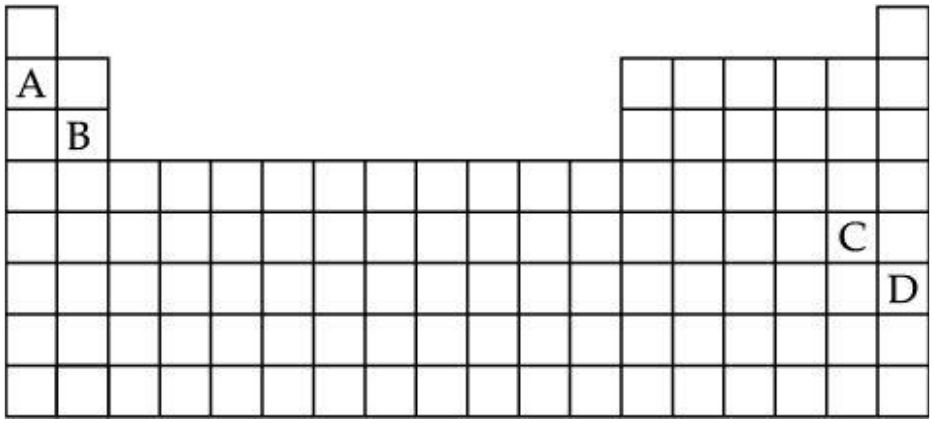
(d) 2 and 1

Ans. (b) 3 and 11

Explanation :

The elements with the atomic number 3 and 11 have the same properties because both elements have same valence shell electronic configuration, *i.e.,* ns^1.

65. The positions of four elements A, B, C and D in the Modern Periodic Table are shown below. Which element is most likely to form an acidic oxide ?



(a) A

(b) B

(c) C

(d) D

Ans. (c) C

Explanation :

From the position of element C in the periodic table, it is clear that it is a non-metal. Therefore C will form the acidic oxide since oxides of non-metals are acidic in nature.

66. Elements P, Q, R and S have atomic numbers 11, 15, 17 and 18 respectively. Which of them are reactive non-metals ?

(a) P and Q

(b) P and R

(c) Q and R

(d) R and S

Ans. (c) Q and R.

Explanation :

We are given that elements P, Q, R and S have atomic numbers 11, 15, 17, and 18.

We have to find reactive non metals in given elements.

We know that atomic number of sodium = 11

Therefore, P is sodium.

Sodium is metal not non metal.

We know that atomic number of phosphorus, P = 15

Therefore, Q is phosphorus.

It is not a metal because it requires 3 electrons to complete its octet.

Atomic number of chlorine = 17

Therefore, element R is chlorine.

It is a non metal since it requires an electron to complete its octet.

Atomic number of argon = 18

Therefore, element S is argon.

It is noble gas because it has completely filled shells. It is non reactive because it does not require any electron to complete its octet.

Hence, Q and R are reactive non metals.

67. 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 ?[NCERT, Exemplar]

(a) A, B, C

(b) B, C, D

(c) A, D, E

(d) B, D, E

Ans. (b) B, C, D.

Explanation :

The first period contains 2 elements. Whereas, both second and third period contains 8 elements. Therefore, the first period contains 1 to 2 atomic number. The second period contains 3 to 10 atomic number. The third contains 11 to 18 atomic number. The fourth period contains 19 to 36 atomic number. Therefore, B, C and D belong to the same period.

68. Which pair of elements belong to the same group if elements A, B, C, D and E have atomic number 9, 11, 17, 12 and 13 respectively.

(a) A and B

(b) B and D

(c) A and C

(d) D and E

Ans. (c) A and C.

Explanation :

Since both A and C elements have the same number of valence electrons which is 7, hence they belong to the same group, i.e. 17th group of the periodic table.

69. _____ element would lose an electron easily ?

(a) Mg

(b) Na

(c) K

(d) Ca

Ans. (d) Ca.

Explanation :

The electronic configuration of calcium is 2, 8, 8, 2. It will lose two electron from its outermost shell because on losing two electrons it will acquire the nearest Nobel gas configuration and will become more stable.

70. Which among the following elements has the largest atomic radii ?[NCERT, Exemplar]

(a) Na

(b) Mg

(c) K

(d) Ca

Ans. (d) Ca.

Explanation :

Calcium will have the highest atomic radii since with the increase in the atomic number atomic radii also increases due to the increase in the number of the electronic shells.

71. The correct increasing order of the atomic radii of O, F and N will be:

(a) O, F, N

(b) N, F, O

(c) O, N, F

(d) F, O, N

Ans. (c) O, N, F.

Explanation :

The increasing order of atomic radii is F, O, N as atomic number of F, O and N are 9,8 and 7 respectively and as the atomic number increases the atomic radii also increases due to the increase in the number of the electronic shells.

72. Which one of the following elements exhibits maximum number of valence electrons ?

[NCERT, Exemplar]

(a) Na

(b) Al

(c) Si

(d) P

Ans. (d) P

Explanation :

Valence electrons in Na, Al, Si and P are 1, 3, 4 and 5. Hence, phosphorus has maximum number of valence electrons.

73. The least reactive element in group 17 is……

(a) Fluorine

(b) Chlorine

(c) Bromine

(d) Iodine

Ans. (d) Iodine.

Explanation :

Iodine is the least reactive element in the group 17 of the periodic table since with the increase in the number of the shells the hold of the nucleus on the electron becomes weak and thus, it is less reactive in nature.

74. Three elements B, Si and Ge are:

[NCERT, Exemplar]

(a) metals

(b) non-metals

(c) metalloids

(d) metal, non-metal and metalloid respectively

Ans. (c) metalloids

Explanation :

The elements B, Si and Ge are metalloids since they have the characteristics of both metals and the non-metals also they have the valence shell electrons as 4 and they form the covalent bonds with the other elements.

75. In periodic table, helium is placed at:

(a) top left corner

(b) bottom right corner

(c) bottom left corner

(d) top right corner

Ans. (d) top right corner

Explanation :

Helium is the second element on the periodic table. It is located in period 1 and group 18 or 8A on the right-hand side of the table. This group contains the noble gases, which are the most chemically inert elements on the periodic table. Thus it is placed on the top right corner in the periodic table.

76. A factor that affects the ionisation potential of an element is ……

(a) atomic size

(b) electron affinity

(c) electro-negativity

(d) neutrons

Ans. (a) atomic size

Explanation :

Larger the atomic size, smaller is the ionisation potential. It is due to that the size of atom increases the outermost electrons farther away from the nucleus and nucleus loses the attraction on that electrons and hence can be easily removed and thus it affects the ionisation potential of the atom.

77. Which of the following element forms basic oxide?

(a) Phosphorous

(b) Argon

(c) Chlorine

(d) Potassium

Ans. (d) Potassium

Explanation :

The elements which can donate their valence electrons to other atoms are the metallic elements which form basic oxides as they give hydroxides in their aqueous solutions.

78. Which of the two elements will form covalent bonds?

X = Group 2

Y = Group 14

Z = Group 16

(a) X and Y

(b) Y and Z

(c) Z and A

(d) None of the above

Ans. (b) Y and Z

Explanation :

Covalent bond is formed by elements having less difference in their electronegativity. Since the covalent bond is formed between two non-metal elements. Now, out of X, Y and Z the element Y (of group 14) and element Z of group (16) are non-metals. Thus the elements Y and Z will form covalent bonds.

79. The correct order of decreasing metallic character of elements Na, Si, Cl, Mg, Al

(a) Cl > Si > Al > Mg > Na.

(b) Na > Mg > Al > Si > Cl

(c) Na > Si > Mg > Al > Cl

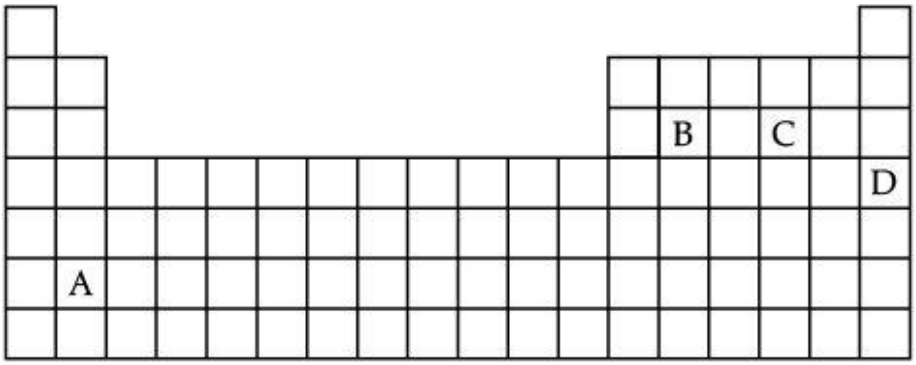
(d) Al > Na > Si > Cl > Mg

Ans. (b) Na > Mg > Al > Si > Cl

Explanation :

Sodium has 1, Mg has 2 and Al and 3, Si has 4 electrons in outermost orbits. But Cl has 7 electrons in its outermost orbit. Hence, sodium shows the maximum character of metallic elements, and chlorine shows the character of a non-metallic elements. Electropositive elements are metallic in character.

80. The positions of four elements A, B, C and D in the modern periodic table are shown below.



The correct order of increasing order of atomic size is:

(a) C < B < D < A

(b) A < B < C < D

(c) B < C < A < D

(d) D < C < B < A

Ans. (a) C < B < D < A

Explanation :

Atomic size decreases along a period and increases down the group.

81. As we move down the group, the number of shells:

(a) increases

(b) decreases

(c) remain Same

(d) none of the above

Ans. (a) increases

Explanation :

As we move down in the group ,number of shells increases .Hence,size of the atom also increases.

82. The commonly used unit of atomic radii is:

(a) angstrom

(b) meters

(c) millimetres

(d) centimetres

Ans. (a) angstrom

Explanation :

Atomic radius is usually expressed in Angstrom units. It is because the size of atom is very small. It is equivalent to $1\times10-10$metres.

83. Nuclear charge is directly proportional to the:

(a) number of electrons

(b) number of neutrons

(c) number of protons

(d) number of nucleons

Ans. (c) number of protons

Explanation :

Protons and neutrons are present in the nucleus and both are collectively called nucleons. Protons are charged particles and neutrons are neutral or do not have any charge on them. So ,thetotal charge on the nucleus is due to the number of protons present in the nucleus.

84. What happens to the nuclear charge as we move down the group in a periodic table?

(a) Increases

(b) Decreases

(c) Remains the same

(d) None of the above

Ans. (a) Increases

Explanation :

Nuclear charge is a function of the number of protons present in an atom. If we move from right to left or from top to bottom in a periodic table we can always observe an increase in the number of protons as there is an increase in the number of electrons.

85. The maximum amount of energy required to remove the most loosely bounded electron from an isolated,neutral, gaseous atom is known as:

(a) electron Affinity

(b) ionisation energy

(c) electro negativity

(d) none of the above

Ans. (b) ionisation energy

Explanation :

Ionization Energy is the amount of energy required to remove an electron from an isolated atom or molecule.

86. Which of the following elements has the highest electro negativity?

(a) Fluorine

(b) Oxygen

(c) Boron

(d) Beryllium

Ans. (a) Fluorine

Explanation :

The electro negativity values for the VIIA group or Halogen value are the highest in their period or row, and decreases as the atomic number of the Halogen increases.The group VIIA /17 or Halogens have a valance electron configuration of 2, 8, 7. This gives the Halogens 7 valance electrons.

The electron configuration causes the Halogens to have a strong pull for one more electron. The definition of electronegativity is the pull of the element for more electrons. Thus the VIIA or Halogens will have the highest electronegativity of any element in

their row, or period.

87. Which of the following has the highest atomic size?

(a) Magnesium

(b) Sodium

(c) Sulphur

(d) Chlorine

Ans. (b) Sodium

Explanation :

Sodium ,Magnesium, Sulphur and Chlorine belongs to the third period. For elements of same period, size decreases while going from left to rightacross a period

88. Which of the following alkali metals is radioactive in nature?

(a) Potassium

(b) Rubidium

(c) Caesium

(d) Francium

Ans. (d) Francium

Explanation :

Francium is the second rarest element on the earth. It has a half - life of about 22 minutes only. It is used in cancer diagnostics , spectroscopic experiments, etc.

89. Which of the following has zero electron affinity?

(a) Halogens

(b) Alkali metals

(c) Alkaline earth metals

(d) Noble gases

Ans. (d) Noble gases

Explanation :

Noble gases have zero electron affinity due to stable electronic configuration.

90. Which of the following is the correct order of the atomic radii of the elements oxygen, fluorine and nitrogen?

(a) O < F < N

(b) N < F < O

(c) O < N < F

(d) F < O < N

Ans. (d) F < O < N

Explanation :

Oxygen (8), fluorine (9) and nitrogen (7) belong to the same period of the periodic table, in the order nitrogen, oxygen and fluorine. Now in a period, on moving from left to right the atomic radius of the elements decreases. Therefore, the atomic radius of nitrogen is the largest.

91. 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

Ans. (b) Mg

Explanation :

Group 2 alkaline earth metal atoms have two valence electrons each. They can donate their two valence electrons to two other chlorine atoms to form the solid compounds of the form XCl_2.This XCl_2 compound being ionic in nature, has a very strong electrostatic force of attraction between 2 chloride ions and 1 metal ion. Thus, a large amount of heat is required to break these strong bonds, causing the compounds to have very high melting and boiling points.

92. Out of Li and Be which has higher ionisation energy?

(a) Li

(b) Be

(c) Both have same

(d) None

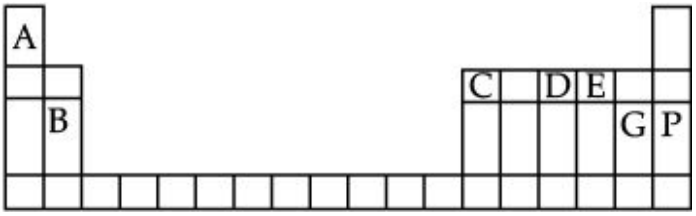
Ans. (a) Li

Explanation :

Ionization Potential is the amount of energy required to remove

the electron from an atom. It is also known as Ionization energy. Ionization energy increases across the period with increase in atomic number. Li and Be belongs to the same period having electronic configuration 2,1 and 2,2 respectively. Hence Be will have more ionization energy tan Li.

93. Observe the following table:



(i) Which element will form an ionic compound with G?

(a) A

(b) B

(c) C

(d) D

Ans. (i) (b)

Explanation :

B belongs to group 2 alkaline earth metal and G belongs to group 17 halogens which are non-metals. Ionic compound is formed between metal and a non-metal.

Assertion and Reasoning Based Questions

94. Assertion: The triad N, P and As will not represent the Dobereiner's triad.

Reason : Because there is so much difference in their atomic

masses.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

Explanation :

The triad N, P and As will not represent the Dobereiner's triad because the average of atomic masses of nitrogen (N) and arsenic (As) is not equal to the atomic mass of phosphorus (P). Thus both assertion and reason are true, but reason is not the correct explanation of assertion.

95. Assertion: The elements of the same group have similar chemical properties.

Reason: The elements of the same group have the different number of valence electrons.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (c) If assertion is true, but reason is false.

Explanation :

The elements of same group have similar chemical properties due to the same number of valence electrons. Thus assertion is true but reason is False.

96. Assertion: Mendeleev's periodic table was not widely accepted.

Reason: It is because hydrogen was not placed properly.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

Explanation :

Mendeleev's periodic table was not widely accepted because all the properties were not explained and also the anomalous behaviour of hydrogen was not explained. Thus, both assertion and reason are true but reason is not the correct explanation of the assertion.

97. Assertion: Nobel gases are placed in different group in periodic table.

Reason: Nobel gases are inert in nature.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (a) If both assertion and reason are true and reason is the correct explanation of assertion.

Explanation :

Noble gases are placed in a separate group because these are inert elements. They have properties which are different from all other elements. Thus both assertion and reason are true and reason is the correct explanation of the assertion.

98. Assertion: The elements of the different group have similar chemical properties.

Reason: It is because they have same number of valence electrons.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (d) If assertion is false, but reason is true.

Explanation :

The elements of the same group have similar chemical properties because of the presence of same number of valence electrons. Thus, assertion is false but reason is true.

99. **Assertion:** Metalloids are present in zig-zag rows in periodic table.

Reason: Metalloids have same properties.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

(a) **Ans.** (b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

Explanation :

It is because they have some properties of metals and some properties of non-metals. Thus, both assertion and reason are true but reason is not the correct explanation of the assertion.

100. **Assertion:**Chlorine is called halogen.

Reason: It is because chlorine reacts with metals to form salts.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (d) If assertion is false, but reason is true.

Explanation :

Elements such as chlorine, bromine and iodine are called halogens because they react with metals to form salts. Thus, assertion is false but reason is true.

101. Assertion: Across a period atomic radius decreases.

Reason: It is because electron is added to the same shell.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (a) If both assertion and reason are true and reason is the correct explanation of assertion.

Explanation :

Atomic radius decreases across a period because electron is added in the same shell. Thus attraction between nucleus and valence shell increases due to which outermost shell is pulled

closer to the nucleus. Nuclear charge is also increasing. Thus, effective nuclear charge increases and atomic size decreases. Thus, both assertion and reason are true and reason is the correct explanation of the assertion.

102. Assertion: Sodium is a metal whereas sulphur is a non-metal.

Reason: From left to right metallic character decreases.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (a) If both assertion and reason are true and reason is the correct explanation of assertion.

Explanation :

Metallic character of elements decreases in a period from left to right. Hence, sodium which is at left is metal and sulphur is a non-metal. Thus, both assertion and reason are true and reason is the correct explanation of the assertion.

103. Assertion: Non-metals are placed on the right-hand side in the periodic table.

Reason: Metalloids shows properties of both metals and non-metals.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

Explanation :

Non-metals are placed on the right-hand side in the periodic table and metalloids in the middle. Thus both assertion and reason are true, but reason is not the correct explanation of assertion.

104. Assertion: The atomic radius decreases in moving from left to right along a period.

Reason: This is due to an increase in nuclear charge.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (a) If both assertion and reason are true and reason is the correct explanation of assertion.

Explanation :

Increased nuclear change is due to increase in nuclear charge which tends to pull the electrons closer to the nucleus and reduces the size of the atom. Thus both assertion and reason are correct and reason is the correct explanation of the assertion.

105. **Assertion :** Out of the Na, Mg and Ar, Ar has the highest ionisation enthalpy.

Reason: Ar has stable inert gas configuration.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (a) If both assertion and reason are true and reason is the correct explanation of assertion.

Explanation :

The elements having inert gas configuration has highest ionisation enthalpy. Thus both assertion and reason are correct and reason is the correct explanation of the assertion.

106. **Assertion:** Metallic character decreases across a period.

Reason: Non metals are electropositive in nature.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (c) If assertion is true, but reason is false.

Explanation :

Non metals are electronegative in nature and metallic character decreases across a period. Thus assertion is true but reason if False.

107. Assertion: The ionisation energy of Mg is more than sodium.

Reason: The ionisation energy decreases in a period from left to right.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

Explanation :

The ionisation energy increases in a period from left to right. Therefore, ionisation energy of Mg is more than sodium. Thus, both assertion and reason are true but reason is not the correct explanation of the assertion.

108. Assertion: Periodicity in elements is the basis for the periodic table.

Reason: Henry Mosley gave the modern periodic law.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

Explanation :

Repetition of properties after regular intervals is the main cause of periodicity of elements. Thus, both assertion and reason are true but reason is not the correct explanation of the assertion.

109. Assertion: Chlorine is less electronegative than fluorine.

Reason: It is because of its small size.

(a) If both assertion and reason are true and reason is the correct explanation of assertion.

(b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

(c) If assertion is true, but reason is false.

(d) If assertion is false, but reason is true.

Ans. (b) If both assertion and reason are true, but reason is not the correct explanation of assertion.

Explanation :

Electronegativity decreases in a group from top to bottom. Therefore, chlorine is less electronegative than fluorine. Thus, both assertion and reason are true but reason is not the correct explanation of the assertion.

Case Based Questions

110. Read the following passage carefully and answer the following questions from Q 110 (i) to 110 (v).

With the constant discovery of a large number of elements, it became necessary to classify them and arrange them according to their periodic properties. Dobereiner arranged the elements with similar properties into groups. He classified some groups of three elements having similar physical and chemical properties, called Dobereiner's triads. John Newland's later arranged all elements in order of increasing atomic masses and found that every eighth element has similar properties as the first one in the chart.

(i) {Cl, Br, I} is a Dobereiner's triad. In this triad, if the atomic masses of Cl and I are 35.5 and 127 respectively, what is the atomic mass of Br?

(a) 162.5

(b) 91.5

(c) 45.625

(d) 81.25

(ii) Which is a Dobereiner's triad:

(a) K, Al, Ca

(b) Li, Al, Ca

(c) Li, Na, K

(d) Li, K, Na

(iii) Newland's law of Octaves is obeyed by two elements A and B showing similar properties. The number of elements between A and B is:

(a) 8

(b) 6

(c) 7

(d) 5

(iv) Properties of Magnesium are similar to those of which element according to Newland's law of octaves?

(a) Beryllium

(b) Lithium

(c) Potassium

(d) Sodium

(v) Elements are arranged in Dobereiner's triad on the basis of:

(a) Atomic mass

(b) Atomic Number

(c) Number of Electrons

(d) Number of Neutrons

Ans. (i) (d) 81.25

(ii) (c) Li, Na, K

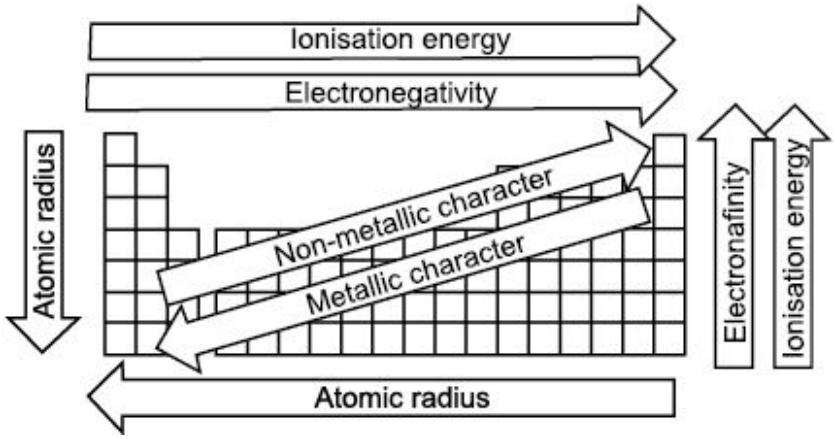
(iii) (b) 6

(iv) (a) Beryllium

(v) (a) Atomic mass

111. Read the following passage carefully and answer the following questions from Q 111 (i) to 111 (v).

When elements are arranged in the increasing order of their atomic numbers, we observe the recurrence of properties of the elements after certain regular intervals. This recurrence is known as periodicity. A number of physical properties such as atomic size, metallic and non-metallic character, etc. show periodic variation. Properties vary differently moving from left to right in a period and top to down in a group. Moving in a period from left to right, the number of shells remain the same but valence electron increase by one number. This results in an increase in nuclear charge. Going down in a group, the number of valence shells increases while the valence electrons remain the same. Observe some periodic table trends in the given figure.



(i) As we go down in a group in the periodic table, the electropositive character of the element

(a) Decreases

(b) Increases

(c) Changes but irregularly

(d) Remains constant

(ii) In the second period in the table, which element has the largest size

(a) N

(b) F

(c) Li

(d) Be

(iii) Which of the following elements has three valence electrons?

(a) Al

(b) S

(c) Cs

(d) Ca

(iv) In the periodic table, the metallic character of the elements:

(a) Increases from left to right and decreases down the group

(b) Decreases from left to right and increases down the group

(c) Increases from left to right and increases down the group

(d) Deceases from left to right and decreases down the group

(v) Moving along a period results in an increase of

(a) Atomic size

(b) Number of valence electrons

(c) Electropositive character

(d) All of the above

Ans. (i) (b) Increases

(ii) (c) Li

(iii) (a) Al

(iv) (b) Decreases from left to right and increases down the group

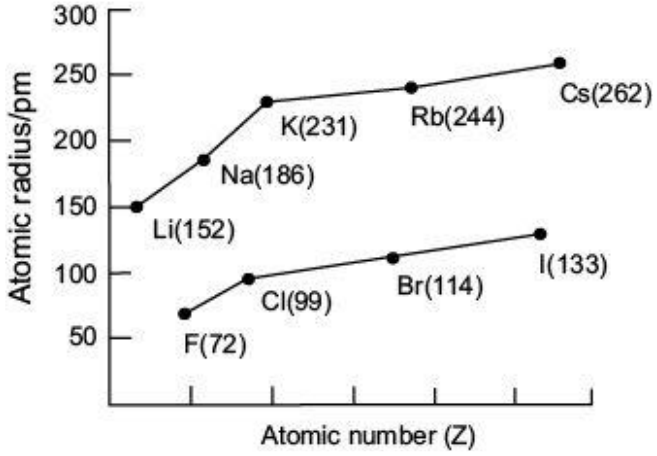
(v) (b) Number of valence electrons

112. Read the following and answer the following questions from Q 112 (i) to 112 (v).

Metallic character: The ability of an atom to donate electrons and form positive ion (cation) is known as electropositivity or metallic character. Down the group, metallic character increases

due to increase in atomic size and across the period, from left to right electro-positivity decreases due to decrease in atomic size.

Non-metallic character: The ability of an atom to accept electrons to form a negative ion (anion) is called non-metallic character or electronegativity. The elements having high electronegativity have a higher tendency to gain electrons and form anion. Down the group, electronegativity decreases due to increase in atomic size and across the period, from left to right electronegativity increases due to decrease in atomic size.



(i) Which of the following correctly represents the decreasing order of metallic character of Alkali metals plotted in the graph?

(a) Cs > Rb > Li > Na > K

(b) K > Rb > Li > Na > Cs

(c) Cs > Rb > K > Na > Li

(d) Cs > K > Rb > Na > Li

(ii) Hydrogen is placed along with Alkali metals in the modern periodic table though it shows non-metallic character:

(a) as Hydrogen has one electron and readily loses electron to form negative ion

(b) as Hydrogen can easily lose one electron like alkali metals to form positive ion

(c) as Hydrogen can gain one electron easily like halogens to form negative ion

(d) as Hydrogen shows the properties of non-metals

(iii) Which of the following has highest electro-negativity?

(a) F

(b) Cl

(c) Br

(d) I

(iv) Identify the reason for the gradual change in electronegativity in halogens down the group.

(a) Electronegativity increases down the group due to decrease in atomic size

(b) Electronegativity decreases down the group due to decrease in tendency to lose electrons

(c) Electronegativity decreases down the group due to increase in atomic radius/tendency to gain electron decreases

(d) Electronegativity increases down the group due to increase in forces of attractions between nucleus and valence electrons

(v) Which of the following reason correctly justifies that, “Fluorine

(72pm) has smaller atomic radius than Lithium (152pm)"?

(a) F and Li are in the same group. Atomic size increases down the group.

(b) F and Li are in the same period. Atomic size increases across the period due to increase in number of shells.

(c) F and Li are in the same group. Atomic size decreases down the group.

(d) F and Li are in the same period and across the period atomic size/radius decreases from left to right.

Ans

. (i) (c) Cs > Rb > K > Na > Li

(ii) (b) As Hydrogen can easily lose one electron like alkali metals to form positive ion

(iii) (a) F

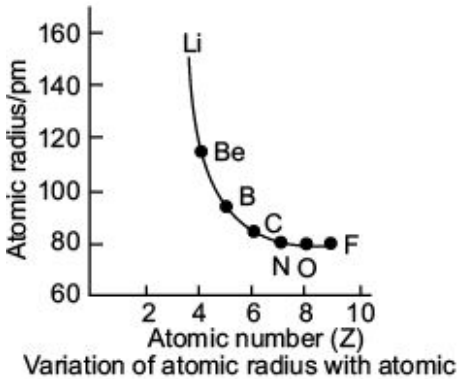
(iv) (c) Electronegativity decreases down the group due to increase in atomic radius/ tendency to gain electron decreases.

(v) (d) F and Li are in the same period and across the period atomic size/radius decreases from left to right.

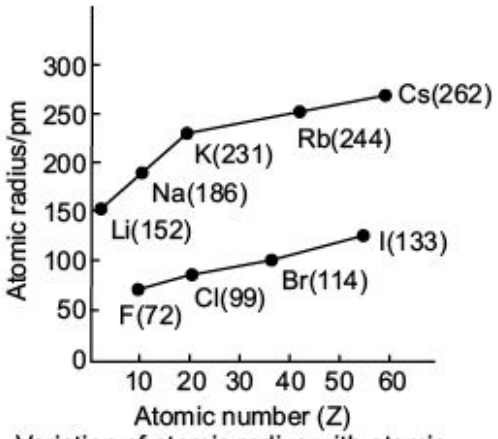
113. Read the following passage carefully and answer the following questions from Q 113 (i) to 113 (v).

Atomic radius is defined as the distance between the center of the nucleus and the outermost shell of electrons. As the effective nuclear charge increases as we move left to right along a period, hence the atomic radii decreases. There is a decrease in atomic

size from Li to F in the second period and from Na to Cl in the third period. In any period the noble size has the largest radius.



Variation of atomic radius with atomic number across the second period



Variation of atomic radius with atomic number for alkali metals with halogens

(i) Which among the following has the maximum atomic radius?

(a) Si

(b) P

(c) Mg

(d) Al

(ii) The element which has the smallest size in group 13 is:

(a) Aluminum

(b) Gallium

(c) Boron

(d) Thallium

(iii) The reason due to which atomic radius decreases as we move across a period is:

(a) atomic number decreases

(b) electrons are removed from the atom

(c) atomic mass increases

(d) effective nuclear charge increases

(iv) The element having the smallest size in the third period of the periodic table is:

(a) Argon

(b) Chlorine

(c) Silicon

(d) Sodium

(v) The correct order of increasing atomic radii for the element set [O, C, F, Cl, Br] is:

(a) F, O, C, Cl, Br

(b) F, C, O, Cl, Br

(c) F, Cl, Br, O, C

(d) C, O, F, Cl, Br

Ans. (i) (c) Mg

(ii) (c) Boron

(iii) (d) effective nuclear charge increases

(iv) (b) Chlorine

(v) (a) F, O, C, Cl, Br

Reasoning Based Questions

114. How does the tendency of the elements to lose electrons change in the Modern Periodic Table in (i) a group , (ii) a period and why? **

Ans. (i) Increase down a group.

Reason: At each succeeding element down a group the number of shells from the nucleus increases, and the effective nuclear force of attraction decreases on the last shell, so it becomes easy for the atom to lose electrons.

(ii) Decreases in a period from left to right.

Reason: As the effective nuclear charge on the valence shell electron increases, the attraction between the valence electron and nucleus increases, so it becomes difficult to lose electrons.

115. Write the name given to the vertical columns and horizontal rows in the Modern Periodic Table. How does the metallic character of elements vary on moving down a vertical column? How does the size of atomic radius vary on moving left to right in a horizontal row? Give reason in support of your answer in the above two cases.*

Ans. Vertical columns are called groups and horizontal rows are called periods. Metallic character increases down the group. As the size increases, the distance between electron and nucleus increases and attraction between nucleus and valence electrons decreases. Atomic size decreases on moving left to right in a period because electron is added in the same shell. So attraction between nucleus and valence shell increases due to which the outermost shell is pulled in closer to the nucleus. Nuclear charge is also increasing. Thus, effective nuclear charge increases and atomic size decreases.

116. The elements Li, Na and K each having one valence electron are in the period 2, 3 and 4 respectively of Modern Periodic Table.***

(i) In which group of the periodic table should they be?

(ii) Which one of them is least reactive?

(iii) Which one of them has the largest atomic radius? Give reason to justify your answer.

Ans. (i) They belong to group 1 because they have one valence electrons.

(ii) Lithium is least reactive.

(iii) Potassium has largest size because atomic size increases down the group.

117. In the modern periodic table a zig-zag line separates metals from non-metals. What are these elements called and why?

Ans. A zig-zag line of elements that separates metal from non-metals are known as metalloids because they have some properties of metals and some properties of non-metals.

118. Why are elements chlorine, bromine and iodine called halogens?

Ans. Element chlorine, bromine and iodine are called halogens because these elements reacts readily with alkali metal and alkaline earth metals to form halide salts. (halo - salt, gene - producer.).

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

Ans. Noble gases are placed in a separate group because these are

inert elements. They have properties which are different from all other elements.

120. What is meant by atomic radius? Explain why it the decreases across a period?*

Ans. The distance from centre of nucleus to outermost shell of an atom is atomic radius. Atomic radius decrease across a period because electron is added in the same shell. So attraction between nucleus and valence shell increases due to which outermost shell is pulled in closer to the nucleus. Nuclear charge is also increasing. Thus, effective nuclear charge increases and atomic size decreases.

121. Na, Mg and Al are the element of the same period of modern periodic table having one, two and three valence electrons respectively, which of these elements (i) has the largest atomic radius, (ii) is least reactive? Justify your answer starting reason for each case.*

Ans. (i) Atomic radius decreases along the period with increase in atomic number. Therefore, the element with largest atomic radius is Na.

$$Na > Mg > Al$$

(ii) All these elements are metals. Reactivity of metals decreases with decrease in atomic radius along the period. Hence, Na is most reactive among the three. So, the order of reactivity is Na > Mg > Al.

122. How does the metallic character of elements change along a

period of the periodic table from the left to the right and why?*

Ans. The metallic character goes on decreasing along a period from left to right because atomic size goes on decreasing therefore, tendency to lose electrons decreases.

123. Nitrogen (Atomic number 7) and phosphorous (atomic number 15) belong to group 15 of the periodic table. Write the electronic configuration of these two electrons. Which of these will be more electronegative and why?*

Ans. Nitrogen = 2, 5

Phosphorous = 2, 8, 5

N is more electronegative than P as from top to bottom down a group, electronegativity decreases. This is because number of shell increases down a group, and thus there is an increased distance between the valence electrons and nucleus, or a greater atomic radius.

124. Explain why:

(i) The elements of the same group have similar chemical properties.

(ii) The elements of the same period have different properties.

Ans. (i) The elements of the same group have similar chemical properties because of the presence of same number of valence electrons.

(ii) The elements of the same period have different properties because number of valence electrons are different.

Very Short Answer Type Questions

125

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

[NCERT]

Ans. Mendeleev's periodic table was based on atomic masses and similarity in formula of hydrides and oxides of elements. According to him, the properties of elements are a periodic function of their atomic masses.

126

. Besides gallium, which other elements have since been discovered that were left by Mendeleev in his Periodic Table? (any two)

[NCERT]

Ans. Scandium and Germanium.

127

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

[NCERT]

Ans. Yes, Dobereiner's triads also exist in the columns of Newlands' Octaves. For example, the triad formed by the elements Li, Na, and K of Dobereiner's triads also occurred in the columns of Newlands' octaves.

128

. What were the limitations of Dobereiner's classification?[NCERT]

Ans. The limitation of Dobereiner's classification is that the elements known at that time could not be classified into groups of triads on the basis of their properties.

129. In the Modern Periodic Table, which are the metals among the first ten elements?

[NCERT]

Ans. Among the first ten elements H, He, Li, Be, B, C, N, O, F, Ne; Lithium (Li) and Beryllium (Be) are metals.

130. Write two reasons responsible for late discovery of noble gases.*

Ans. **(a)** They are inert gases.

(b) Their valency is zero.

131. State one reason for placing Mg and Ca in the same group of the periodic table.****

Ans. They have same number of valence electrons and show similar chemical properties.

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

[NCERT]

Ga, Ge, As, Se, Be

Ans. Metallic character of an element is defined as the easiness of its atom in losing electrons. According to the modern periodic

table, the metallic character of an element decreases while moving from left to right across a period and increases down the group. Among the elements Ga, Ge, As, Se Be, Be and Ga are expected to be most metallic and out of Be and Ga, Ga is bigger in size and hence has a greater tendency to lose electrons than Be. Thus, Ga is more metallic than Be.

133

. Compare the radii of two species X and Y. Give reasons for your answer.

[NCERT]

(i) X has 12 protons and 12 electrons, (ii) Y has 12 protons and 10 electrons.

Ans. Y has less electrons than X. This means that Y is cation of X. Therefore, radii of Y is less than X.

134

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

[NCERT]

Ans. 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.

135

. The electronic configuration of two elements X and Y are 2, 8, 8, 3 respectively. Write atomic numbers of X and Y.*

Ans. Atomic number of X = 2, 8, 7 = 17

Atomic number of Y = 2, 8, 8, 3 = 21

136

. Write the atomic numbers of two elements ‘X’ and ‘Y’ having electronic configuration 2, 8, 2 and 2, 8, 6 respectively.*

Ans. Atomic number of X = 2 + 8 + 2 = 12

Atomic number of Y = 2 + 8 + 6 = 16

137

. The atomic numbers of three elements A, B and C are 12, 18, and 20 respectively. State giving reason, which two elements will show similar properties.

Ans. A and C will show similar properties due to same number of valence electrons *i.e.,* 2.

138

. Write any one difference between the electronic configuration of group-1 and group -2 elements.*

Ans. Group 1 elements have 1 valence electron while group 2 elements have 2 valence electrons.

139

. The atomic numbers of three elements X, Y and Z are 3, 11 and 17 , respectively. State giving reason which two elements will show similar chemical properties.*

Ans. The two elements X and Y will show same chemical properties because they have same number of valence electron in group. They form positively charged ions by losing one electron.

140

. Write the name, symbol and electronic configuration of an element X whose atomic number is 11.*

Ans. The element whose atomic number is 11 is sodium.

Its symbol is Na.

Electronic configuration—2, 8, 1

Valency 1

141

. Answer the following questions:

(i) How would the tendency to lose electrons change as we go from left to right across a period of the periodic table?

(ii) How do the atomic radii of elements change as we go from left to right in a period of the periodic table?

Ans. (i) On moving from left to right in a period, the tendency of atoms to lose electrons decreases.

(ii) On moving from left to right in a period, the atomic size decreases.

142

. Elements have been arrangement in the following sequence on the basis of their increasing atomic masses.

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

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

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

Ans. **(i)** (a) F and Cl (b) Na and K.

(ii) Newland's law of octaves.

143

. State the following:

(i) Write the formulae of chlorides of Eka-silicon and Eka-aluminium.

[NCERT]

(ii) Write the number of elements in 2nd and 5th period in Modern Periodic Table?

(iii) Write the number of a group in which metallic, metalloid and non-metallic, all three types of elements, are present.

(iv) Write the number of horizontal rows in the modern periodic table. What are these rows called?

(v) Write the number of vertical columns in the modern periodic table. What are these columns called?

(vi) Write the formula used to determine the maximum numbers of electrons which a shell in an atom can accommodate?

Ans. **(i)** $GeCl_4$, $GaCl_3$

(ii) 2nd period has 8 elements, 5th period has 18 elements.

(iii) Group 14.

(iv) There are seven horizontal rows in the modern periodic table. These rows are called periods.

(v) There are 18 vertical columns in the modern periodic table. These are known as groups.

(vi) $2n^2$, where n is the number of shell.

Short Answer Type Questions

144

. State the main aim of classifying elements. Which is the more fundamental property of elements that is used in the development of modern periodic table? Name and state the law based on this fundamental property. On which side of the periodic table one can find metals, non- metals and metalloids?*****

Ans. The main aim of classification is to make study of elements systematic and easy. The fundamental property of elements that is used in the development of modern periodic table is Atomic number. According to Modern Periodic law, “Physical and Chemical Properties of the elements are a periodic function of their atomic numbers”. In a periodic table, metals are on the left and non-metals are on the right. Metalloids at the border of metals and beginning of non- metals.

145

. What is Newlands’ law of octaves? Explain with an example.

Ans. According to this law, when elements are arranged in the order of increasing atomic masses, the properties of the eighth element (starting from a given element) are a repetition of the properties of the first element.

For example: Lithium shows similarity with sodium.

146

. State Mendeleev’s periodic law. Write two achievements of Mendeleev’s periodic table.

Ans. Mendeleev’s Periodic Law states that ‘Properties of elements are the periodic function of their atomic masses.

Achievements :

(a) It could classify all the elements discovered at that time and helped in the discovery of new elements

(b) It helped in correction of atomic mass of some of the elements.

147. Answer the following questions:

(i) 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.

(ii) In the classification of the then known elements, Mendeleev was guided by two factors. What are those two factors?

Ans. **(i)** This is done so that the elements with similar properties could be grouped together. Therefore, to arrange elements with similar properties together, cobalt is placed before Nickel neglecting its atomic mass.

(ii) The two factors are as follows:

(a) Increasing atomic masses.

(b) Grouping together of elements having similar properties.

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

Ans. 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 gas being inert, could be placed in a separate group without disturbing the original order.

149

. How it can be proved that the basic structure of the Modern Periodic Table is based on the electronic configuration of atoms of different elements?*

Ans. Modern periodic law states that the physical and chemical properties of an element are the periodic function of the atomic number of that element. Electronic configuration of the elements plays an important role in the placement of element in the modern periodic table. The valence shell electron on an element decides its position in a particular group or period for example, if the configuration of an element is 2, 1 it means that the element is lithium (Li = 2, 1) and it belongs to the 2nd period and 1st group of the modern periodic table.

150

. Use Mendeleev's periodic table to predict the formulae for the oxides of the following elements: K, C, Al, Si, Ba.[NCERT]

Ans. K belongs to group 1. Therefore, the oxide will be K_2O.

C belongs to group 4. Therefore, the oxide will be CO_2.

Al belongs to group 3. Therefore, the oxide will be Al_2O_3.

Si belongs to group 4. Therefore, the oxide will be SiO_2.

Ba belongs to group 2. Therefore, the oxide will be BaO.

151

. Can the following groups of elements be classified as Dobreiner'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.

Ans. (a) Na, Si, Cl cannot be classified as Dobereiner's triad because here the elements do not belong to the same group and have different electronic configuration.

Na–2, 8, 1; Si–2, 8, 4 and Cl–2, 8, 7

(b) Be, Mg, Ca are the elements of Dobereiner's triad because the mass of Mg is the arithmetic mean of the other two elements.

i.e., Be and Ca = $\frac{9 + 40}{2}$ = 24.

152

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

[NCERT]

Ans. Modern periodic table removes various anomalies of Mendeleev's periodic table on the following points :******

(a) Position of isotopes : As Modern periodic table is based on atomic number, isotopes can be placed at one place in same group in modern periodic table.

(b) Anomalous position of some pair of elements: In

Mendeleev periodic table, some of the elements having higher atomic mass are placed before the elements having lower atomic mass. This defect of Mendeleev periodic table was overcome in Modern periodic table since it is based on atomic numbers.

(c) Prediction of new elements : In long form of periodic table, the position and properties of new elements can be predicted easily on the basis of their atomic numbers or electronic configuration.

153. Answer the following questions:

(i) What is the basic difference in approach between Mendeleev's periodic law and the Modern periodic law?

(ii) In between nitrogen and oxygen; whose ionisation energy is high and why?

Ans. (i) The basic difference in approach between Mendeleev's periodic law and Modern periodic law is the change in basis of classification of elements from atomic weight to atomic number.

(ii) The electronegativity of N is greater than O because Nitrogen has stable and exactly half-filled p-orbitals.

154. Answer the following questions:*

(i) How many groups and periods are there in the modern periodic table? How do the atomic size and metallic character of elements vary as we move:

(a) down a group and

(b) from left to right in a period

(ii) State the changes in valency and metallic character of elements as well as we move from left to right in a period. Also state the changes, if any, in the valency and atomic size of elements as we move down a group.

Ans. **(i)** There are a total of 18 groups and 7 periods in a periodic table.

(a) As we move down the group the atomic size as well as metallic character of elements increases.

(b) Both metallic character and atomic size decreases as we move from left to right in a period.

(ii) Valency increases and the metallic character decreases as we move from left to right. Valency remains same and the size increases as we move down the group in periodic table.

155 . The position of three elements A, B and C in the Periodic Table are shown below:

[NCERT]

Group 16	Group 17
—	—
—	A
—	—
B	C

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

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

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

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

Ans. (i) A is a non-metal.

(ii) C is less reactive than A, as reactivity decreases down the group in halogens.

(iii) C will be smaller in size than B as moving across a period, the nuclear charge increases and therefore, electrons come closer to the nucleus.

(iv) A will form an anion as it accepts an electron to complete its octet.

156. An element belongs to third period and group 16 of modern periodic table.*******

(i) Determine the number of valence electrons and valency of T.

(ii) Molecular formula of the compound when X reacts with hydrogen and write its electron dot structure.

(iii) Name the element X and state whether it is metallic or non-metallic.

Ans. (i) Valency electron = 6

Valency = 2

(ii) H_2S

(iii) Sulphur, Non-metal.

157. The elements of the second period of the Periodic Table are

given below: Li, Be, B, C, N, O, F.

(i) Give reason to explain why atomic radii decrease from Li to F.

(ii) Identify the most (a) metallic and (b) non-metallic element.

Ans. (i) On moving from left to right in a period force of attraction between nucleus and electrons increases which results in decrease in size.

(ii) (a) Most metallic element is 'Li'.

(b) Most non-metallic element is 'F'.

158. Answer the following questions:

(i) What property do all elements in the same column of the periodic table as boron have in common?

[NCERT]

(ii) What property do all elements in the same column of the periodic table as fluorine have in common?

Ans. (i) All the elements in the same column as boron have the same number of valence electrons *i.e.,* 3. Hence, they all have valency equal to 3.

(ii) All the elements in the same column as fluorine have the same number of valence electrons *i.e.,* 7. Hence, they all have valency equal to 1.

159. 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.

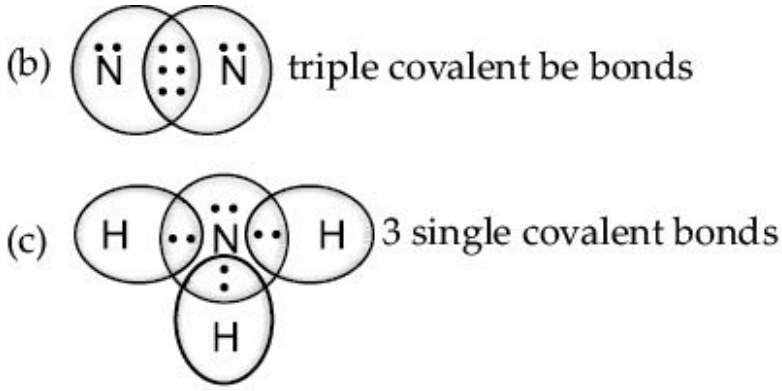
(i) Identify the element X. How many valence electrons does it have?

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

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

Ans

. (i) Nitrogen (atomic no. 7). Its electronic configuration is 2, 5; it has 5 valence electrons.



160

. Which element has:[NCERT]

(i) two shells, both of which are completely filled with electrons?

(ii) the electronic configuration 2, 8, 2?

(iii) a total of three shells, with four electrons in its valence shell?

(iv) a total of two shells, with three electrons in its valence shell?

(v) twice as many electrons in its second shell as in its first shell?

Ans. (i) Neon has two shells, both of which are completely filled with electrons (2 electrons in K shell and 8 electrons in L shell).

(ii) Magnesium has the electronic configuration 2, 8, 2.

(iii) Silicon has a total of three shells, with 4 electrons in its valence shell (2 electrons in K shell, 8 electrons in L shell and 4 electrons in M shell).

(iv) Boron has a total of two shells, with three electrons in its valence shell (2 electrons in K shell and 3 electrons in L shell).

(v) Carbon has twice as many electrons in its second shell as in its first shell (2 electrons in K shell and 4 electrons in L shell).

161. . An element X (atomic number 17) reacts with an element Y (atomic number 20) to form a divalent halide.

(i) Where in the periodic table are elements X and Y placed?

(ii) Classify X and Y as metal (s), non-metal (s) or metalloid (s).

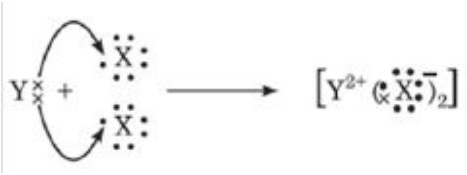
(iii) What will be the nature of oxide of element Y ? Identify the nature of bonding in the compound formed.

(iv) Draw the electron dot structure of the divalent halide.

Ans. (i) X belongs to Group 17 and 3^{rd} period Y belongs to Group 2 and 4^{th} period.

(ii) X — Non-metal and Y — Metal.

(iii) Basic oxide; Ionic bonding.

(iv) 

162

. From the following elements:*

4Be ; 9F ; 19K ; 20Ca

(a) Select the elements having one electron in the outermost shell.

(b) Two elements of the same group.

Write the formula of the compound and mention the nature of the compound formed by the union of 19 K and element X(2, 8, 7).

Ans

. (a) 'K' has only one electron in the outermost shell

19K: 2, 8, 8, 1

(b) Be and Ca both are the members of 2nd group. K has only one electron in its outermost shell while the element X is only one electron short from its octet. So there would be transfer of one electron from K to X. Formula of compound: KX Nature of compound: Ionic or Electrovalent.

163

. Answer the following questions:*

(i) What are metalloids?

(ii) Name any four metalloids?

(iii) Predict which of the following elements will form cation and will form anions?

(a) Na,

(b) Al,

(c) Cl,

(d) O.

(iv) Name two elements that are inert in nature.********

Ans

. (i) Borderline elements which are intermediate in properties between metals and non-metals are called metalloids.

(ii) Boron, silicon, germanium and arsenic.

(iii) Na and Al are metals. They form cations.

(iv) Cl and O are non-metals. They form anions.

164

. Name the following elements:[NCERT]

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

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

(iii) Three elements with filled outermost shells.

(iv) Name two elements you would expect to show chemical reactions similar to magnesium. What is the basis for your choice?**[NCERT]**

Ans. (i) Lithium (Li), Sodium (Na), and Potassium (K) have a single electron in their outermost shells.

(ii) Magnesium (Mg) and Calcium (Ca) have two electrons in their outermost shells.

(iii) Neon (Ne), Argon (Ar) and Xenon (Xe) have filled outermost shells.

(iv) Calcium (Ca) and strontium (Sr) are expected to show chemical reactions similar to magnesium (Mg). This is because the number of valence electrons (2) is same in all these three elements and they belong to same group.

165. Answer the following questions:

(i) Lithium, sodium, potassium are all metals that react with water to liberate hydrogen gas. Is there any similarity in the atoms of these elements? **[NCERT]**

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

Ans. (i) Yes, they all belong to group 1 *i.e,* their atoms have one electron in their outermost shell.

(ii) Both Helium (He) and Neon (Ne) have filled outermost shells. Helium has a duplet i.e., two electrons in its K shell, while neon has an octet *i.e*, 8 electrons in its L shell.

166. An atom has electronic configuration 2, 8, 7.

[NCERT]

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

(ii) 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).

Ans. (i) The atomic number of this element is 17.

(ii) It would be chemically similar to F(9) with configuration as 2, 7.

167

. Nitrogen (atomic number 7) and phosphorus (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?

[NCERT]

Ans.

Element	K	L	M
Nitrogen	2	5	
Phosphorus	2	8	5

Nitrogen is more electronegative than phosphorus, because on moving down a group, the number of shell increases and electronegativity decreases.

168

. Answer the following questions:*

(i) Three elements X, Y and Z belong to 17th group but 2nd, 3rd and 4th period respectively. Number of valence electrons in Y is 7. Find the number of valence electrons in X and Z.

(ii) Na, Mg, Al and P belong to third period but are placed in first,

second, thirteen and fifteenth group. Number of shells occupied in Mg is three. What is the number of occupied shells in Na, Al and P. Give reasons for your answer.

(iii) The atomic radius of three elements A, B and C of a periodic table are 186 pm, 104 pm and 143 pm respectively. Giving a reason, arrange these elements in the increasing order of atomic numbers in a period.

Ans. (i) Number of valence electrons in X and Z will be 7 because the number of electrons in the outermost shell in the elements in same group is same.

(ii) In Na, Al and P number of occupied shells are three. The reason for this is that elements with same number of occupied shells are placed in same period.

(iii) Order of atomic number of elements will be :
A < C < B. Out of three, A has largest atomic radius, then C and finally B and atomic radius decreases along a period.

169

. Name any two elements of group one and write their electronic configuration. What similarity do you observe in their electronic configuration? Write the formula of oxide of any of the above said elements.*

Ans. Two elements of group 1 are Sodium (11) and Potassium (19).

Electronic configuration,

Na = 2, 8, 1.; K = 2,8,8,1.

Both have one electrons in their valence shell. The formula of their oxide is: Na_2O and K_2O.

170

. Na, Mg and Al are the elements of the same period of modern periodic table having one, two and three valence electrons respectively. Which of these element (i) has the largest atomic radius , (ii) is least reactive ? Justify your answer stating reason for each case.*

Ans

. (i) Na or Sodium. The atomic size decreases from left to right due to the increase in nuclear charge.

(ii) Al is least reactive because the tendency to lose electron decreases from, left to right.

171

. Give an example of:*

(i) A metal that is liquid at room temperature.

(ii) A non-metal that is liquid at room temperature.

(iii) An inert gas (At. No. < 20)

Ans

. (i) Mercury

(ii) Bromine

(iii) Helium or Neon or Argon.

172

. The electronic configuration of an element is 2, 8, 4. State its:*

(i) Group and period in the Modern Periodic Table.

(ii) Name and write its one physical property.

Ans. (i) Si = 2, 8, 4

(a) It means that it belongs to 3rd period and 14th group.

(b) The name of element is silicon.

(ii) It is a metalloid. (i.e., element that has properties of both metals and non-metals).

173. . Based on the group valency of elements write the molecular formula of the following compounds giving justification for each :*

(i) Oxide of first group elements.

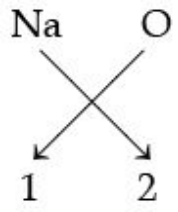
(ii) Halide of the elements of group thirteen, and

(iii) Compound formed when an element, A of group 2 combines with an element, B of group seventeen.

Ans. (i) Sodium is a group one element (Na) so its configuration is 2, 8, 1 and its valency is 1.

Oxide has a valency of 2.

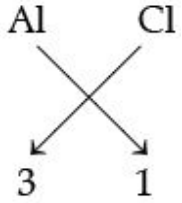
So, their formula would be



Formula for sodium oxide is Na_2O.

(ii) Halide is any Halogen. Group 13 means for example, we take Aluminium (Al), its configuration is 2, 8, 3, valency of Al is 3, valency of Cl is 1.

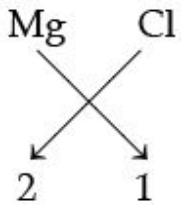
So



Formula would be $AlCl_3$ (Aluminium chloride).

(iii) Element of group 2 for example Mg 2, 8, 2, its valency would be 2.

Element of group 17 would be Cl 2, 8, 7, valency would be 1.



Formula would be $MgCl_2$ (Magnesium chloride).

Long Answer Type Questions

174

. List the merits and demerits of Mendeleev periodic table.

Ans. Merits of Mendeleev periodic table:

(a) At some places the order of atomic weight was changed in order to justify the chemical and physical nature.

(b) Mendeleev left some gap for new elements which were not discovered at that time.

(c) One of the strengths of Mendeleev's periodic table was that, when inert gases were discovered they could be placed in a

new group without disturbing the existing order.

Demerits of Mendeleev periodic table:******

(a) Position of hydrogen: Hydrogen resembles alkali metals (forms H^+ ion just like Na^+ ions) as well as halogens (forms H^- ion similar to Cl^- ion).Therefore, it could neither be placed with alkali metals (group I) nor with halogens (group VII).

(b) Position of isotopes: Different isotopes of same elements have different atomic masses, therefore, each one of them should be given a different position in the periodic table. On the other hand, because they are chemically similar, they had to be given same position.

(c) Anomalous pairs of elements: At certain places, an element of higher atomic mass has been placed before an element of lower atomic mass. For example, Argon (39.91) is placed before potassium (39.1).

175

. Answer the following questions:

(i) The modern periodic table has been evolved through the early attempts of Dobereiner, Newland and Mendeleev. List one advantage and one limitation of all three attempts.*

(ii) Name the scientist who first of all showed that atomic number of an element is a more fundamental property than its atomic mass.

(iii) State Modern Periodic law.

Ans. (i) **(a) Dobereiner:**

Advantage: Group three elements having similar properties they

were called as the Dobereiner triads. He arranged them in order of increasing atomic mass and the mass of middle element was equal to the average of the other two elements.

Limitation: He was able to identify only 4 traids but he failed in his attempt to group nitrogen, phosphorus and arsenic because atomic mass of phosphorus is not the average of other two.

(b) Newland:

Advantages: He arranged the elements in horizontal rows in order of increasing in atomic mass. The property of every 8^{th} element was similar to the 1^{st} element.

Limitation: His arrangement was only applicable to lighter elements.

(c) Mendeleev:

Advantage: He arranged the elements in order of there increasing atomic mass and he corrected the mass of beryllium from 4.5 to 13.5 *u*.

Limitation: Position of hydrogen and isotopes were not justified in his periodic table.

(ii) Henry Moseley showed that atomic number of an element is a more fundamental property than its atomic mass.

(iii) Modern periodic law states that “the properties of elements are the periodic function of their atomic number. Repetition of properties is due to the same outer electronic configuration.”

176

. Answer the following questions:

(i) List any three observations which posed a challenge to Mendeleev's Periodic law.********

(ii) How does the metallic character of elements vary on moving from

(a) left to right in a period,

(b) from top to bottom in a group of the Modern Periodic Table?

Give reason for your answer.

Ans

. (i) Three observations which posed a challenge to Mendeleev's Periodic law are:

(a) The position of isotopes could not be explained.

(b) Wrong order of atomic masses of some elements could not be explained.

(c) A correct position could not be assigned to hydrogen in the periodic table.

(ii) (a) On moving from left to right in a period, the metallic character of elements increases because electropositive character decreases.

(b) On going down in a group of the periodic table, the metallic character of elements increases because electropositive character of elements increases.

177

. Answer the following questions:

(i) What is a group in the periodic table? In which part of a group would you separately expect the elements to have : (a)

the greatest metallic character, (b) the largest atomic size?

(ii) In what respects do the properties of group 1 elements differ from those of group 17 elements?

(iii) From the stand point of atomic structure, what determines which element will be the first and which is the last in a period of the periodic table?

(iv) Explain why, the properties of elements are repeated after 2, 8, 18 and 32 elements in the periodic table.

(v) What are the advantages of the periodic table?

Ans

. (i) The vertical columns in a periodic table are called groups.

(a) The greatest metallic character is found in the elements in the lowest part of the group.

(b) The largest atomic size is found in the lowest part of the group.

(ii) Group 1 elements have 1 valence electron and are ionic in chemical reactions, whereas, the elements of group 17 have 7 valence electrons. They all are non-metals.

(iii) The number of valence electrons in the atoms of elements decides which element will be the 1st element in a period and which will be the last in a period.

(iv) The properties of elements are repeated after 2, 8, 18 and 32 elements in the periodic table because the electronic configurations of the elements are repeated in this manner.

(v) Advantages of the periodic table:

(a) It is easier to remember the properties of an element if its

position in the periodic table is known.

(b) The type of compounds formed by an element can be predicted by knowing its position in the periodic table.

178

. The electronic configuration of three elements A, B and C is given below:

A = 2. B = 2, 6 C = 2, 8, 2

(i) Which element belongs to the second period?

(ii) Which one of them is a noble gas?

(iii) What is the valency of B?

(iv) Name the element C.

(v) Which is a metal?

Ans

. (i) B belongs to second period as its valency is two.

(ii) A(2 = helium) is a noble gas.

(iii) 2 (8-6).

(iv) Magnesium (At. No. 12)

(v) C is a metal.

179

. The electrons in the atoms of four elements A, B, C and D are distributed in three shells having 1, 3, 5 and 7, electrons respectively in their outermost shells. Write the group numbers in which these elements are placed in the Modern Periodic Table. Write the electronic configuration of the atoms of B and D, and

the molecular formula of the compound formed when B and D combine.********

Ans. A—1st group.

B—13th group.

C—15th group.

D—17th group.

Electronic configuration

B ⟶ Atomic number = 13

K	L	M
2	8	3

D ⟶ Atomic number = 17

K	L	M
2	9	7

The molecular formula of the compound when B and D combine is BD_3.

180

. Atoms of eight elements A, B, C, D, E, F, G and H have the same number of electronic shells but different number of electrons in their outermost shell. It was found that elements A and G combine to form an ionic compound. This compound is added in a small amount to almost all vegetable dishes during cooking. Oxides of elements A and B are basic in nature while those of E and F are acidic. The oxide of D is almost neutral. Based on the above information answer the following questions:*

(i) To which group or period of the Periodic Table do the listed elements belong?

(ii) What would be the nature of compound formed by a combination of elements B and F?

(iii) Which two of these elements could definitely be metals?

(iv) Which one of the eight elements is most likely to be found in gaseous state at room temperature?

(v) If the number of electrons in the outermost shell of elements C and G be 3 and 7 respectively, write the formula of the compound formed by the combination of C and G.

Ans. (i) A and B belong to group 1 and 2 because they form basic oxides. C belongs to group 13 as it has 3 valence electrons. D belongs to group 14 as it forms almost neutral oxide. E and F belong to group 15 and 16 as they form acidic oxides, G belongs to group 17 as it has 7 valence electrons and H belongs to group 18. They belong to 3rd period of the periodic table because AG is NaCl, added in a small amount to almost all vegetable dishes during cooking and Na and Cl belong to 3rd period.

(ii) Ionic compounds will be formed because 'B' is metal and 'F' is non-metal. 'B' can lose two electrons and 'F' can gain two electrons.

(iii) A and B are definitely metals as they form basic oxides.

(iv) G and H are in gaseous state at room temperature.

(v) CG_3 is the formula of the compound formed by combination of C and G.

181

. Explain the periodicity of following properties of elements:

(i) Atomic radius

(ii) Ionisation enthalpy

Ans. **(i) Atomic radius:** In a period, atomic radius generally decreases from left to right. In a period there is a gradual increase in the nuclear charge. Since valence electrons are added in the same shell, they are more and more strongly attracted towards nucleus. This gradually decreases atomic radii. Atomic radii increase in a group from top to bottom. As we go down a group the number of shells increases and valence electrons are present in higher shell and the distance of valence electrons from nucleus increases. Both the factors decrease the force of attraction between nucleus and valence electron. Therefore, atomic size increases on moving down a group.

(ii) Ionisation enthalpy: Ionisation energy decreases in a group from top to bottom. This is due to the fact that the force of attraction between valence electrons and nucleus decreases in a group from top to bottom. Thus, less energy is required to remove electron from atom. On the either hand, the force of attraction between valence electron and nucleus increases in a period from left to right. As a consequence of this, the ionisation energy increases in a period from left to right.

(iii) Electronegativity: Electronegativity is relative tendency of a bonded atom to attract the bond-electrons towards itself. Electronegativity decreases in group from top to bottom. In a period, electronegativity increases from left to right because atomic size decreases.

Differentiate Between

182

. Compare and contrast the arrangement of elements in Mendeleev's periodic Table and the Modern Periodic Table.

Ans.

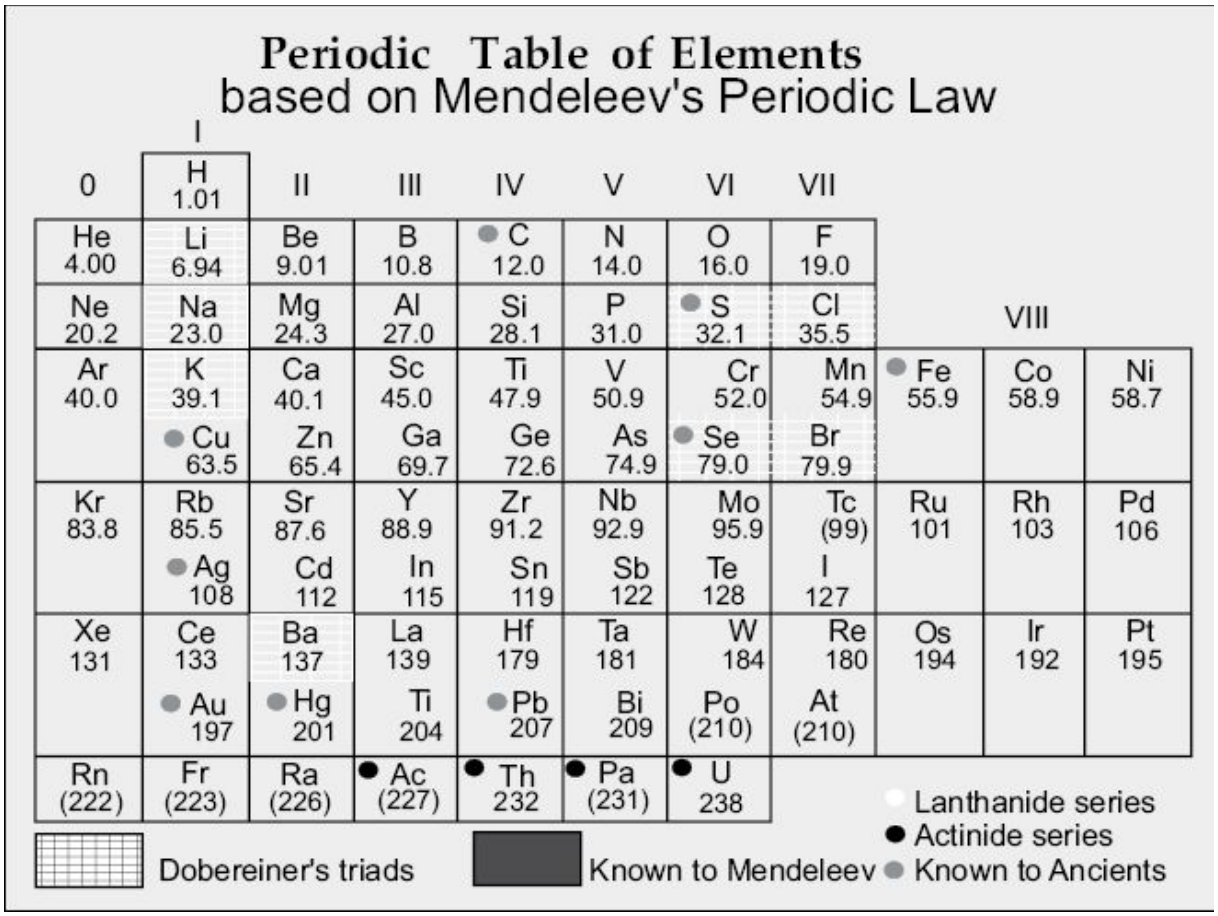
	Mendeleev's periodic table	**Modern periodic table**
(a)	Elements are arranged in the increasing order of their atomic masses.	Elements are arranged in the increasing order of their atomic numbers.
(b)	There are a total of 7 groups and 6 periods.	There are a total of 18 groups and 7 periods.
(c)	Elements having similar properties were placed directly under one	Elements having the same valence shell are present in the same period while elements having the same number of valence electrons are present in the same

	another.	group.
(d)	Position of isotopes is not clear.	Position of isotopes is clear.
(e)	Electronic configuration cannot be predicted from the position of element.	Electronic configuration can be predicted from the position of element.

Analysis and Evaluation Based Questions

183

. Mendeleev arranged 63 elements known at that time in the periodic table. According to Mendeleev “the properties of the elements are a periodic function of their atomic masses.” The table consists of eight vertical columns called ‘groups’ and horizontal rows called ‘periods’. Merits of Mendeleev’s Periodic Table: At some places the order of atomic weight was changed in order to justify the chemical and physical nature. Mendeleev left some gap for new elements which were not discovered at that time. One of the strengths of Mendeleev’s periodic table was that, when inert gases were discovered they could be placed in a new group without disturbing the existing order. Its main characteristics are that the elements are arranged in vertical rows called groups and horizontal rows called periods.



(i) What is the basis of arrangement of elements in Mendeleev's periodic table?

(ii) Why were there some gaps in Mendeleev's periodic table?

(iii) State whether the statement is true or false. Mendeleev's periodic table consists of eight vertical columns called 'groups' and horizontal rows called 'periods'.

(iv) X, Y and Z are the elements of a Dobereiner's triad. If the atomic mass of X is 7. and that of Z is 39. What should be the atomic mass of Y?

Ans. (i) In Mendeleev's periodic table, elements are arranged according to atomic masses.

(ii) There were some gaps in Mendeleev's periodic table for unknown elements.

(iii) Mendeleev's periodic table was divided into groups and columns. Therefore, the given statement is true.

(iv) According to Dobereiner's triad, the atomic mass of middle element is the average of other two elements. Therefore, (7 + 39) = 46/2 Y = 23.

184

. An element belongs to group 2 and element Q belongs to group 17 of long form of periodic table.

(i) How many valence electrons are there in P?

(ii) What is the valency of P?

(iii) How many valence electrons are there in Q?

(iv) What is the valency of Q?

(v) Write the chemical formula of P and Q.

Ans. (i) P has 2 valency electrons as valence electrons are equal to group number.

(ii) Valency of P is +2.

(iii) Q has 7 valence electrons.

(iv) Valency of Q is – 1. (valency = group number – 18 *i.e.,* 17 -18)

(v) The formula of the compound is PQ_2.

185

. By giving reasons state which amongst the given below elements

does not belong to the same period.

6P12, 7Q14, 8R16, 11S23

Ans. The electronic configuration of the elements is given as:

Element	Atomic No.	Electronic configuration
P	6	2, 4
Q	7	2, 5
R	8	2, 6
S	11	2, 8, 1

Element P, Q and R have only two electron shells and hence, they belong to the same period i.e., 2nd period.

186

. An element X has both K and L shell completely filled with electrons. The element has atomic number 10.

(i) Identify the element.

(ii) To which group does it belong?

(iii) Write its electronic configuration.

Ans. (i) The element is Neon.

(ii) It belongs to group 18 of periodic table.

(iii) Electronic configuration: 2,8.

187

. In each of the following pairs, choose the atom having the bigger size:

(i) Mg (At. No.12) or Cl (At. No. 17)

(ii) Na (At. No. 11) or K (At. No. 19)

Ans. (i) Mg since atomic size decreases from left to right in a period.

(ii) K since atomic size increases on going down a group.

188. Answer the following questions:

(i) An element X has mass number 40 and contains 21 neutrons in its atom. To which group of the periodic table does it belong?

(ii) The element X forms a compound X_2Y. Suggest an element that Y might be and give reasons for your choice.

Ans. (i) Group 1 (2, 8, 8, 1).

(ii) Oxygen (X is monovalent so Y has to be divalent to form the compound X_2Y)

189. The elements A, B and C belong to groups 1, 14 and 17 respectively of the periodic table.

(i) Which two elements will form a covalent compound?

(ii) Which two elements will form an ionic compound?

(iii) Noble gases do not react with other elements. Why?

(iv) Atom is electrically neutral but still it has a tendency to form an ion. Why?

Ans. (i) B and C, will form covalent compounds since both are non-metals.

(ii) A and C will form on ionic compound since A is an alkali metal and C is non-metal.

(iii) Elements react in order to complete its octet. Noble gases have complete octet. Therefore, they do not react with other elements.

(iv) The elements have valence electrons. Metals have less valence electrons and give out the valence electrons to form cations to complete the outermost shell and attain nearest noble gas configuration. Likewise, non metals attain electrons to form anions to complete the outermost shell and attain nearest noble gas configuration.

190

. The atomic numbers of the three elements X, Y and Z are 2, 6 and 10 respectively. Which two elements belong to the same group ? Which two elements belong to the same period ? Give reasons for your choice.

Ans. X (2) and Z (2, 8). Both X and Z have zero valency hence they belong to same group: noble gases. Y and Z. Y: 2, 4 and Z: 2, 8 so, both of them belong to second period with two shells filled.

Creating Based Questions

191

. Write the contrasting points present in modern periodic table, against the following given points of Mendeleev's table :

(i) Elements arranged according to atomic mass.

(ii) It has 8 groups and 6 periods.

Ans. The contrast points can be written as :

(i) In modern periodic table the elements are arranged

according to atomic number.

(ii) Modern periodic table has 18 groups and 7 periods.

192. Study the chart carefully and answer the following questions from Q 192 (i) to 192 (v).

GROUP → PERIOD ↓	1	2	3-12	13	14	15	16	17	18
2	A					B			C
3				D	E				F

(i) Which element present in the chart has the same number of electrons as K^+ and Cl^- ?

(a) C

(b) D

(c) E

(d) F

(ii) Which formula is correct for oxide of D?

(a) DO

(b) D_2O

(c) D_2O_3

(d) D_2O_5

(iii) Most metallic character is shown by which of the following:

(a) D

(b) E

(c) F

(d) B

(iv) Chloride of element E has the formula

(a) ECl_5

(b) ECl_4

(c) ECl_2

(d) ECl_3

(v) Character of metalloid is shown by which of the following?

(a) E

(b) A

(c) B

(d) C

Ans. (i) (d) F

(ii) (c) D $_2O_3$

(iii) (a) D

(iv) (b) ECl_4

(v) (a) E

193

. Read the following information the and answer the following questions from Q 193 (i) to 193 (v).

The following table shows the position of the elements A, B, C, D,

E, F, G, H, I, J, K, L, M, N in the period table.

Groups→ Periods ↓	1	2	3-12	13	14	15	16	17	18
2		A		B		C		D	E
3	F			G	H			I	
4	J	K				L	M		N

With reference to the table, answer the following:

(i) Which elements have complete outer electronic configuration?

(a) F and J

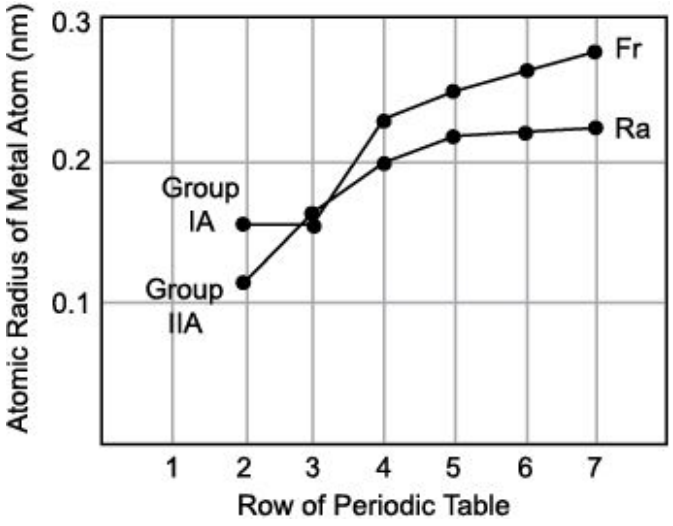
(b) D and E

(c) E and N

(d) M and N

(ii) Atomic size refers to the radius of an atom. The atomic size may be visualised as the distance between the centre of the nucleus and the outermost shell of an isolated atom.

Study the given graph which represents the trend of atomic size with respect to the periodic table.



Which of the following is the correct order for atomic size?

(a) A > B > C > D > E

(b) F < G < H < I

(c) J > K > L < M > N

(d) E < F < G < H < I

(iii) Which of the following states Modern Periodic Law?

(a) Properties of elements are the periodic function of their atomic number

(b) Properties of elements are the periodic function of their atomic size

(c) Properties of elements are the group function of their atomic number

(d) Properties of elements are the periodic function of their valency

(iv) Which of the following reason correctly justifies that “bromine has smaller atomic radius than potassium”?

(a) Br and K are in the same group. Atomic size increases down the group.

(b) Br and K are in the same period. Atomic size increases across the period due to increase in number of shells.

(c) Br and K are in the same group. Atomic size decreases down the group.

(d) Br and K are in the same period. Atomic size decreases across the period from left to right.

(v) Identify the correct elements from the table.

(a) B- boron, C- Neon, M- oxygen

(b) G-aluminium, I- Chlorine, K-calcium

(c) F- sodium, K- caesium, L- Lithium

(d) B- boron, H- carbon, L- Nitrogen

Ans. (i) (c) E and N

(ii) (a) A > B > C > D > E

(iii) (a) Properties of elements are the periodic function of their atomic number.

(iv) (d) Br and K are in the same period. Atomic size decreases across the period from left to right.

(v) (b) G-aluminium, I- Chlorine, K-calcium

194

. Consider the following elements, A, B, C and D in the given periodic table:

Group 16	Group 1	Group 2
----	----	----
----	B	D
A	----	----
----	C	----

(i) Which element is the most electronegative element?

(ii) Which element is the most unreactive ?

(iii) Which element forms acidic oxides ?

(iv) Which element has 6 electrons in outer orbital ?

Ans. (i) Element B would be the most electronegative element.

(ii) Element D would be the most unreactive element.

(iii) Element B and C forms acidic oxides.

(iv) Element A has 6 electrons in outer orbital.

195

. Question number 194(i)-194(iv) are based on table given below. Study the table and answer the following questions.

Atomic number	Element	Electronic configuration
1	Hydrogen	1
8	Oxygen	2, 6
6	Carbon	2, 4
9	Flourine	2, 7

(i) What is valency of oxygen ?

(ii) Give the chemical formula formed by hydrogen and oxygen.

(iii) What is the electron dot structure of above formed compound in (ii) part ?

(iv) What is the chemical formula for element H, F used for bond formation ?

(a) H_2F

(b) HF

(c) HF_2

(d) HF_3

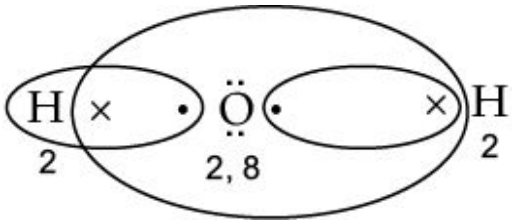
Ans. (i) Valency of oxygen is 2.

(ii) $2H + O \rightarrow H_2O$

1 2, 6

The chemical formula formed is H_2O.

(iii)



(iv) (b) HF.

196

. The position of eight elements in the modern periodic table is given below with atomic numbers.

Period Number	Elements	
2	Li (3)	Be (4)
3	Na (11)	Mg (12)
4	K (19)	Ca (20)
5	Rb (37)	Sr (38)

Answer the following question with reference to the above table.

(i) Write the electron configuration of Calcium (Ca).

(ii) Predict the number of valence electrons in Strontium (Sr).

(iii) What is the number of shells in Rubidium (Rb)?

(iv) Predict whether K is a metal or a non-metal?

Ans. (i) Electronic configuration of Calcium is 2, 8, 8, 2.

(ii) The number of valence electrons in Strontium (Sr) is 2.

(iii) The number of shells in Rubidium (Rb) is 5.

(iv) Potassium (K) is a metal, which has one valence electron.

197

. Based on the table given below answer the following questions:

Period	Group 1	Group 2
1.	A (3)	E (4)
2.	B (11)	F (12)
3.	C (19)	G (20)
4.	D (37)	H (38)

(i) What is the electronic configuration of F?

(ii) What is the number of valence electrons in the atom of F?

(iii) Write the size of the atoms of E, F, G and H in decreasing order.

(iv) Out of B, E and F which one has the biggest atomic size?

Ans. (i) 'F' has electronic configuration 2, 8, 2.

(ii) 'F' has two valence electrons.

(iii) H > G > F> E is decreasing order of size of atoms.

(iv) 'B' is having biggest atomic size among B, E and F.

198

.

Period	**Group 1**	**Group 2**
1.	A (3)	E (4)
2.	B (11)	F (12)
3.	C (19)	G (20)
4.	D (37)	H (38)

(i) What is the electronic configuration of F?

(ii) What is the number of valence electrons in the atom of F?

(iii) Write the size of the atoms of E, F, G and H in decreasing order.

(iv) Out of B, E and F which one has the biggest atomic size?

Ans. (i) 'F' has electronic configuration 2, 8, 2.

(ii) 'F' has two valence electrons.

(iii) H > G > F> E is decreasing order of size of atoms.

(iv) 'B' is having biggest atomic size among B, E and F.

199

. An element X forms a chloride with the formula XCl_2, which is a solid with a high melting point. Predict the most likely outer orbital electronic configuration of X and also name two more elements from same group of the Periodic Table to which elements X belongs.

Ans. The element X has 2 electrons in outer orbital as it forms a dichloride (XCl_2). So, this element belongs to group 2 of periodic table. Other elements of group 2 are magnesium (Mg) and beryllium (Be).

200

. Oxygen (atomic number 8) and sulphur (atomic number 16) belong to group 16 of the periodic table. Write the electronic configuration of the two elements. Which of them will be more electronegative ? Why ?

Ans. Oxygen has atomic number 8, electronic configuration will be

$\longrightarrow$ 2, 6

Sulphur has atomic number 16, electronic configuration will be $\longrightarrow$ 2, 8, 6

Oxygen with two shells will be more electronegative because it can easily gain electron due to its smaller size of atom, the nuclear charge attracts the electron easily to become negative ion.

201. Consider the following elements, A, B, C and D in the given periodic table :

Group 16	Group 17	Group 18
.....	.....	.....
.....	B	D
A	.....	.....
.....	C	.....

(i) Which element is the most electronegative element ?

(ii) Which element is the most unreactive ?

(iii) Which element forms acidic oxides ?

(iv) Which element has 6 electrons in outer orbital ?

Ans. (i) Element B would be the most electronegative element.

(ii) Element D would be the most unreactive element.

(iii) Element B and C forms acidic oxides.

(iv) Element A has 6 electrons in outer orbital.

Self- Assessment

202

. What is Newland's Law of octaves?

203

. How isotopes of all the elements posed a challenge to Mendleev's periodic table?

204

. What is Newland's law of Octaves? Explain with an example.

205

. What name is given to the horizontal rows in a periodic table?

206

. Why does silicon is classified as metalloid?

207

. What are isotopes?

208

. What is Modern periodic Law?

209

. The valency of group 13 elements is:

(a) 1

(b) 2

(c) 3

(d) 4

210. Which of the following is a metalloid?

(a) Carbon

(b) Silicon

(c) Tin

(d) Lead

211. Which of the following statements is not correct about the trends when going from left to right across the long form of periodic table?

(i) Elements become less metallic in nature.

(ii) Number of valence electrons increases.

(iii) Elements lose their electrons more easily.

(iv) The oxides become more acidic.

212

. An element with atomic number 14 is hard and forms an acidic oxide and a covalent halide. To which of the following categories does the element belong?

(a) (i) Metal

(a) (ii) Metalloid

(a) (iii) Non-metal

(a) (iv) Left hand side element

213

. Define the following terms:

(i) Periodicity

(ii) Electrongain enthalpy

(iii) Electronegativity

(iv) Ionisation energy

214

. A set of alkaline earth metals are:

(a) Ca, Sr, Ba

(b) Na, K, Ca

(c) Na, Li, K

(d) Na, K, Rb

215

. The element which is essentially an essential constituent of all organic compounds belong to:

(a) Group 1

(b) Group 14

(c) Group 15

(d) Group 16

216

. In the following set of elements, one element does not belong to the set. Select this element and state why it does not belong:

Oxygen, Nitrogen, Carbon, Chlorine, Fluorine

217

. Consider the following elements:

Na, Ca, Al, K, Mg, Li

(i) Which of these elements belong to the same period of the periodic table?

(ii) Which of these elements belong to the same group of the periodic table?

218

. An element belongs to the first group and third period of the periodic table. What conclusion can you draw from its position?

219

. How does electronic configuration of atoms change in a period with increase in atomic number?

220

. **Assertion:** The ionization energy of Mg is more than that of sodium.

Reason: The ionization energy decreases in a period from left to right.