KINETICS
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IIT-JEE | Medical | Foundations

Periodic Classification of Elements

OBJECTIVE TYPE QUESTIONS

Multiple Choice Questions (MCQs)

1. Cl, Br and I is a Döberiener's triad. If the atomic masses of Cl and I are 35.5 and 127 respectively then the atomic mass of Br is
(a) 162.5 (b) 91.5
(c) 81.25 (d) 45.625

2. According to Mendeléev's periodic law, the properties of elements are a periodic function of their
(a) atomic numbers (b) atomic masses
(c) atomic volumes (d) atomic sizes.

3. The elements with atomic number 3 to 10 belong to the second period. Identify the most electropositive and the most electronegative element respectively.
(a) F, Li (b) Li, F
(c) Li, Ne (d) Ne, Li

4. According to modern periodic law, the properties of elements are a periodic function of their
(a) atomic masses (b) atomic volumes
(c) atomic numbers (d) densities.

5. Arrange the following atoms in the order of increasing atomic radius : F, Cl, C, O
(a) F, Cl, O, C (b) C, O, F, Cl
(c) O, C, F, Cl (d) F, O, C, Cl

6. Li, Na and K is a Dobereiner triad. The atomic masses of Li and K are 7 and 39 respectively. What is the expected mass of Na?
(a) 7 (b) 18
(c) 23 (d) 39

7. Element X has a proton number equal to 17. Which of the following statements about X is not correct?
(a) X is a member of Group VII.
(b) X has 7 electrons in the outermost electron shell.
(c) X has three occupied electron shells.
(d) X gains one electron to form X^+.

8. Which of the following statements is correct about elements ${}^{19}_{9}A$ and ${}^{37}_{17}B$?
(a) A is more electronegative than B.
(b) A forms a positive ion and B forms a negative ion.
(c) A and B have the same number of neutrons.
(d) A and B have the same number of electrons.

9. Mendeleev peridicted the existence of two elements and named them as *eka*-silicon and *eka*-aluminium. Identify the element which took their position at later stage.
(a) Si and Ge (b) Si and Ga
(c) Ge and Ga (d) Si and Al

10. Which of the following statements is not a correct statement about the trends when going from left to right across the periods of the periodic table?
(a) The elements become less metallic in nature.
(b) The number of valence electrons increases.
(c) The atoms lose their electrons more easily.
(d) The oxides become more acidic.

11. The correct order of increasing acidic nature of SO_2, SiO_2, P_2O_3 and Al_2O_3 is
(a) $SO_2 < P_2O_3 < SiO_2 < Al_2O_3$
(b) $Al_2O_3 < SiO_2 < SO_2 < P_2O_3$
(c) $Al_2O_3 < SiO_2 < P_2O_3 < SO_2$
(d) $SiO_2 < SO_2 < Al_2O_3 < P_2O_3$

12. It was found that the law of octaves was applicable only upto
(a) chlorine (b) potassium
(c) calcium (d) argon.

13. Electronic configurations for four elements A, B, C and D are given below :
A : 2,1 B : 2,8 C : 2,8,1 D : 2,8,8
Identify the correct statements.
(i) Elements A and B belong to the second period.
(ii) Elements A and C belong to the same group.
(iii) Element C is more reactive than element A.

(iv) Elements *C* and *D* belong to the third period
(a) (i) and (iii)
(b) (i), (ii) and (iii)
(c) (ii) and (iv)
(d) All the statements are correct.

14. Which of the following properties does not match elements of halogen family?
(a) They have seven electrons in their valence shell.
(b) They are diatomic in their molecular form.
(c) They are highly reactive.
(d) They are metallic in nature.

15. "The properties of the elements are periodic function of their atomic numbers". The statement was given by
(a) N. Bohr (b) J. W. Dobereiner
(c) D. I. Mendeleev (d) H. G. J. Moseley.

16. Which of the following orders of atomic radii is correctly represented?
(a) B > C > N (b) B > O > C
(c) C > B > N (d) C > B > O

17. Which statement about the elements in periodic table is correct?
(a) The elements are arranged in order of increasing atomic mass.
(b) The elements in a period have the same number of outer electrons.
(c) The elements in a group have the same number of occupied electron shells.
(d) The non-metallic characteristic of the elements decreases down a group and increases across a period.

18. The scientist who showed that the atomic number of an element is a more fundamental property than its atomic mass is
(a) Henry Moseley
(b) Johann Wolfgang Dobereiner
(c) John Newlands
(d) Dmitri Ivanovich Mendeleev.

19. Silicon is surrounded by the elements of atomic number 6, 13, 15 and 32 in the periodic table, then
(a) the properties of the elements of atomic numbers 6 and 32 will be similar to silicon
(b) the properties of the elements of atomic numbers 13 and 15 will be similar to silicon
(c) the properties of the elements of atomic numbers 6 and 13 will be similar to silicon
(d) the properties of elements of atomic numbers 15 and 32 will be similar to silicon.

20. An element *M* forms an ion M^-. The electronic configuration of this ion is (2,8). Which statement is true?
(a) *M* is in Group VI and Period 2.
(b) *M* is Group VII and Period 2.
(c) *M* is in Group VII and Period 3.
(d) *M* is in Group VI and Period 3.

21. It was assumed by Newlands that only
(a) 56 elements existed in nature
(b) 57 elements existed in nature
(c) 59 elements existed in nature
(d) 63 elements existed in nature.

22. The proton numbers of four elements are given below.

Element	*W*	*X*	*Y*	*Z*
Proton number	5	12	15	20

Which of the following pairs of elements belong to the same group of the periodic table?
(a) *W* and *X* (b) *W* and *Y*
(c) *X* and *Z* (d) *Y* and *Z*

23. When Mendeleev started his work, the number of known elements were
(a) 68 (b) 53
(c) 57 (d) 63

24. The positions of four elements *K, L, M* and *N* in the periodic table are shown below :

Group 13	Group 14	Group 15
K	–	–
–	*L*	–
Ga	*M*	*N*

Which of the following statements are correct?
(I) *K, L, M* and *N* are metalloids.
(II) *K* is a metal while *L, M* and *N* are non-metals.
(III) Among these four elements, *K* is the smallest in size.
(IV) *K* is a metal while *L* and *M* are metalloids and *N* is a non-metal.
(a) II and III (b) I and III
(c) III and IV (d) None of these

25. The number of elements in third period of the periodic table is
(a) 2 (b) 8
(c) 10 (d) 14

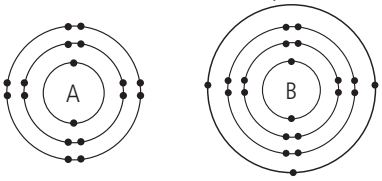
26. Study the given table carefully.

Groups → Periods ↓	1	2	3 to 12	13	14	15	16	17	18
2							*Q*		*R*
3		*P*	*S*			*T*			*U*

Identify *P, Q, R, T* and *U*.

	P	***Q***	***R***	***T***	***U***
(a)	Mg	O	Ne	P	Ar
(b)	O	Mg	Ar	P	Ne
(c)	Mg	O	Ar	P	Ne
(d)	O	Mg	Ne	P	Ar

27. The given diagram shows the electron arrangement of two elements, *A* and *B*.



Which of the following statements is correct about the two elements?

(i) *A* is a Period 3 element.

(ii) *B* is a Group III element.

(iii) Both *A* and *B* have strong metallic characteristics.

(iv) Both *A* and *B* from positive ions.

(a) (ii) only (b) (i) and (ii) only

(c) (iii) and (iv) only (d) (i), (ii), (iii) and (iv)

28. The 'law of octaves' was enunciated by

(a) Lother Meyer (b) Mendeleev

(c) Dobereiner (d) Newlands.

29. Element *X* is in period 3 and group III of the periodic table. The electronic configuration of *X* is

(a) 2, 1 (b) 2, 3

(c) 2, 8, 3 (d) 2, 8, 5

30. Döberiener's system of classification into triads was not found to be useful as he could identify only

(a) two triads (b) three triads

(c) four triads (d) five triads.

31. Identify the correct statements.

(i) In Mendeleev's periodic table, elements were arranged in the order of their increasing atomic masses and it was also observed that there occurs a periodic recurrence of elements with similar physical and chemical properties.

(ii) In 1913, Dmitri Ivnovich Mendeleev showed that the atomic number of an element is more fundamental property than its atomic mass.

(iii) He was the most important contributor to the early development of a Periodic Table of elements wherein the elements were arranged on the basis of their fundamental property, the atomic mass and also on the similarity of chemical properties.

(iv) Among chemical properties, Mendeléev concentrated on the compounds formed by elements with oxygen and hydrogen.

(v) Mendeléev formulated a Periodic Law, which states that 'the properties of elements are the periodic function of their atomic numbers'.

(vi) Mendeléev's Periodic Table contains vertical columns called 'groups' and horizontal rows called periods.

(a) (ii) and (v)

(b) (i), (iii), (iv), (v) and (vi)

(c) (i), (iii), (iv) and (vi)

(d) All the statements are correct.

32. Two elements *A* and *B* belong to group 1 and 2 respectively. Identify the correct statements.

(i) Valency of *A* is one while that of *B* is two.

(ii) Oxide of *A* has formula *AO* and that of *B* is B_2O

(iii) Element *A* is more metallic as compared to element *B*.

(iv) Element *A* is smaller than *B* in size.

(a) (ii) and (iv) (b) (i) and (iv)

(c) (i) and (iii) (d) (ii) and (iv)

33. Considering the elements B, Al, Mg and K, the correct order of their metallic character is

(a) B > Al > Mg > K (b) Al > Mg > B > K

(c) Mg > Al > K > B (d) K > Mg > Al > B

34. State True (T) or False (F) for the given statements.

(i) John Newlands, arranged the known elements in the order of increasing atomic numbers.

(ii) He started with the element having the lowest atomic mass (hydrogen) and ended at thorium which was the 56th element.

(iii) He found that every ninth element had properties similar to that of the first.

(iv) The properties of lithium and sodium were found to be the same.

(v) Beryllium and magnesium resemble each other.

(vi) Newlands' law of octaves worked well with higher elements only.

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
(a)	F	T	F	T	T	T
(b)	T	F	T	F	T	T
(c)	T	F	F	F	T	T
(d)	F	T	F	T	T	F

35. An element X belongs to group 14^{th} and 2^{nd} period of the periodic table. Its atomic number will be

(a) 6 (b) 14

(c) 7 (d) 15

36. Which of the following pairs of atomic numbers represents elements belonging to the same group?

(a) 11 and 20 (b) 12 and 30

(c) 13 and 31 (d) 14 and 33

37. Moving down a group of the periodic table,

(a) the number of valence electrons increases

(b) the metallic characteristics of the elements increases

(c) the ability of the elements to form positive ions decreases

(d) the atomic number of the elements decreases.

38. The number of elements in the 5th period of periodic table are

(a) 8 (b) 18

(c) 10 (d) 32

39. The basic character of MgO, SrO, K_2O and NiO increases in the order

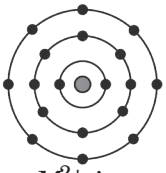
(a) $K_2O < SrO < MgO < NiO$

(b) $NiO < MgO < SrO < K_2O$

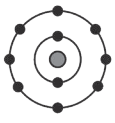
(c) $MgO < NiO < SrO < K_2O$

(d) $K_2O < MgO < NiO < SrO$

40. Element M forms an ion, M^{2+} and element X forms an ion, X^{2-}. The electronic arrangements of these ions are shown as :



M^{2+} ion



X^{2-} ion

Which of the following statements about the elements M and X is/are incorrect?

I. M is in group 2 and period 4 of the periodic table.

II. M is a non-metal and X is a metal.

III. X is in group 15 and period 2 of the periodic table.

IV. M and X form MX type compound.

V. On moving from M towards X in the periodic table, electronegativity decreases.

(a) II, III and V (b) I and IV

(c) Only II (d) II and III

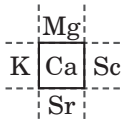
41. In the Modern Periodic Table, calcium (Z = 20) is surrounded by the elements with atomic numbers 12, 19, 21 and 38. Which of the following will have physical and chemical properties resembling calcium?

(a) 12, 38

(b) 12, 19, 38

(c) 19, 38

(d) 12, 19



42. X, Y and Z are the three elements, each one belongs to any one of the groups IA, IIIA and VA. The oxide of X is amphoteric, the oxide of Y is highly acidic, and the oxide of Z is highly basic. Identify the groups to which these elements X, Y and Z belong?

	X	*Y*	*Z*
(a)	VA	IA	IIIA
(b)	IA	VA	IIIA
(c)	IIIA	IA	VA
(d)	IIIA	VA	IA

43. Moving across a period of the Periodic Table,

(a) the elements become more electronegative

(b) the metallic character of the elements increases.

(c) the ability of the elements to lose electrons increases.

(d) the elements form ions with increasing negative charge.

44. The proton number of four elements are given below :

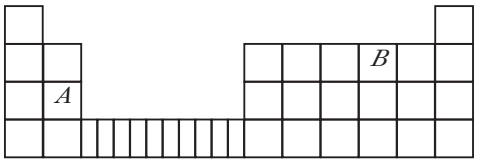
Element	W	X	Y	Z
Proton number	8	13	15	19

Which of the following pairs of elements belong to the same period of the periodic table?

(a) W and X (b) W and Y

(c) X and Y (d) Y and Z

45. The position of elements *A* and *B* are shown in the periodic table below:



Which of the following statements is correct about the two elements?

(a) *A* and *B* have the same electron structure.
(b) *A* and *B* have the same number of filled electron shells.
(c) *A* is a metal and *B* is a non-metal.
(d) *A* is in period 2 and *B* is in group III.

46. Which element has the largest size in the second period?

(a) N (b) F
(c) Li (d) Be

47. From the given set of metals and non-metals identify the non-metals. S, Mg, Al, P, N, Na, K.

(a) S, P, K (b) Mg, Al, Na
(c) S, P, N (d) S, Al, K

48. Which of the following combination of elements belong to the same group?

(a) N, P, As (b) Li, Be, Al
(c) Na, Mg, Al (d) O, S, Cl

49. From top to bottom in a group of the periodic table the electropositive character of the element

(a) increases
(b) decreases
(c) remains unchanged
(d) changes irregularly.

50. In the third period of the periodic table, the element having smallest size is

(a) Na (b) Al
(c) Cl (d) Si

51. Which is true about electronegativity order?

(a) P > Si (b) C > N
(c) Br > Cl (d) Sr > Ca

52. In the given metals one with the smallest size is

(a) Rb (b) Cs
(c) K (d) Na

53. Which of the following is the most non-metallic element?

(a) Br (b) Cl
(c) P (d) S

54. Which of the following elements is a metalloid?

(a) Pb (b) Sb
(c) Bi (d) Zn

55. Identify the pair of atomic numbers representing *s*-block elements.

(a) 7, 15 (b) 9, 17
(c) 2, 10 (d) 11, 12

56. Which of the given pairs of atomic numbers represents elements in the same group?

(a) 11, 19 (b) 6, 12
(c) 4, 16 (d) 8, 17

57. The effective nuclear charge acting on the valence shell electrons

(a) increases across a period
(b) decreases down the group
(c) both (a) and (b)
(d) none of the above.

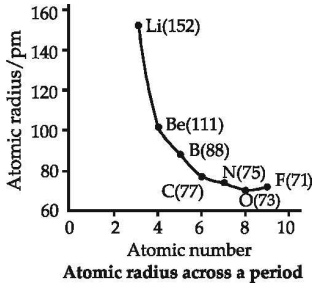
58. Which of the following will have equal number of electrons?

(a) Cl^- and Br^- (b) Na^+ and Mg^{2+}
(c) Ar and Ne (d) Mg^{2+} and Ca^{2+}

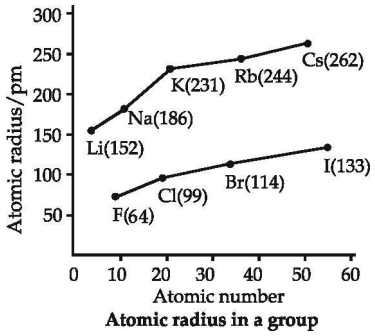
Case Based MCQs

Case I : Read the passage given below and answer the following questions from 59 to 63.

The distance between the centre of the nucleus and the outermost shell of electrons is known as atomic radius. On moving from left to right along a period, atomic radii decrease because effective nuclear charge increases. For example, the atomic size decreases regularly from Li to F in the second period and from Na to Cl in the third period. It may, however, be noted that in any period, the noble gas has the largest size. On moving down in a group, atomic radii increase.



Atomic radius across a period



Atomic radius in a group

59. Which of the following has the maximum atomic radius?
(a) Al (b) Si
(c) P (d) Mg

60. The element with the smallest size in group 13 is
(a) gallium (b) thallium
(c) aluminium (d) boron.

61. The atomic radius decreases as we move across a period because
(a) atomic mass increases
(b) atomic number decreases
(c) effective nuclear charge increases
(d) electrons are removed.

62. In the third period of the periodic table, the element having smallest size is
(a) Na (b) Ar
(c) Cl (d) Si

63. Among O, C, F, Cl, Br, the correct order of increasing atomic radii 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

Case II : Read the passage given below and answer the following questions from 64 to 67.

In 1913, Henry Moseley showed that the atomic number of an element is the more fundamental property than its atomic mass. Accordingly, Mendeleev's periodic law was modified and atomic number was adopted as the basis of modern periodic table.
In this periodic table, the elements are arranged in increasing order of their atomic numbers.
There are 18 vertical columns in the periodic table which constitute 18 groups or families. The groups are numbered as 1, 2, 3, ... upto 18. All the members of a particular group have similar outer shell electronic configuration. There are seven horizontal rows of the periodic table which are known as periods.

64. All the elements in a period in the periodic table have the same
(a) atomic number
(b) electronic configuration
(c) atomic weight
(d) valence shell.

65. Which of the following combinations of elements belong to the same group?
(a) N, P, S (b) Li, Na, K
(c) Na, Mg, Al (d) O, S, Cl

66. The atoms of elements belonging to the same group of periodic table have same number of
(a) protons
(b) electrons
(c) neutrons
(d) electrons in outermost shell.

67. In the periodic table, the element with atomic number 16 will be placed in the group
(a) fourteen (b) sixteen
(c) thirteen (d) fifteen.

Case III : Read the passage given below and answer the following questions from 68 to 72.

Maximum number of electrons that can be accommodated in a shell is given by the formula : $2n^2$, where n is the number of the outermost from the nucleus.
For example, K shell – $2 \times (1)^2 \Rightarrow 2$, hence, K-shell can accommodate maximum 2 electrons. L shell – $2 \times (2)^2 \Rightarrow 8$, hence, L-shell can accommodate maximum 8 electrons.
In the modern periodic table, elements are placed according to their electronic configuration. The elements present in any group have the same number of valence electrons. The elements present in any period contain the same number of shells. The first period of the modern periodic table corresponds to the filling of electrons in the first energy shell, *i.e.*, K-shell, first period has two elements. The second period of the periodic table corresponds to the filling of electrons in the second energy shell, *i.e.*, L-shell, second period contains eight elements. The third, fourth, fifth, sixth and seventh periods have 8, 18, 18, 32 and 32 elements respectively.

68. Electronic configuration of an element 'X' is 2, 1. The number of elements present in the period to which 'X' belongs is
(a) 8 (b) 32
(c) 18 (d) 2

69. Among the given elements *A, B, C, D* and *E* with atomic numbers 2, 3, 7, 10 and 30 respectively, which of these belong to the same period?
(a) *A*, *B*, *C* (b) *B*, *C*, *D*
(c) *A*, *D*, *E* (d) *B*, *D*, *E*

70. The elements *A*, *B*, *C* and *D* have atomic numbers 4, 12, 17 and 19 respectively. Which pair of elements belong to the same period?
(a) *B* and *C* (b) *A* and *B*
(c) *A* and *D* (d) *C* and *D*

71. Which of the following have the same number of electrons in outermost shell?
(a) Elements with atomic numbers 3, 11, 19
(b) Elements with atomic numbers 14, 15, 16
(c) Elements with atomic numbers 12, 20, 28
(d) Elements with atomic numbers 10, 18, 26

72. Which of the following elements has two shells and both are completely filled?
(a) Helium (b) Neon
(c) Calcium (d) Fluorine

Case IV : Read the passage given below and answer the following questions from 73 to 77.

Mendeleev arranged the 63 elements known at that time in order of their ascending atomic masses and prepared a periodic table. Mendeleev's periodic table contains vertical columns called 'groups' and horizontal rows called 'periods'. Elements with similar properties were placed in same groups.
The basis of Mendeleev's classification is his periodic law which states that :
(I) Atomic mass is the fundamental property of elements.
(II) The physical and chemical properties of elements are periodic function of their atomic masses.

73. Which of the following metals is not placed in eighth group of Mendeleev's periodic table?
(a) Fe (b) Na
(c) Co (d) Ni

74. In Mendeleev's periodic table, silver belongs to IB group. The group to which silver belongs in the modern periodic table is
(a) first (b) eleventh
(c) tenth (d) sixteenth.

75. 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

76. The properties of *eka*-aluminium predicted by Mendeleev were the same as properties of which element that was discovered later?
(a) Scandium (b) Germanium
(c) Gallium (d) Aluminium

77. Which of the following statements is not correct about Mendeleev's periodic table?
(a) In the Mendeleev's periodic table, some places were left vacant for new elements which were not discovered at that time.
(b) Group VIII like groups I-VII has been divided into two sub-groups A and B.
(c) The group of an element in the periodic table represents its valency.
(d) Li and C belong to same period in Mendeleev's periodic table.

Case V : Read the passage given below and answer the following questions from 78 to 82.

Study the following table in which positions of six elements *A*, *B*, *C*, *D*, *E* and *F* are shown as they are in the modern periodic table :

Group → / Period ↓	1	2	3-12	13	14	15	16	17	18
2	*A*					*B*			*C*
3				*D*	*E*				*F*

78. Which element in the given table has same number of electrons as in K^+ and Cl^-?
(a) *C* (b) *F*
(c) *E* (d) *D*

79. The formula of the oxide of element *D* will be
(a) *DO* (b) D_2O
(c) D_2O_3 (d) D_2O_5

80. Which of the following elements has most metallic character?
(a) *F* (b) *D*
(c) *E* (d) *B*

81. Element *E* forms a chloride with formula
(a) ECl_2 (b) ECl_3
(c) ECl_4 (d) ECl

82. Which of the following elements is a metalloid?
(a) *A* (b) *B*
(c) *C* (d) *E*

Assertion & Reasoning Based MCQs

For question numbers 83-95, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Both assertion and reason are true, and reason is correct explanation of the assertion.
(b) Both assertion and reason are true, but reason is not the correct explanation of the assertion.
(c) Assertion is true, but reason is false.
(d) Assertion is false, but reason is true.

83. Assertion : In Newlands' octaves, the properties of lithium and sodium were found to be same.

Reason : Sodium is the eighth element after lithium.

84. Assertion : Decreasing order of atomic radii is : Cl > F > O > S.

Reason : Atomic radius increases as the number of energy level increases and decreases as nuclear charge increases.

85. Assertion : Increasing order of metallic character is : P < Si < Be < Mg < Na

Reason : Metallic character increases along a period and decreases down a group.

86. Assertion : According to Mendeleev's periodic law, the properties of elements is the periodic function of their atomic numbers.

Reason : Mendeleev placed some elements with higher atomic mass before the elements with lower atomic mass.

87. Assertion : Elements in the same vertical column have similar properties.

Reason : Periodic properties of elements is a function of atomic number.

88. Assertion : Group18 is placed at the extreme right of the periodic table.

Reason : It is in accordance with their electronic configuration.

89. Assertion : Atomic radius in general decreases along a period.

Reason : In a period, effective nuclear charge decreases.

90. Assertion : Number of valence electrons decreases down the group.

Reason : Number of valence electrons increases when we move left to right in a period.

91. Assertion : In Dobereiner's triad, the three elements present have same gaps of atomic numbers.

Reason : Elements in a triad have similar properties.

92. Assertion : Alkali metals do not form dipositive ions.

Reason : After loss of one electron alkali metals achieve stable configuration of noble gas.

93. Assertion : Atomic size of As is more than that of P.

Reason : Atomic size decreases along a period.

94. Assertion : Down the group, atomic radius increases.

Reason : Electrons are added in new shell.

95. Assertion : Atomic size of potassium is greater than that of sodium.

Reason : As we go down the group, atomic radius increases.

SUBJECTIVE TYPE QUESTIONS

Very Short Answer Type Questions (VSA)

1. Write the atomic numbers of two elements '*X*' and '*Y*' having electronic configurations 2, 8, 2 and 2, 8, 6 respectively.

2. State the Modern periodic law of classification of elements.

3. N, O, F cannot be classified as Döbereiner's triad. Why?

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

5. Name two elements which show same kind of chemical reactivity as sodium.

6. What is the valency of silicon with atomic number 14?

7. Write any one difference in the electronic configurations of group 1 and group 2 elements.

8. Why does atomic size decrease as we move from left to right along a period in the periodic table?

9. Out of Li and K which will have stronger metallic character and why?

10. Write the number of horizontal rows in the Modern Periodic Table. What are these rows called?

Short Answer Type Questions (SA-I)

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

(a) group and period in the Modern Periodic Table.

(b) name and write its one physical property.

12. Choose from the following :
$_4$Be, $_9$F, $_{19}$K, $_{20}$Ca

(i) The element having one electron in the outermost shell.

(ii) Two elements of the same group.

13. What is meant by periodicity of properties of elements? Why are the properties of elements placed in the same group of the periodic table similar?

14. Rewrite the following statements after correction, if necessary

(i) Elements in the same period have equal valency.

(ii) The metallic character of elements in a period increases gradually on moving from left to right.

15. In the Modern Periodic Table, the element calcium (atomic number = 20) is surrounded by elements with atomic numbers 12, 19, 21 and 38. Which of these elements have physical and chemical properties resembling those of calcium and why?

16. Carbon (atomic number = 6) and silicon (atomic number = 14) are elements in the same group of the periodic table. Give the electronic arrangements of the carbon and silicon atoms and state the group in which these elements occur.

17. From the list of the elements given below, select three elements which form a Döbereiner's triad. F, Mg, Ca, Br, Li, Rb, Cl, Sr, I.

18. Three elements '*X*', '*Y*' and '*Z*' having atomic numbers 11, 7 and 6 respectively react with oxygen to form their oxides.

(a) Arrange these oxides in increasing order of their basic nature.

(b) Give reason for your answer.

19. Give reason – While going down in group 1 lithium is least electropositive while caesium is most electropositive.

20. Elements magnesium and oxygen respectively belong to group 2 and group 16 of the Modern Periodic Table. If the atomic numbers of magnesium and oxygen are 12 and 8 respectively, draw their electronic configuration and show the process of formation of their compound by transfer of electrons.

Short Answer Type Questions (SA-II)

21. Calcium is an element with atomic number 20. Stating reason answer each of the following questions :

(i) Is calcium a metal or non-metal?

(ii) Will its atomic radius be larger or smaller than that of potassium with atomic number 19?

(iii) Write the formula of its oxide.

22. Two elements *A* and *B* belong to the 3rd period of Modern Periodic Table and are in group 2 and 13 respectively. Compare their following characteristics in tabular form.

(a) Number of electrons in their atoms

(b) Size of their atoms
(c) Their tendencies to loose electrons
(d) The formula of their oxides
(e) Their metallic characters
(f) The formula of their chlorides

23. An element *X* has a total of 31 nucleons, out of which 16 are neutrons.
(a) Write the electronic configuration of an atom of element *X*.
(b) Determine the group and period number of element *X*.
(c) Give the formula of the ion formed by element *X*.

24. Chlorine is an element in period 3 of the Periodic Table. Bromine is found in period 4 of the Periodic Table. These two elements may be from different periods of the periodic table, but they have many similar properties.

Element	Molecular formula	Number of valence electrons
Chlorine		
Bromine		

(a) Complete the given table.
(b) Explain why the properties of chlorine and bromine closely resemble one another.
(c) Lithium is an element from Group I of the Periodic Table. Write the formula of the compound formed between lithium and
(i) chlorine
(ii) bromine.
(iii) What type of bonding is found in these compounds? Give reason.

25. Potassium, bromine and krypton are elements in period 4 of the Periodic Table.
(a) In which group of the periodic table can these elements be found?
(i) Potassium (ii) Bromine (iii) Krypton
(b) Bromine exists as a molecule. Draw a 'dot-and-cross' diagram to show the bonding in a molecule of bromine.
(c) Krypton does not react with either potassium or bromine. Explain the unreactive nature of krypton.

26. How many elements can be accommodated in each period of the periodic table? What are these periods called on the basis of number of elements?

27. The atomic number of an element '*X*' is 20.
(i) Determine the position of the element '*X*' in the periodic table.
(ii) Write the formula of the compound formed when '*X*' reacts/combines with another elements '*Y*' (atomic number 8).
(iii) What would be the nature (acidic or basic) of the compound formed? Justify your answer.

28. An element '*X*' is placed in the 3^{rd} group and 3^{rd} period of the Modern Periodic Table. Answer the following questions stating reason for your answer in each case :
(a) Write the electronic configuration of the element '*X*'.
(b) Write the formula of the compound formed when the element '*X*' reacts with another element '*Y*' of atomic number 17.
(c) Will the oxide of this element be acidic or basic ?

29. (a) Which is more basic (i) K_2O or Na_2O (ii) K_2O or CaO?
(b) Name a species that will be isoelectronic with each of the following atoms or ions :
(i) Ne (ii) Cl^-
(iii) Ca^{2+} (iv) Rb

30. Na, Mg and Al are the elements of the 3^{rd} periods of the Modern Periodic Table having group number 1, 2 and 13 respectively. Which one of these elements has the (a) highest valency, (b) largest atomic radius, and (c) maximum chemical reactivity? Justify your answer stating the reason for each.

31. The second period of the long form of periodic table contains the following elements :
Li Be B C N O F Ne
(a) Write down their electronic configurations.
(b) Do they contain the same number of valence electrons?
(c) Do they contain the same number of shells?

32. In the following table six elements *A*, *B*, *C*, *D*, *E* and *F* (here letters are not the usual symbols of the elements) of the Modern Periodic Table with atomic number 3 to 18 are given :

3 *A*	4	5	6	7	8 *E*	9	10 *G*
11 *B*	12 *C*	13	14 *D*	15	16	17 *F*	18

(a) Which of these
(i) a noble gas, (ii) a halogen?
(b) If *B* combines with *F*, what would be the formula of the compound formed?
(c) Write the electronic configurations of *C* and *E*.

33. The atomic number of an element is 16. Predict

(i) the number of valence electrons in its atom
(ii) its valency
(iii) its group number
(iv) whether it is a metal or a non-metal
(v) the nature of oxide formed by it
(vi) the formula of its chloride.

34. The positions of three elements *A*, *B* and *C* in the periodic table are indicated below :

Group 16	Group 17	
–	–	(First period)
–	*A*	(Second period)
–	–	(Third period)
B	*C*	(Fourth period)

(a) State whether element *C* would be a metal or a non-metal? Why?
(b) Which is the more active element *A* or *C*? Why?
(c) Which type of ion (cation or anion) will be formed by the element *C*? Why?

35. Element *Y* is given the chemical symbol ${}^{40}_{20}Y$.

(a) What is the electronic configuration of element *Y*?
(b) Determine the position of element *Y* in the periodic table.
(c) Explain how an atom of element *Y* can form an ion.

Long Answer Type Questions (LA)

36. (a) How does metallic character of elements in Modern Periodic Table vary on moving from

(i) left to right in a period
(ii) top to bottom in a group?

Explain with the help of an example in each case.

(b) If an element *X* is placed in group-14, what will be the nature of bond in its chloride? Write the chemical formula of the compound formed.
(c) An element *X* has mass number = 35 and number of neutrons = 18. What is the atomic number of *X*? Write electronic configuration of *X* and determine its valency.

37. (a) Consider three elements Na, Cl, Ar and answer the following.

(i) Discuss their metallic and non-metallic character.
(ii) Discuss the acid-base character of their oxides.

(b) The element with atomic number 14 is hard and forms acidic oxide and a covalent halide. To which of the categories does the element belong?

38. In the table given below, some of the elements of the periodic table with atomic numbers from 3 to 18 are given. These are represented by letters, which are not the usual symbols of the elements.

3	4	5	6	7	8	9	10
A					*E*		*G*
11	12	13	14	15	16	17	18
B	*C*		*D*			*F*	

(a) Which of these
(i) is an alkaline earth metal?
(ii) are alkali metals?
(iii) is an element with valency 4?
(b) If *A* combines with *F*, what would be the formula of the resulting compound?
(c) What is the electronic arrangement of *G*?

39. The table below shows the electronic configuration of six elements.

Element	Electronic configuration
P	2,1
Q	2,4
R	2,7
S	2,8,7
T	2,8,8
U	2,8,8,1

(a) Give the letter (s) of
(i) two elements that are in the same period of the periodic table.
(ii) two elements that are in the same group of the periodic table.
(iii) a noble gas.
(iv) group VII non-metals.

(v) element which forms positive ion.

(b) (i) Give the formula of the compound formed between elements P and S.

(ii) What type of bonding would you expect in the compound formed?

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

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

(c) State Modern periodic law.

ANSWERS

OBJECTIVE TYPE QUESTIONS

1. (c) : In a triad, the atomic mass of the central atom is near the average of the other two atoms.

Atomic mass of bromine $= \frac{35.5+127}{2} = 81.25$

2. (b) : According to Mendeleev's periodic law the properties of elements are the periodic function of their atomic masses.

3. (b) : The most electropositive element is Li and the most electronegative element is F in second period.

4. (c)

5. (d) : (Atomic radius increases down the group while it decreases from left to right in a period).

6. (c) : Atomic mass of sodium will be mean mass of the lithium and potassium.

Atomic mass of Na $= \frac{7+39}{2} = \frac{46}{2} = 23$

7. (d)

8. (a)

9. (c)

10. (c) : The atoms lose their electrons with difficulty due to the increasing effective nuclear charge.

11. (c)

12. (c)

13. (d) : Elements in a period have same number of shells. Thus elements *A* and *B* belong to the second period while *C* and *D* belong to the third period. Elements in a group have same number of valence electrons. Thus, *A* and *C* belong to the same group. Element *C* is more reactive than element *A* due to bigger size and weaker force of attraction between the nucleus and the valence electrons.

14. (d) : Halogens are electronegative elements hence, non-metallic in nature.

15. (d)

16. (a) : Atomic radius increases down the group while it decreases from left to right in a period.

17. (d)

18. (a)

19. (a) : Elements carbon, silicon and germanium having atomic numbers 6, 14 and 32 respectively belong to the same group so, they have same properties.

20. (b) : As M^- has electronic configuration 2, 8, hence, *M* has 2, 7 configuration which belongs to Fluorine (F). F lies in VII group and second period.

21. (a)

22. (c)

23. (d)

24. (b) :

Group 13	Group 14	Group 15
K (B)	–	–
–	*L* (Si)	–
Ga	*M* (Ge)	*N* (As)

B, Si, Ge and As are metalloids and among these B is the smallest in size.

25. (b)

26. (a)

27. (b)

28. (d) : Law of octaves was given by John Alexander Newlands.

29. (c)

30. (b)

31. (c)

32. (c) : Oxide of *A* has formula A_2O and that of *B* is *B*O as valency of *A* is one while that of *B* is two.
Element *B* is smaller than *A* in size as atomic size decreases along a period from left to right.

33. (d) : Metallic character increases down a group and decreases across a period. K is in group 1 and Mg in group 2. Hence, K is more metallic than Mg. B and Al are in third group but B is above Al hence, Al is more metallic than B. These facts give the following order of metallic character : K > Mg > Al > B.

34. (d) : John Newlands arranged the known elements in the order of increasing atomic masses.

He found that every eighth element had properties similar to that of the first. Newlands law of octaves worked well with lighter elements only.

35. (a) : Group 14 shows that it has 4 electrons in outermost shell and 2nd period shows it has 2 shells hence the electronic configuration of the element will be 2, 4 or atomic number of the element is 6 (carbon).

36. (c) : Atomic number = 13 (Al) 2, 8, 3
Atomic number = 31 (Ga) 2, 8, 18, 3
Both have same number of valence electrons, hence belong to same group.

37. (b)

38. (b)

39. (b) : Basic character of oxides increases with increase in electropositive character.

40. (a) : From the given electronic arrangements of ions,
M^{2+} ion : 2, 8, 8 X^{2-} ion : 2, 8

Thus, *M* : 2, 8, 8, 2 and *X* : 2, 6

So, *M* is Ca and *X* is O.

I. Ca is in group 2 and period 4 of the periodic table.
II. Ca is a metal and O is non-metal.
∴ Statement II is incorrect.
III. O is in group 16 and period 2 of the periodic table.
∴ Statement III is incorrect.
IV. Ca and O form CaO compound.
V. On moving from Ca towards O in the periodic table, electronegativity increases.
∴ Statement V is incorrect.

41. (a) : Because these elements belong to same group.

42. (d) : Oxides of metals are basic while the oxides of non-metals are acidic. As we move from left to right in a period, basic character of oxides decreases while the acidic character of oxides increases. Thus, element *X* belongs to IIIA, *Y* belongs to VA and *Z* belongs to IA.

43. (a)

44. (c)

45. (c)

46. (c) : Li is the first element of the second period. As the size decreases in the period from left to right, therefore, Li is the largest element in the period.

47. (c) : S, P, N are non-metals while Mg, Al, K and Na are metals.

48. (a) : N, P and As belongs to the same group.

49. (a) : As the size of the atom increases, electropositive character increases.

50. (c) : Atomic size decreases across the period. Cl has the smallest size.

51. (a) : Electronegativity increases from left to right in a period and decreases down the group.

52. (d) : Na is the second element in the group in the order of Li, Na, K, Rb, Cs.

53. (b)

54. (b)

55. (d)

56. (a) : Atomic number 11 : 2, 8, 1
Atomic number 19 : 2, 8, 8, 1

57. (c)

58. (b) : Na^+ and Mg^{2+} are isoelectronic (*i.e.* equal number of electrons) having 10 electrons each.

59. (d) : In general, the atomic radii decrease along a period and increase down a group.

Atom	$_{12}Mg$	$_{13}Al$	$_{14}Si$	$_{15}P$
Radius (pm)	160	143	111	106

Thus, Mg has maximum atomic radius.

60. (d) : Boron is the first element of group 13, hence it is smallest in size.

61. (c) : Effective nuclear charge increases along a period and due to addition of electrons in the same shell it causes the incoming electron to experience more force of attraction by the nucleus. Therefore, the size of the atom decreases.

62. (c) : Atomic size decreases across the period. Cl has smaller size than Ar. Argon has larger atomic size as compared to Cl due to the inert nature (it has completely filled outer shell).

63. (a) : Atomic size decreases from left to right in a period and increases from top to bottom in a group. Thus, the order is F < O < C < Cl < Br.

64. (d): All the elements in a period have the same valence shell.

65. (b) : Li, Na and K belong to the same group (group 11).

66. (d)

67. (b) : Element with atomic number 16 has electronic configuration 2, 8, 6. Hence, it will be placed in $10 + 6 = 16^{th}$ group.

68. (a) : '*X*' is Li. It belongs to second period. Number of elements present in a period = $2 \times n^2$, where *n* is the number of outermost shell from the nucleus. Thus, second period has 2×2^2 *i.e.*, 8 elements.

69. (b) : *B* is Li, *C* is N, *D* is Ne and they all belong to second period.

70. (a) : Electronic configurations of

		K	*L*	*M*	*N*	
A	:	2,	2			⇒ 2nd period
B	:	2,	8,	2		⇒ 3rd period
C	:	2,	8,	7		⇒ 3rd period
D	:	2,	8,	8,	1	⇒ 4th period

Thus, *B* and *C* belong to the same period.

71. (a) : Li, Na and K belong to group 1. Hence one electron is present in outer most shell.

72. (b) : $_{10}Ne : \overset{K}{2} \quad \overset{L}{8}$

Both *K* and *L* shells are completely filled.

73. (b)

74. (b)

75. (d)

76. (c) : Scandium – *eka*-boron
Gallium – *eka*-aluminium
Germanium – *eka*-silicon

77. (b) : Group VIII consists of three triads such as Fe, Co, Ni; Ru, Rh, Pd and Os, Ir, Pt arranged in 4^{th}, 5^{th} and 6^{th} periods respectively.

78. (b) : *F* is argon which has atomic number 18. It has 18 electrons. K^+ and Cl^- ions also have 18 electrons each.

79. (c) : *D* is aluminium which is an element of group 13. Valency of aluminium is 3. Hence, the formula of its oxide will be Al_2O_3.

80. (b) : *D* is aluminium, which has the most metallic character among the given elements.

81. (c) : Valency of *E* is 4. Hence, the formula of the chloride will be ECl_4.

82. (d) : *E* is silicon which is a metalloid.

83. (a)

84. (d) : Correct order is S > Cl > O > F.

85. (c) : The elements can be arranged in different periods and groups as follows :

Period/Group	1	2	13	14	15
2^{nd}	—	Be	—	—	—
3^{rd}	Na	Mg	—	Si	P

As metallic character decreases along a period and increases down a group, so Na is the most metallic element and P is the least metallic element and among Be and Mg, Mg is more metallic. Hence, increasing order of metallic character is : P < Si < Be < Mg < Na.

86. (d) : According to Mendeleev's periodic law, the properties of elements are the periodic function of their atomic masses.

87. (b) : Elements in the same vertical column (group) have similar properties due to similar outer electronic configurations.

88. (a)

89. (c) : Effective nuclear charge increases along a period.

90. (d) : Number of valence electrons remains same in a group.

91. (d) : In Dobereiner's triad, the atomic mass of the middle element was roughly the average of the atomic masses of other two elements.

92. (a)

93. (b) : Atomic size increases down a group.

94. (a) : New shells are added down the group, hence, atomic radius increases.

95. (a)

SUBJECTIVE TYPE QUESTIONS

1. Electronic configuration of *X* = 2, 8, 2

∴ Atomic number is 2 + 8 + 2 = 12

Similarly,

Electronic configuration of *Y* = 2, 8, 6

∴ Atomic number is 2 + 8 + 6 = 16

2. Modern periodic law states that the physical and chemical properties of elements are the periodic function of their atomic numbers.

3. Although the atomic mass of O (16 u) is approximately an average (16.5 u) of the atomic masses of N (14 u) and F (19 u), *i.e.*, (14 + 19)/2 = 16.5 but they cannot be regarded as a Döbereiner's triad because their properties are altogether different.

4. Germanium, Scandium.

5. Lithium (Li) and potassium (K) both belong to the same group as sodium (Na), So, they will show the same chemical properties as sodium.

6. Atomic number of silicon = 14

Electronic configuration = 2, 8, 4

As silicon (Si) contains four electrons in its outermost shell, its valency will be four.

7. Group 1 elements have one electron in their outermost shell while group 2 elements have two electrons in their outermost shell.

8. Effective nuclear charge increases as we move from left to right in the periodic table so atomic size decreases.

9. Potassium (K) will have stronger metallic character than lithium (Li) because as we move from top to bottom in a group, the size increases which increases the ease of liberation of electrons.

10. There are seven horizontal rows of elements in the Modern periodic table which are known as periods.

11. (a) The element belongs to group 14 and 3rd period of the Modern Periodic Table.

(b) The element is silicon. It is non-lustrous.

12. The electronic configurations of the given elements are :

$_4$Be = 2, 2

$_9$F = 2, 7

$_{19}$K = 2, 8, 8, 1

$_{20}$Ca = 2, 8, 8, 2

(i) Potassium (K) has one electron in its outermost shell.

(ii) Be and Ca have two electrons in their outermost shells hence, they belong to same group.

13. When elements are arranged in increasing order of their atomic numbers, elements with similar chemical properties are repeated at definite intervals. This is known as periodicity of properties of elements.

Elements placed in the same group of the periodic table have similar properties because they have same number of outermost electrons and hence, show same valency. Thus, they all will form similar type of compounds.

14. (i) Elements in the same group have equal valency

(ii) The metallic character of elements in a period decreases gradually on moving from left to right.

15. From the given data, the electronic configuration of different elements can be written as :

Calcium (20) = 2, 8, 8, 2

Element with atomic number 12 = 2, 8, 2

Element with atomic number 19 = 2, 8, 8, 1

Element with atomic number 21 = 2, 8, 8, 3

Element with atomic number 38 = 2, 8, 18, 8, 2

It can be easily seen that elements with atomic numbers 12 and 38 have two electrons in their outermost shell thus, they belong to same group as that of calcium. So, they will show the physical and chemical properties resembling those of calcium.

16. Electronic arrangement of carbon : 2, 4

Electronic arrangement of silicon : 2, 8, 4

Both C and Si belong to group 14.

17. Cl, Br and I form a Döbereiner's triad because atomic mass of Br is approximetly equal to the average of the atomic mass of Cl and I. Although Mg, Ca and Sr have similar properties but the atomic mass of Ca (40 u) is not an average of the atomic masses of Mg (24.31 u) and Sr (87.62 u). Therefore, these elements do not constitute a Döebereiner's triad.

18. $_{11}X$ = 2, 8, 1

$_7Y$ = 2, 5

$_6Z$ = 2, 4

(a) $Y < Z < X$

(b) X is metallic in nature hence, its oxide is basic in nature. While Y and Z are non-metals and their oxides are acidic in nature.

19. As we move down in a group, an electron shell is added after every change of period. For example, lithium has only two electron shells around the nucleus, but caesium has six electron shells around the nucleus. Thus, the positive charge within the nucleus holds the valence electrons of lithium more strongly than caesium. In other words, the valence electrons are held very loosely in case of caesium than lithium. Thus, caesium can lose its valence electrons more easily and hence, is more electropositive as compared to lithium, which is less electropositive. In other words, caesium is more metallic in character than lithium.

20. Atomic number of magnesium = 12

$\therefore$ Electronic configuration = 2, 8, 2

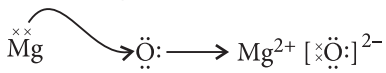
Valency of magnesium (Mg) = 2

Similarly, for oxygen (O) atomic number = 8

Electronic configuration = 2, 6

Valency of oxygen = 8 – 6 = 2

Formation of their compound will be as follows :



21. Given that, atomic number of calcium is 20.

So, its electronic configuration = 2, 8, 8, 2

(i) As, it has 2 valence electrons in the outermost shell which can be easily lost, so it is a metal.

(ii) Atomic number of K (potassium) is 19 so, it is placed before Ca(20) in the same period.

On moving from left to right in a period, the atomic radius decreases.

Hence, atomic radius of Ca(20) will be smaller than that of K(19).

(iii) The valency of calcium as well as oxygen is 2 thus, the formula of the oxide will be CaO.

22. Electronic configuration of A = 2, 8, 2 *i.e.*, Mg

Electronic configuration of B = 2, 8, 3 *i.e.*, Al

Characteristics		A	B
(a)	No. of electrons in their atoms	12	13
(b)	Size of their atoms	Bigger	Smaller
(c)	Tendency to loose electrons	More	Less
(d)	Formula of their oxides	AO	B_2O_3
(e)	Metallic character	More	Less
(f)	Formula of their chlorides	ACl_2	BCl_3

23. (a) Number of protons = 31 – 16 = 15

Number of electrons = 15

Electronic configuration = 2,8,5

(b) Element X has five valence electrons.
Hence, element X is from Group V.
Element X has three occupied shells.
Hence, element X is in Period 3.

(c) Formula of the ion formed by $X = X^{3-}$

24. (a)

Element	Molecular formula	Number of valence electrons
Chlorine	Cl_2	7
Bromine	Br_2	7

(b) Chlorine and bromine are in the same group *i.e.*, Group VII of the Periodic Table.

Chlorine and bromine have seven valence electrons each. Since both have the same number of valence electrons, they have similar chemical properties.

Both readily gain or share one electron to achieve a stable octet configuration.

(c) (i) LiCl (ii) LiBr

(iii) Ionic bonds

Lithium has one valence electron.

Lithium readily loses this valence electron to achieve a noble gas configuration similar to helium.

$Li \rightarrow Li^+ + e^-$

Chlorine and bromine have seven valence electrons each.

Chlorine readily gains one electron to achieve a noble gas configuration similar to argon.

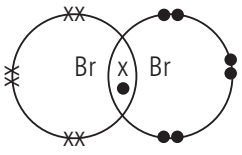
$Cl + e^- \rightarrow Cl^-$

Bromine readily gains one electron to achieve a noble gas configuration similar to krypton.

$Br + e^- \rightarrow Br^-$

Oppositely charged ions are attracted together by strong electrostatic forces of attraction to form ionic bonds.

25. (a) (i) Group I (ii) Group 17 (iii) Group 18

(b) 

(c) Krypton has a stable electronic configuration, with 8 electrons in its valence shell. Hence, it does not lose, gain or share electron(s) with another atom.

26. Based on the maximum capacity of a shell according to the formula $2n^2$ the number of elements in each period can be given as follows :

$n = 1$ (Maximum no. of elements 2). Thus, first period has 2 elements. It is called very short period.

$n = 2$ (Maximum no. of elements 8). Thus, 2nd period has 8 elements. It is called short period.

$n = 3$ (Maximum no. of elements 8). Thus, 3rd period has 8 elements. It is called short period.

$n = 4$ (Maximum no. of elements 18). Thus, 4th period has 18 elements. It is called long period.

$n = 5$ (Maximum no. of elements 18). Thus, 5th period has 18 elements. It is called long period.

$n = 6$ (Maximum no. of elements 32). Thus, 6th period has 32 elements. It is called very long period.

$n = 7$ (Maximum no. of elements 32). Thus, 7th period has 32 elements. It is also called very long period.

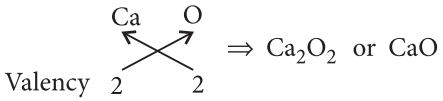
27. Atomic number of element X is 20 so, it is calcium (Ca).

Electronic configuration of Ca = 2, 8, 8, 2

(i) As calcium has two valence electrons in its outermost shell, so it belongs to group 2.

Moreover, it has four shells which indicates that it belongs to period number 4.

(ii) Calcium forms a basic oxide having the formula :



(iii) When calcium oxide is treated with water then calcium hydroxide (Basic oxide) is formed.

$$CaO + H_2O \longrightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_2}$$

28. X is placed in 3rd group (IIIA) and 3rd period of the Modern periodic table then it must be aluminium (Al).

As it belongs to 3rd group so it will have 3 electrons in its outermost shell.

Also it belongs to 3rd period, so it will have 3 shells.

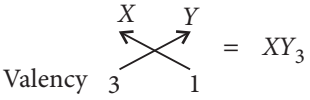
(a) Electronic configuration of $X = 2, 8, 3$

(b) Atomic number of Y is 17

Electronic configuration is 2, 8, 7

Valency of $Y = 8 - 7 = 1$

$\therefore$ Formula of compound formed when X reacts with Y is



(c) Al_2O_3 is amphoteric in nature *i.e.*, acidic as well as basic oxide.

29. (a) (i) K_2O

Potassium (K) and sodium (Na) belong to same group and the basic nature of oxides increases down the group. Therefore, K_2O is more basic than Na_2O.

(ii) K_2O

Potassium (K) and calcium (Ca) belong to the same period and basic nature of oxides decreases from left to right in a given period. Therefore, K_2O is more basic than CaO.

(b) (i) Na^+ (ii) S^{2-}

(iii) K^+ (iv) Sr^{2+}

30. Period number of Na, Mg and Al is 3

Group number of Na, Mg and Al are 1, 2 and 13 respectively.

(a) Aluminium (Al) will show highest valency of 3 as it belongs to group number 13 (valency = 13 – 10 = 3). Moreover, along the period from left to right valency first increases to maximum and then decreases.

(b) Sodium (Na) will have the largest atomic radius because as we move along the period from left to right, the atomic radius decreases.

(c) Sodium (Na) will have maximum chemical reactivity because as we move along the period from left to right, chemical reactivity decreases.

31. (a) Electronic configurations of the elements :

Li	Be	B	C	N	O	F	Ne
2, 1	2, 2	2, 3	2, 4	2, 5	2, 6	2, 7	2, 8

(b) These elements do not contain same number of valence electrons.

(c) They contain same number of shells (*K* and *L*).

32. (a) (i) Noble gas = *G*

(ii) Halogen = *F*

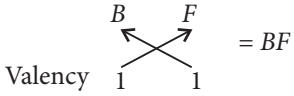
(b) *B*(11) = 2, 8, 1

F(17) = 2, 8, 7

Valency of *B* = 1

Valency of *F* = 8 – 7 = 1

Formula of the compound formed :



(c) Electronic configuration of *C*(12) = 2, 8, 2

Electronic configuration of *E*(8) = 2, 6

33. Atomic number of element (*E*) is 16

∴ Electronic configuration = 2, 8, 6

(i) Number of valence electrons in its atom = 6

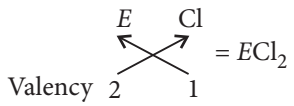
(ii) Valency = 8 – 6 = 2

(iii) As there are 6 valence electrons thus, its group number is 10 + 6 = 16

(iv) This element is a non-metal.

(v) The nature of oxide formed by this element is acidic.

(vi) The formula of the chloride of non-metal '*E*' will be



34. (a) *C* belongs to group 17 and hence, it will have 7 valence electrons in the outermost shell and has a tendency to gain electrons thus, it is a non-metal.

(b) Among *A* and *C*, *A* will be more reactive as the reactivity decreases down the group. So, *A* has more tendency to gain electrons.

(c) *C* will form negatively charged ion which is known as anion because group 17 elements have seven electrons in their outermost shell so, they have strong tendency to gain an electron to attain the noble gas configuration.

35. (a) Proton number = 20 = number of electrons

Electronic configuration = 2, 8, 8, 2

(b) Element *Y* is in group II and period 4 because it has 2 electrons in outermost shell and four occupied shells.

(c) It is easier for an atom of element *Y* to lose the two valence electrons to achieve an electronic configuration similar to argon (2, 8, 8). Hence, an atom of element *Y* will form a positive ion with charge equal to its group number, *i.e.* 2. The formula of the ion is Y^{2+}.

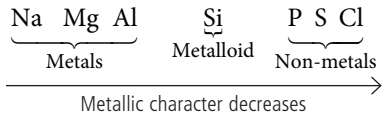
36. (a) In the Modern periodic table, there are 18 vertical columns called groups and 7 horizontal rows called periods.

Trend of metallic character :

(i) Along the period from left to right : Metallic character of elements decreases as we move from left to right in a period. Metallic character depends on the electropositive character (tendency to lose electrons) of the elements. As we go across the period from left to right, one electron is added to same shell at every stage which increases the effective nuclear charge and hence, valence electrons becomes more and more closer to the nucleus. Due to this, the tendency of atoms to lose valence electrons and form positive ions decreases. Hence, electropositive character decreases resulting in decrease of metallic character.

Example :

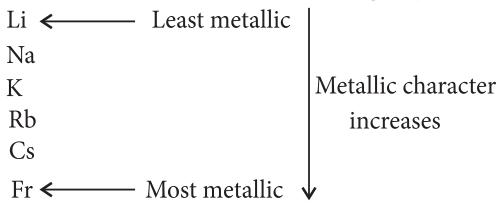
Variation of metallic character across the period :



(ii) Down the group : Metallic character of elements increases on moving down the group as the electropositive character increases down the group.

Example :

Variation of metallic character down the group :



(b) Since element '*X*' is placed in group 14, therefore, its valency is 14 – 10 = 4. Further, since it is difficult to either lose all the four valence electrons or gain four more electrons, therefore, it prefers to share these four electrons to acquire the stable electronic configuration of the nearest inert gas. Thus, the nature of the bond of chloride of element '*X*' is covalent and the chemical formula is XCl_4.

(c) Mass number of *X* = 35

Number of neutrons = 18

∴ Number of electrons = Number of protons

= (Mass number – Number of neutrons)

= 35 – 18 = 17

Number of electrons of *X* = Atomic number of *X* = 17

Thus, electronic configuration of *X* = 2, 8, 7

As it has 7 electrons in the outermost shell, so it belongs to 17^{th} group. Moreover the electrons are present in three shells, so it belongs to 3^{rd} period.

Valency of *X* = 8 – 7 = 1

37. (a) The electronic configurations of these elements are Na : 2, 8, 1 ; Cl : 2, 8, 7 and Ar : 2, 8, 8

(i) Sodium has only 1 electron in its valence shell which it can lose easily. Therefore it is a typical metal, chlorine has seven electrons in its outermost shell, it can easily accept one electron to get noble gas configuration, hence it is a typical non-metal. Ar is a noble gas.

(ii) The oxide of Na *i.e.* Na_2O dissolves in water to form NaOH which is a strong base. The oxide of chlorine *i.e.* Cl_2O_7 dissolves in water to give $HClO_4$ which is a strong acid.

Ar does not form any oxides.

$Na_2O + H_2O \rightarrow 2NaOH$

$Cl_2O_7 + H_2O \rightarrow 2HClO_4$

Hence, both metallic character of the elements and basic character of oxides decreases from left to right across a period.

(b) Non-metal, because it forms acidic oxide and covalent halide which are characteristics of non-metals.

38. (a) (i) *C* is an alkaline earth metal.

(ii) *A* and *B* are alkali metals.

(iii) *D* is an element with valency 4.

(b) If *A* combines with *F*, the formula of the resulting compound will be A^+F^-., *i.e.*, *AF.*

(c) The electronic arrangement of *G* is 2, 8.

39. (a) (i) *P*, *Q* and *R* (two electron shells) or *S* and *T* (three electron shells).

(ii) *P* and *U* (one valence electron) or *R* and *S* (seven valence electrons).

(iii) *T* (completely filled valence shell).

(iv) *R* or *S* (seven valence electrons).

(v) *P* or *U* (one valence electron).

(b) (i) *PS*

(ii) ionic bonding.

40. (a) Advantage of Dobereiner's triads : It recognised a relationship between properties of elements and their atomic weights.

Limitation of Dobereiner's triads : Dobereiner could identify only three triads. He was not able to prepare triads of all the known elements.

Advantages of Newland's law of octaves : This law provided a basis for the classification of elements into groups of elements having similar properties.

Limitation of Newlands' law of octaves : This law worked only for the lighter elements. All the element discovered at that time could not be classified into octaves.

Advantages of Mendeleev's periodic table : He classified all the 63 elements discovered at that time on the basis of similarities in their properties.

Limitation of Mendeleev's periodic table : Increasing order of atomic masses could not be maintained in all cases e.g., cobalt with higher atomic mass was placed before nickel.

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

(c) Modern periodic law states that the physical and chemical properties of elements are the periodic function of their atomic numbers.