5 PERIODIC CLASSIFICATION OF ELEMENTS

CONCEPTS

1. Early chemists classified elements as metals and non-metals on the basis of a set of physical and chemical properties.

2. **Dobereiner** classified elements on the basis of "Law of Triads" which states that "atomic mass of the middle element of a triad is almost the arithmetic mean of the other two elements".

3. A triad of elements is a group of three elements arranged in the order of increasing atomic masses, such that a group of such elements have similar physical and chemical properties.

4. Newland classified elements on the basis of "Law of Octaves" stated by him. According to this law :

'When the elements are arranged in the order of increasing atomic mass, the properties of the eighth element (starting from a given element) are a repetition of the properties of the first element.

5. Mendeleev stated the law for the classification of elements based on the increasing atomic masses of the elements and the similarity in their physical and chemical properties.

6. Mendeleev's Periodic Law states "the physical and chemical properties of elements are the periodic function of their atomic masses".

7. Mendeleev's Periodic Table is a tabular chart, representing systematic arrangement of elements in groups and periods in the order of their increasing atomic masses.

8. In the original Mendeleev's Periodic Table :

(i) There are eight vertical columns called groups. The groups from I to VII are subdivided into two groups, i.e., subgroup 'a' and subgroup 'b'. Thus, on the whole, there are 15 vertical columns.

(ii) The properties of elements in the same subgroup or main group are similar.

(iii) The horizontal rows in the Periodic Table are called periods.

(iv) In a period, the properties of elements gradually change from metallic to non-metallic character.

(v) There are a few gaps in the Periodic Table. These gaps were left knowingly as these elements were not known at that time.

9. **H.G.J. Moseley** modified Mendeleev's Periodic Law by changing atomic mass to atomic number, which is a more fundamental property of the element. It states : "the physical and chemical properties of elements are the periodic function of their atomic numbers".

10. In the modern version of Mendeleev's Periodic Table :

(i) There are nine vertical columns called **groups**.

(ii) These groups are numbered from 0 to 8 and not from 1 to 9.

(iii) Zero group consisting of rare gases was not known when Mendeleev prepared his original periodic table.

(iv) Groups from I to VII are divided into subgroups A and B.

(v) Horizontally, periodic table is divided into seven rows, running from left to right. These rows are called **periods**. There are 7 (seven) periods in all.

11. Modern Periodic Law :

It states : ''Properties of elements are the periodic function of their atomic numbers''.

12. Neils Bohr reconstructed the periodic table commonly called the ***Long form of the Periodic Table.***

13. Long form of the Periodic Table :

In the long form of the periodic table, the elements are arranged in groups and periods on the basis of the ***electronic configuration of elements.***

14. Characteristic of the Long form of the Periodic Table.

(a) Characteristics of the Groups :

1. There are 18 groups in the long form of the periodic table.
2. Group 1 is on the extreme left hand side and group 18 on the extreme right hand side of the periodic table.
3. Groups 1, 2 and 13 to 17 contain ***normal elements.*** The normal elements are sometimes called *representative elements.* In these elements, all the *inner shells are completely filled with electrons,* except the *outermost shell which is incomplete.*
4. The elements in group 18 are known as *noble gases* or *inert gases.* They have 8 *electrons* in their *valence shell,* except *helium*, which has *2* electrons in the valence shell.
5. The elements in group 3 to group 12 are called ***transition elements***. In transition elements, the *outermost shell as well as the shell next to the outermost shell* (penultimate shell) *are incomplete.*

(b) Characteristics of the Periods :

1. There are seven periods in all, such that each period has consecutive (or continuous) atomic numbers.
2. The number of elements in a period correspond to the maximum number of electrons which can be accommodated in one shell of the element.
3. The number of the period to which an element belongs is given by the number of the outermost shell (quantum number).

15. Rare Earth or Lanthanides : They are inner transition elements from atomic number 57 (Lanthanum) to atomic number 71 (Lutetium). They are kept outside the periodic table to mark their peculiar properties.

16. Actinides : They are inner transition elements from atomic number 89 (Actinium) to atomic number 103 (Lawrencium). They are kept outside the Periodic Table to mark their peculiar properties.

17. On moving from left to right across a period, the number of electrons in the valence shell increases by one in groups 1, 2, 13, 14, 15, 16, 17 and 18.

18. On moving from left to right across a period, the valency of elements with respect to hydrogen increases in group 1, 2, 13, and 14 and decreases in the groups 15, 16 and 17 till it is zero in group 18.

19. On moving from left to right across a period, the valency of elements with respect to oxygen increases in groups 1, 2, 13, 14, 15, 16, 17, and then it is zero in group 18.

20. On moving from left to right across a period, the atomic size of the elements decreases in groups 1, 2, 13, 14, 15, 16, 17 and then suddenly increases.

21. On moving from left to right across a period, the metallic character of the elements gradually decreases and non-metallic character gradually increases, till in the 18th group it becomes a noble gas.

22. On moving from left to right across a period, the chemical activity of the elements gradually decreases, then it starts increasing, such that the element in the last group is chemically inert.

23. On moving from left to right across a period, the basic nature of the oxides gradually decreases and the acidic nature of the oxides gradually increases.

24. As one moves down a group, the number of electrons in the valence shell in groups 1 and 2 are the same as the number of the group. The number of electrons in groups 13 to 18 is equal to : the number of the group –10.

25. All the elements in a group have the same valency which is equal to the number of electrons in the valence shell.

26. The atomic size of the elements increases as one moves down the group.

27. (a) While moving down in a group of metals (1, 2 and 13), the metallic character of elements increases.

(b) While moving down in a group of non-metals (14, 15, 16 and 17), the electronegative character of non-metals decreases.

28. (a) While moving down in a group of metals (1, 2 and 13), the chemical activity of metals increases.

(b) While going down in a group of non-metals (14, 15, 16, 17), the chemical activity decreases.

29. (a) While going down in a group of metals, the physical properties, such as melting point and boiling point, decrease gradually.

(b) While going down in a group of non-metals, the physical properties, such as melting point and boiling point, increase gradually.

I. SUMMATIVE ASSESSMENT

NCERT QUESTIONS WITH THEIR ANSWERS

SECTION A : IN-TEXT QUESTIONS

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

Ans. Triad of Li, Na and K exists in Newland's octave.

Triad of Cl, Br and I does not exist, because there are Co and Ni in between Cl and Br. Triad of Ca, Sr and Ba does not exist, because there is Zn in between Ca and Sr.

2. What were the limitations of Dobereiner's classification?

Ans. 1. Classification into triads left room for chance. It is possible to group quite dissimilar elements into a triad.

2. Quite a large number of elements cannot be grouped into a triad.

3. What were the limitations of Newland's Law of Octaves?

Ans. 1. It did not include all the elements known at that time.
2. It did not recognise the transition elements.
3. Position of hydrogen was not justified along with fluorine and chlorine.

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1. Use Mendeleev's Periodic Table to predict the formulae for the oxides of the following elements:

(i) K, (ii) C, (iii) Al, (iv) Si and (v) Ba.

Ans. (i) K(potassium) belongs to group I.

Thus, formula of its oxide is K_2O, as its valency is 1.

(ii) C (carbon) belongs to group IV. Thus, formula of its oxide is CO_2, as its valency is 4.

(iii) Al (aluminium) belongs to group III. Thus, formula of its oxide is Al_2O_3, as its valency is 3.

(iv) Si (silicon) belongs to group IV. Thus, formula of its oxide is SiO_2, as its valency is 4.

(v) Ba (barium) belongs to group II. Thus, formula of its oxide is BaO, as its valency is 2.

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

Ans. 1. Eka-silicon which is Germanium in group IIIA.

2. Eka-boron which is Scandium in group III B.

3. What were the criteria used by Mendeleev in creating his periodic table? **(V.Imp.)**

Ans. 1. The chemical and physical properties of an element is the periodic function of its atomic mass.

2. The elements were arranged in a period such that their properties changed from metallic to non-metallic.

3. The elements were arranged in groups, such that all the elements have same, but graded physical and chemical properties.

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

Ans. 1. Noble gases are chemically inactive and hence constitute a separate group.
2. Noble gases as a group offer a perfect dividing line for starting a new period in the periodic table.

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1. How could the Modern Periodic Table remove various anomalies of Mendeleev's Periodic Table?

Ans. The classification of elements in the Modern Periodic Table is based on atomic numbers. This removes the anomalies such as :

(i) Anomalous pairs of elements and the position of isotopes in Mendeleev's Periodic Table.

(ii) Modern Periodic Table relates the position of elements to their electronic configuration, whereas Mendeleev's Periodic Table is silent about electronic configuration.

(iii) Transition elements are placed in the middle of the Periodic Table in a far better position as compared to Mendeleev's Periodic Table.

(iv) Modern Periodic Table provides a clear demarcation of different kinds of elements, such as (i) Active metals, (i) Non-metals, (iii) Transition metals, (iv) Metalloids, (v) Inert gases, (vi) Lanthanides, (vii) Actinides.

(v) Modern Periodic Table clearly explains the variation in properties of the elements on the basis of electronic configuration, which is not possible in case of Mendeleev's Periodic Table.

2. Name two elements you would expect to show chemical reactions similar to magnesium. What is the basis of your choice?

Ans. Beryllium and calcium will show chemical reactions similar to magnesium. It is because all of them belong to group 2 and hence have same number of valence electrons.

3. Name :

(a) three elements that have a single electron in their outermost shell.

(b) two elements that have two electrons in their outermost shell.

(c) three elements with filled outermost shell.

Ans. (a) Lithium, sodium, potassium

(b) Magnesium, calcium (c) Helium, neon, argon.

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

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

Ans. (a) Yes, lithium, sodium and potassium belong to group I and hence have one electron in their valence shell. Thus, they have similar reactions with water.

(b) Helium has only two electrons in its K-shell. As its K-shell is fully satisfied therefore, it is chemically unreactive.

Much the same way, electronic configuration of neon is K(2), L(8). As, its valence shell has an octet, therefore, it is chemically unreactive.

5. In the Modern Periodic Table which are the metals amongst the first ten elements.

Ans. Lithium (Li) and beryllium (Be) are metals.

6. By considering their position in the periodic table, which one of the following elements would you expect to have maximum metallic characteristics. Ga, Ge, As, Se, Be?

Ans. Be will have maximum metallic character as it has 2 valence electrons.

SECTION B: QUESTIONS AT THE END OF THE CHAPTER

1. 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 becomes less metallic in nature.

(b) The number of valence electrons increases.

(c) The atoms lose their electrons more easily.

(d) The oxides becomes more acidic.

Ans. **(c)** is the correct choice. It is because the atoms lose their electrons with great difficulty.

2. An 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) sodium (b) magnesium (c) aluminium (d) silicon

Ans. **(b)** is the correct option. It is because the ionic bond between magnesium and chlorine is very strong.

3. Which element has :

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

(b) the electronic configuration is 2, 8, 2?

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

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

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

Ans. **(a)** Element is neon [2(K), 8(L)]

(b) Element is magnesium [2(K), 8(L), 2(M)]

(c) Element is silicon [2(K), 8(L), 4(M)]

(d) Element is boron [2(K), 3(L)]

(e) Element is carbon [2(K), 4(L)]

4. What property do all the elements in the same column of the periodic table : (i) boron, (ii) flourine, have in common?

Ans. (i) All the elements in the column of boron will have two electrons in their valence shell.

(ii) All the elements in the column of fluorine will have seven electrons in their valence shell.

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

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

(b) To which of the following elements would it be chemically similar? (Atomic numbers are given in parentheses).

N (7), F (9), P (15), Ar (18)

Ans. (a) Atomic number of the element is 17.

(b) F(9) will be chemically similar to the element with atomic number 17.

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

Group 16	Group 17
———	———
———	A
———	———
B	C

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

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

(c) State whether C is larger or smaller in size than B.

(d) Which type of ion, cation or anion, will be formed by element A? **[2011 (T-II)]**

Ans. (a) A is a non-metal. (b) C is less reactive than A.

(c) C is smaller in size than B. (d) A forms an anion.

7. Nitrogen (atomic number 7) and phosphorus (atomic number 15) belong to group 15 of the periodic table. Write the electronic configurations of these elements. Which of these will be more electronegative? Why? **[2011 (T-II)]**

Ans. Electronic configuration of nitrogen is [2(K), 5(L)]

Electronic configuration of phosphorus is [2(K), 8(L), 5(M)]

Nitrogen is more electronegative than phosphorus. It is because, less the number of electron shells around the nucleus, more is the tendency to attract electrons in the valence shell and hence, the element becomes more electronegative.

8. How does the electronic configuration of an atom relate to its position in the Modern Periodic Table?

Ans. (a) The number of electrons in the valence shell determine the group of the element. If the element has 1 or 2 electrons, then it belongs to group 1 or 2, respectively. If the element has 3 to 8 electrons, then its group is equal to 10 + number of valence electrons.

(b) The number of electron shells in an atom determines its period. For example, if an element has 4 electron shells, it belongs to the 4th period.

9. In the Modern Periodic Table, calcium (atomic no. 20) is surrounded by elements with atomic numbers 12, 19, 21, 38. Which of these have physical properties resembling calcium?

Ans. Calcium has electronic configuration [2(K), 8(L), 8(M), 2(N)]

The element of atomic number 38 has electronic configuration [2(K), 8(L), 18(M), 8(N), 2(O)].

Thus, calcium resembles the element of atomic number 38, because both of them have 2 valence electrons.

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

Ans. (i) The elements are arranged in Mendeleev's Periodic Table in the increasing order of atomic weights while in the Modern Periodic Table, they are arranged in the increasing order of atomic numbers.

(ii) There are three anomalous pairs of elements where atomic mass of the preceeding element is higher than that of the following element.

Example :	*Preceeding Element*	*Following Element*
	Argon (39.9)	Potassium (39.1)
	Cobalt (58.9)	Nickel (58.6)
	Tellurium (127.6)	Iodine (126.9)

In the Modern Periodic Table, no such anomalous pairs exist as the atomic number of the preceeding element is lower than the following element in all the three cases.

(iii) There is no place for isotopes in Mendeleev's Periodic Table while in the Modern Periodic Table, isotopes of an element are placed in the same position as the element.

(iv) Hydrogen was not given a definite position in Mendeleev's Periodic Table. It was placed in group IA and group VI B in the original periodic table. In the Modern Periodic Table, hydrogen is placed in group I. Its position is justified taking into consideration the electronic configuration of the element.

(v) Mendeleev's concept of transition elements was defective since he regarded elements of group VIII as transition elements.
The Modern Periodic Table recognises three series of transition elements.

ADDITIONAL QUESTIONS
(As per CCE pattern)

A. Very Short Answer Questions [1 Mark]

Previous Years' Questions

1. How and why does the atomic size vary as you go :
(i) from left to right across a period? (ii) down a group? **[2009, 2011 (T-II)]**

Ans. (i) Atomic size decreases on moving from left to right across a period. This is due to the increase in nuclear charge which tends to pull the electrons closer to the nucleus and reduces the size of the atom.

(ii) Atomic size increases on moving down a group. This is due to addition of new shells which increases the distance between the outermost electrons and the nucleus even though nuclear charge increases.

2. How will the tendency to gain electrons change as we go from left to right across a period? Why? **[2009, 2011 (T-II)]**

Ans. On moving from left to right across a period, metallic character decreases and non-metallic character increases.

Since metals tend to lose electrons and non-metals tend to gain electrons, the tendency to gain electrons increases as we move from left to right across a period.

3. How does electronic configuration of atoms change in a period with increase in atomic number? **[2009]**

Ans. On moving across a period from left to right, the atomic number of the elements increases, therefore, the number of electrons in the valence shell increases from 1 to 8, i.e, the first element in the given period will have one electron in its valence shell and the last element in the same period will have eight electrons.

4. Lithium, sodium and potassium form a Dobereiner's triad. The atomic masses of lithium and potassium are 7 and 39 respectively. Predict the atomic mass of sodium. **[2009]**

Ans. Atomic mass of sodium

$$= \frac{\text{At. mass of lithium + At. mass of potassium}}{2}$$

$$= \frac{7+39}{2} = \frac{46}{2} = 23$$

5. Chlorine, bromine and iodine form a Dobereiner's triad. The atomic masses of chlorine and iodine are 35.5 and 126.9 respectively. Predict the atomic mass of bromine . **[2009]**

Ans. Atomic mass of bromine

$$= \frac{\text{Atomic mass of chlorine + Atomic mass of iodine}}{2}$$

$$= \frac{35.5+126.9}{2} = 81.2$$

6. Calcium, strontium and barium form a Dobereiner's triad. The atomic masses of calcium and barium are 40 and 137 respectively. Predict the atomic mass of strontium. **[2009]**

Ans. Atomic mass of strontium

$$= \frac{\text{At. mass of calcium + At. mass of barium}}{2}$$

$$= \frac{40+137}{2} = 88.5$$

7. State the first limitation of Mendeleev's Periodic Table. **[2009]**

Ans. Hydrogen was not given a fixed position in Mendeleev's Periodic Table.

8. Why was the system of classification of elements into triads not found suitable? **[2009]**

Ans. (i) Only a few similar elements could be grouped into triads and quite a large number of elements were left out.

(ii) It was also possible to group quite dissimilar elements into triads.

9. Why could no fixed position be given to hydrogen in Mendeleev's Periodic Table? **[2009]**

Ans. Hydrogen resembled both the alkali metals and the halogens. So, it was placed above both the groups and could not be given a fixed position in Mendeleev's Periodic Table.

10. What are 'groups' and 'periods' in the periodic table? **[2009]**

Ans. The vertical columns in the periodic table are known as groups while the horizontal rows are known as periods.

11. Why did Mendeleev have gaps in his periodic table? **[2009]**

Ans. Some gaps were left knowingly by Mendeleev for undiscovered elements. This accelerated the process of discovering these elements as their properties were predicted by Mendeleev on the basis of other elements present in the same group.

12. Element M forms a chloride with the formula MCl_2 which is a solid with a high melting point. To which group of the periodic table does the element 'M' belong? **[2008]**

Ans. Since the element M forms the compound MCl_2, its valency is 2. Therefore, it belongs to group 2.

Other Important Questions

1. State the Law of Triads of elements?

Ans. It states that the atomic mass of the middle element of a triad is roughly the arithmetic mean of the other two elements.

2. Who propounded the Law of Triads? Give an example of a triad.

Ans. J.W. Dobereiner in 1817 propounded the Law of Triads. Lithium, sodium and potassium constitute a triad and have similar physical and chemical properties.

3. What is the achievement of classification of elements into triads? **(Imp.)**

Ans. The basic achievement of classification on the basis of triads is that it recognised for the first time, the relationship between the atomic masses and properties of elements.

4. State the Law of Octaves for the classification of elements.

Ans. When the elements are arranged in the order of their increasing atomic mases, the properties of the eighth element (starting from a given element) are a repetition of the properties of the first element.

5. Who stated the Law of Octaves? Why was it named as Law of Octaves?

Ans. Newland stated the Law of Octaves. He found that when elements are arranged in the order of their increasing atomic masses, the elements with similar properties reoccurred each time, after every seventh element, like the musical notes in octaves.

6. State Mendeleev's Periodic Law.

Ans. It states that the physical and chemical properties of all the elements are the periodic function of their atomic masses.

7. How many groups and periods were there in the original Mendeleev's Periodic Table?

Ans. There were eight groups and seven periods in the original Mendeleev's Periodic Table.

8. How many groups in the original Mendeleev's Periodic Table, are further subdivided in sub groups 'a' and 'b'?

Ans. Groups one to seven are subdivided into subgroup 'a' and subgroup 'b'.

9. How many vertical columns are there in the original Mendeleev's Periodic Table?

Ans. There are 15 vertical columns in the original Mendeleev's Periodic Table.

10. Why was there no zero group in the original Mendeleev's Periodic Table? **(Imp.)**

Ans. The elements of the zero group were not discovered at the time when Mendeleev made the periodic table and hence there was no zero group in his periodic table.

11. Who made the modern version of Mendeleev's Periodic Table and why? **(Imp.)**

Ans. H.G.J. Moseley made the modern version of Mendeleev's Periodic Table. It is because, more elements were discovered. Furthermore, he found that atomic number of an element is a more fundamental property than atomic mass.

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

Ans. The arrangement of these elements is known as Dobereiner's triad. Example, lithium, sodium and potassium.

13. Elements have been arranged in the following sequence on the basis of their increasing atomic masses. **[HOTS]**

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

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

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

Ans. (a) (i) F and Cl (ii) Na and K.

(b) Newland's Law of Octaves.

14. What are lanthanides? Where are they placed in the periodic table?

Ans. Elements from atomic number 57 to 71 are called lanthanides. All of them belong to group III B. They are placed outside the periodic table.

15. What are actinides? Where are the actinides placed in the periodic table?

Ans. The elements from atomic number 89 to 103 are called actinides. All of them belong to group III B and are placed outside the periodic table.

16. Where are the transition elements placed in the long form of the periodic table?

Ans. Transition elements are placed in groups 3 to 12 in three periods, i.e., periods 4,5 and 6 in the middle of the periodic table.

17. An element with atomic number 11 is an alkali metal. Into which families should you place the elements with atomic number 10 and 12? **(Imp.)**

Ans. The element with atomic number 10 is placed in the family of noble gases and the element with atomic number 12 in the family of alkaline earth metals.

18. Which period is the shortest in the long form of the periodic table? Name all the elements in this period.

Ans. First period is the shortest in the long form of the periodic table, It has only two elements, i.e., hydrogen (at. no. 1) and helium (at. no. 2)

19. How many periods are called long periods? How many elements are there in the long periods?

Ans. Periods 4 and 5 are called long periods. They have eighteen elements each.

20. Name : (a) the most metallic element (b) the most non-metallic element.

Ans. (a) Francium is the most metallic element

(b) Fluorine is the most non-metallic element.

21. What happens to the melting points and boiling points of elements while moving down in a group? **(Imp.)**

Ans. The melting points and boiling points decrease while moving down in group of metals.

The melting points and boiling points increases while moving down in group of non-metals.

22. "Hydrogen occupies a unique position in the Modern Periodic Table". Justify the statement **[HOTS]**

Ans. Hydrogen resembles alkali metals as well as halogens. Therefore, it can be placed in group 1 as well as in group 17.

23. Arrange the following elements in the increasing order of their metallic character. **[HOTS]**

Mg, Ca, K, Ge, Ga

Ans. Ge < Ga < Mg < Ca < K

24. Compare the radii of two species X and Y. Give reasons for your answer. **[HOTS]**

(a) X has 12 protons and 12 electrons (b) Y has 12 protons and 10 electrons

Ans. Radii of Y is less than X because Y is a cation of X.

25. Identify the elements with the following property and arrange them in the increasing order of their reactivity. **[HOTS]**

(a) An element which is a soft and reactive metal

(b) The metal which is an important constituent of limestone

(c) The metal which exists in the liquid state at room temperature

Ans. (a) Na or K (b) Ca (c) Hg

Increasing order of reactivity is

Hg < Ca< Na < K

26. 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. **[HOTS]**

Ans. Elements with similar properties were grouped together. Cobalt resembled rhodium and nickel resembled palladium placed below it (in period 5)

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

Ans. XCl_4 ; Covalent bonding

28. Arrange the following elements in increasing order of their atomic radii. **[HOTS]**

(a) Li, Be, F, N (b) Cl, At, Br, I

Ans. (a) F < N < Be < Li (b) Cl < Br < I < At

29. Write the formulae of chlorides of Eka-silicon and Eka-aluminium, the elements predicted by Mendeleev. **[HOTS]**

Ans. (a) $GeCl_4$, $GaCl_3$

B. Short Answer Questions - I [2 Marks]

Previous Years' Questions

1. An element has electronic configuration 2, 8, 3. What is the atomic number of this element? To which (i) group and (ii) period this element belong? **[2011 (T-II)]**

Ans. Atomic number is 13.

(i) Group – 13 (ii) 3rd Period

2. (a) How does atomic radius change as we move from left to right in a period?

(b) The positions of three elements P, Q and R in the periodic table are shown below

Group 15	Group 16	Group 17
.....	.....	.....
.....	.....	Q
.....	.....	.....
P	.....	R

Which one of the three elements is most non-metallic? **[2011 (T-II)]**

Ans. (a) On moving from left to right in a period, the atomic radius of the elements decreases in groups 1, 2, 13, 14, 15, 16, 17 and then suddenly increases.

(b) Q is most non-metallic element.

3. State the positions of (i) isotopes of the same element and (ii) hydrogen in the Modern Periodic Table. **[2011 (T-II)]**

Ans. (i) All isotopes have same atomic number. So they have same place for a particular element.

(ii) Hydrogen is not given a definite position. It was placed in group I A and group VII B in the Modern Periodic Table.

4. How does the tendency to gain electrons change as we go down the 16th group of periodic table? Why? **[2011 (T-II)]**

Ans. (i) As we go down the 16th group of periodic table, tendency to gain electrons decreases because the electronegative character (non metallic character) of elements gradually decreases.

5. Give reasons for the following :

(a) Lithium atom is smaller than sodium atom.

(b) Chlorine (atomic number 17) is more electronegative than sulphur (atomic number 16) **[2011 (T-II)]**

Ans. (a) As we moves down in a group, an electron shell is added after every change of period. Sodium has one more shell than lithium.

Li (3) = 2, 1

Na (11) = 2, 8, 1

Due to less number of shells, lithium atom is smaller than sodium atom.

(b) The nucleus of chlorine has more tendency to attract an extra electron than the nucleus of sulphur because chlorine needs only one 1 electron to complete its shell. Hence, chlorine is more electronegative than sulphur.

6. (a) State the Modern Periodic Law.

(b) Name the element which has twice as many electrons in its second shell as in its first shell. Write its electronic configuration also. **[2011 (T-II)]**

Ans. (a) **Modern Periodic Law :** Properties of elements are the periodic function of their atomic numbers.

(b) Carbon (atomic number 6) has twice electrons in its second shell as compared to first shell because its electronic configuration is 2, 4.

7. (a) What is common in the elements belonging to the same period of periodic table?
(b) Why are chlorine and bromine kept in the same group of the periodic table? **[2011 (T-II)]**

Ans. (a) The number of shells around the nucleus is same in same period of periodic table.
(b) Chlorine (Cl (17) – 2, 8, 7) and bromine (Br (35) – 2, 8, 18, 7) have same number of electrons in their outermost shell. So they are kept in the same group of periodic table.

8. An element belongs to third period and second group of the periodic table.
(a) State number of valence electrons in it. (b) Is it a metal or a non-metal?
(c) Name the element. (d) Write the formula of its oxide. **[2011 (T-II)]**

Ans. (a) 2 (Two valence electrons) (b) Metal (c) Magnesium (d) MgO

9. Account for the following :
(a) Elements C, N, O and F are all placed in the second period of the periodic table.
(b) Elements of group 17 are monovalent. **[2011 (T-II)]**

Ans. (a) Elements C, N, O and F have two shells around the nucleus. Hence, they all are placed in second period of Periodic Table.
(b) Elements of group 17 have 7 electrons in their outermost shell. They need only one electron to complete their shell. Hence, they are monovalent.

10. This question refers to the elements of periodic table with atomic numbers 3 to 18 :
(a) Which of them are noble gases? (b) Which of them are halogens?
(c) Which of them are alkali metals?
(d) What is the electronic configuration of an element with atomic number 10? **[2011 (T-II)]**

Ans. (a) Neon (Ne) and Argon (Ar) (b) Fluorine (F) and chlorine (Cl)
(c) Lithium (Li) and Sodium (Na) (d) 2, 8

11. Fluorine (atomic number 9) and chlorine (atomic number 17) are members of the periodic table.
(i) Write their electronic configurations.
(ii) Which one is more electronegative? Give one reason. **[2011 (T-II)]**

Ans. (i) Fluorine (9) — 2, 7
Chlorine (17) — 2, 8, 7
(ii) Fluorine is more electronegative because it has only two shells around the nucleus so it will easily form F^- ions.

12. A metal 'X' forms an oxide having the formula XO. It belongs to third period in the Modern Periodic Table. Write the atomic number, valency, electronic configuration and name of the group to which the element belongs. **[2011 (T-II)]**

Ans. Atomic number — 12
Valency — 2
Electronic configuration 2, 8, 2
The element belongs to II group.

13. The elements of the third period of the periodic table are given below:

Group	I	II	III	IV	V	VI	VII
Period 3	Na	Mg	Al	Si	P	S	Cl

(a) Which atom is bigger, Na or Mg? Why ?

(b) Identify the most (i) metallic (ii) non-metallic element in period 3. **[2009, 2011 (T-II)]**

Ans. (a) Na is bigger.

This is because, there is an increase in the nuclear charge as we move from Na to Mg. As a result the electrons are pulled closer to the nucleus in Mg and this reduces the size of the atom.

(b) (i) Na (sodium) (ii) Cl (chlorine)

14. Two elements M and N belong to groups I and II respectively and are in the same period of the periodic table. How do the following properties of M and N vary? **[2009, 2011 (T-II)]**

(i) Sizes of their atoms (ii) Their metallic characters

(iii) Their valencies in forming oxides (iv) Molecular formulae of their chlorides

Ans. (i) The atomic radii of M is greater than N.

(ii) M is more metallic than N.

(iii) M has a valency of 1 and N has a valency of 2.

(iv) MCl, MCl_2

15. (a) What is meant by periodicity in properties of elements with reference to the periodic table?

(b) Why do all elements of the same group have similar properties? **[2008, 2011 (T-II)]**

Ans. (a) The repetition of similar properties of elements at regular intervals is known as periodicity of properties.

(b) The chemical properties of elements are the periodic function of their valence electrons. Since all the elements in a group have the same number of valence electrons, therefore they have similar properties.

16. State two main properties of elements on which Mendeleev's periodic classification was based. Why could no fixed position be assigned to hydrogen in his periodic table? **[2008, 2011 (T-II)]**

Ans. (i) The elements were arranged in Mendeleev's Periodic Table on the basis of their atomic masses and also similarities in their chemical properties.

Hydrogen resembled both the alkali metals and the halogens and therefore no fixed position could be assigned to it.

17. How and why does the atomic size vary as you go : **[2009]**

(i) from left to right along a period? (ii) down a group?

Ans. (i) As one moves from left to right across a period, there is a consecutive addition of a proton in the nucleus and an electron in the valence shell of an element. The electron is always added in the same valence shell in the same period. However, the addition of proton in the nucleus increases the positive charge, which consequently pulls the extra nuclear electrons in the outermost shell inward. Thus, atomic size decreases with the increase in the number of protons as one moves from left to right in a period.

(ii) As one moves from top to bottom in a group, a new shell of electrons is added to the atoms at every step. There is an increase in the distance between the outermost shell electrons and the nucleus of the atom. Thus atomic size increases moving down a group.

18. The elements of the second period of the periodic table are given below:

Li Be B C N O F

(a) Give reason why atomic radii decreases from Li to F.

(b) Identify the most (i) metallic (ii) non-metallic element. **[2009]**

Ans. (a) As we move across a period (from Li to F) there is an increase in the nuclear charge which tends to pull the electrons closer to the nucleus and thus reduces the size of the atom.

(b) (i) Li (lithium) (ii) F (fluorine)

19. State Mendeleev's Periodic Law. Write two achievements of Mendeleev's Periodic Table. **[2009]**

Ans. The physical and chemical properties of elements are the periodic functions of their atomic masses.

(i) It was based on the more fundamental property of atomic mass of an element. Therefore, it is better than the earlier methods of classification.

(ii) The gaps left for the undiscovered elements accelerated the process of discovering these elements since their properties were already known.

20. What physical and chemical properties of elements were used by Mendeleev in creating his periodic table? List two observations which posed a challenge to Mendeleev's Periodic Law. **[2008]**

Ans. Mendeleev examined the relationship between the atomic masses of the elements and the formulae of the oxides and hydrides formed by them while creating his periodic table.

(i) Mendeleev had to place an element with a slightly greater atomic mass before an element with a slightly lower atomic mass. For example, cobalt (at. mass 58.9) appeared before nickel (at. mass 58.7).

(ii) Mendeleev predicted the existence of some elements that were not discovered then. He left gaps in his periodic table to accommodate these elements.

Other Important Questions

1. Why was there a necessity for classification of elements? Give at least two reasons. **(Imp.)**

Ans. (i) Classification leads to correlate the properties of elements with the fundamental properties which is a characteristic of all elements.

(ii) Classification further reveals the relationship between one element with another element.

2. (i) Name an alkali metal, other than lithium, sodium and potassium.

(ii) Name an alkaline earth metal other than calcium, strontium and barium.

(iii) Name one halogen, other than chlorine, bromine and iodine.

(iv) Name a non-metal having properties similar to carbon.

Ans. (i) Rubidium (ii) Magnesium (iii) Fluorine (iv) Silicon

3. What is the achievement of Dobereiner's Law of Triads? **(Imp.)**

Ans. The basic achievement of Law of Triads is that it recognised for the first time, the relationship between the atomic mass and the physical and chemical properties of an element.

4. State two achievements of Law of Octaves. **(Imp.)**

Ans. (i) Atomic mass of an element was recognised as the basis of classification.

(ii) The periodicity (repetition of properties) as a fundamental property of elements was recognised for the first time.

5. (i) What are transition elements?

(ii) Which amongst the following are transition elements? K, Mn, Ca, Cr, Cu, Cs, Fe and Pt.

Ans. (i) The elements in which the outermost shell and the shell next to the outermost shell are incomplete are called transition elements.

(ii) Mn, Cr, Cu, Fe and Pt are transition elements.

6. Give the name and symbol of the element that occupies each of the following positions in the periodic table:

(i) Period 2, group 13 (ii) Period 1, group 1

(iii) Period 4, group 2 (iv) Period 3, group 17

Ans. (i) Element is boron (ii) Element is hydrogen

(iii) Element is calcium (iv) Element is chlorine

7. Name four alkaline earth metals. To which group of the long form of the periodic table do they belong?

Ans. The four alkaline earth metals are magnesium, calcium, strontium and barium. They belong to group 2 of the long form of the Periodic Table.

8. Oxygen (at. no. 8) and sulphur (at. no. 16) belong to the same group. On the basis of electronic configuration state the periods in which these elements occur in the long form of the periodic table.

Ans. For oxygen :

Electronic configuration of oxygen (at. no. 8) = 2(K), 6(L)

As, an atom of oxygen has 2 electron shells, therefore, it belongs to the **2nd Period.**

For sulphur :

Electronic configuration of sulphur (at. no.16) = 2(K), 8(L), 6(M).

As, an atom of sulphur has 3 electron shells, therefore, it belongs to the **3rd Period.**

9. Where would you expect to find the element with atomic number 20 in the long form of the periodic table?

Ans. Electronic configuration of calcium (at. no. 20) = 2(K), 8(L), 8(M), 2(N).

As the atom of calcium has 4 electrons shells, thus, it belongs to the 4th period.

As the atom of calcium has 2 electrons in the valence shell, therefore, it belongs to the 2nd group.

Thus, to sum up calcium belongs to the **4th period** and **2nd group** of the long form of the periodic table.

10. Which period is : (i) shortest, (ii) longest, (iii) incomplete, in the long form of the periodic table? How many elements are there in (i) and (ii)?

Ans. (i) First period is the shortest.

(ii) Sixth period is the longest.

(iii) Seventh period is also the longest, but incomplete.

The first period has 2 elements, whereas the sixth period has 32 elements.

11. The atoms A and B have electronic configuration (2, 8, 8, 1) and (2, 7), respectively.
(i) To which period A and B belong? (ii) To which group A and B belong?

Ans. (i) A belongs to the **fourth** period and B belongs to the **second** period.
(ii) A belongs to the **first** group and B belongs to group **seventeen**.

12. How many periods are called the short periods in the long form of the periodic table? Give their :
(i) period numbers, (ii) number of elements in each period, (iii) name one element in each period.

Ans. (i) Period number 2 and 3 are called short periods.
(ii) Each of the short period has 8 elements.
(iii) Lithium belongs to period 2 and sodium belongs to period 3.

13. How many periods are called very long periods? Give their period numbers and state which one amongst them is incomplete? How many elements are there in the very long incomplete period?

Ans. Last two periods in the long form of the periodic table are called very long periods. Their period numbers are six and seven, respectively. The seventh period is incomplete. It has 29 elements so far.

14. Amongst the elements given below, pick out the elements which are : (i) most electropositive, (ii) most electronegative and (iii) noble gas.

Li, Be, B, C, N, O, F, Ne, Na, Mg, Al, Si, P, S, Cl, Ar, K and Ca.

Ans. (i) Potassium is the most electropositive element.
(ii) Fluorine is the most electronegative element.
(iii) Neon and argon are noble gases.

15. How is the atomic volume of sodium related to (i) magnesium and (ii) potassium?

Ans. (i) Atomic volume of sodium is more than magnesium.
(ii) Atomic volume of sodium is less than potassium.

16. Na Mg Al Si P S Cl

The elements given above are from the 3rd period of the long form of the periodic table. State what happens when one moves from left to right to : (i) metallic character of elements, (ii) atomic radii of elements.

Ans. (i) The metallic character gradually changes to non-metallic character.
(ii) The atomic radii gradually decreases.

17. Atomic numbers of three elements A, B and C are 9, 12 and 17, respectively. Amongst A, B and C : (i) which elements belong to the same group? (ii) which elements belong to the same period?

Ans. Electronic configuration of A (at. no. 9) = 2(K), 7(L).
Electronic configuration of B (at. no. 12) = 2(K), 8(L), 2(M).
Electronic configuration of C (at. no. 17) = 2(K), 8(L), 7(M).

(i) Elements A and C, belong to the same group, because they have the same number of valence electrons.

(ii) Elements B and C, belong to the same period, because they have the same number of electron shells.

18. P (86 pm), Q (231 pm), R (152 pm)

P, Q and R are the elements, such that their atomic radii is shown in brackets. Furthermore, they have the same number of electrons in their valence shell.

(i) Do these elements belong to the same group or same period?

(ii) Arrange the elements, such that the most metallic element comes first and the least metallic element comes last.

Ans. (i) The elements belong to the same group because they have the same number of valence electrons.

(ii) The arrangement of elements is Q > R > P. It is because, more the atomic radii, more metallic is the element.

19. Can the following groups of elements be classified as Dobereiner's triad? **[HOTS]**

(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) No, because all these elements do not have similar properties although the atomic mass of silicon is roughly the average of the atomic masses of sodium (Na) and chlorine (Cl).

(b) Yes, because they have similar properties and the mass of magnesium (Mg) is roughly the average of the atomic masses of Be and Ca.

20. Identify and name the metals out of the following elements whose electronic configurations are given below.

(a) 2, 8, 2 (b) 2, 8, 1 (c) 2, 8, 7 (d) 2, 1 **[HOTS]**

Ans. (a), (b) and (d) are metals.

(a) Magnesium (b) Sodium (d) Lithium

21. Mendeleev predicted the existence of certain elements not known at that time and named two of them as Eka-silicon and Eka-aluminium.

(a) Name the elements which have taken the place of these elements.

(b) Mention the group and the period of these elements in the Modern Periodic Table.

(c) Classify these elements as metals, non-metals or metalloids.

(d) How many valence electrons are present in each one of them? **[HOTS]**

Ans. (a) Germanium (Ge) and Gallium (Ga)

(b) Group 14, Period 4 and Group 13, period 4

(c) Ge- Metalloid, Ga- Metal

(d) Ga – 3, Ge - 4

C. Short Answer Questions - II [3 Marks]

Previous Years' Questions

1. An element X belongs to group 17 and third period of the periodic table.

(a) Write electronic configuration of the element. What is its valency?

(b) Predict its nature, whether it is a metal or non-metal.

(c) Give the formula of the compound formed when it combines with an element Y having valency three. **[2011 (T-II)]**

Ans. (a) Electronic configuration — 2, 8, 7. Its valency is one.

(b) It is a non-metal (c) YX_3

2. Three elements A, B and C have atomic number 7, 8 and 9 respectively.

(a) What would be their positions in the Modern Periodic Table (Mention group and period both)?

(b) Arrange A, B and C in the decreasing order of their size.

(c) Which one of the three elements is most reactive and why? **[2011 (T-II)]**

Ans. (a) A, B and C occupy 2nd period of periodic table and 15, 16 and 17 groups respectively.

(b) A > B > C because atomic size decreases as we move from left to right across a period.

(c) C has electronic configuration 2, 7. It needs only one electron to complete its outermost shell. So it is more reactive.

3. Given below are four elements with their atomic numbers

Elements	Atomic numbers
A	16
B	11
C	3
D	14

(a) Identify the elements which belong to the same group of the Modern Periodic Table.

(b) Arrange the given elements in decreasing order of atomic size.

(c) Write the formula of the oxide of B.

(d) Which of the above elements is a metalloid? **[2011 (T-II)]**

Ans. (a) B and C (b) B > D > A > C (c) B_2O (d) D is a metalloid

4. (a) The elements of the second period along with their atomic number in parenthesis are given below :

B (5), Be (4), O (8), N (7), Li (3), C (6), F (9)

(i) Arrange them in the same order as they are in the periodic table.

(ii) Which element has the (i) largest (ii) smallest atom?

(b) Why does the atomic radius change as we move from left to right in a period?

[2011 (T-II)]

Ans. (a) (i) Li (3), Be (4), B (5), C (6), N (7), O (8), F (9).

(ii) Li is largest and F is smallest atom.

(b) As one moves from left to right across a period, there is a consecutive addition of a proton in the nucleus and an electron in the valence shell of an element. The electron is always added in the same valence shell in the same period. However, the addition of proton in the nucleus increases the positive charge, which consequently pulls the extra nuclear electrons in the outermost shell inward. Thus, atomic size decreases with the increase in the number of protons as one moves from left to right in a period.

5. (a) How is the valency of an element determined from its position in the periodic table?

(b) Magnesium has atomic number 12. To which (i) group (ii) period of the periodic table does it belong?

(c) The valency of all the elements in a group is same. Why? **[2011 (T-II)]**

Ans. (a) The valency of an element with respect to hydrogen increases from 1 to 4 and then falls to 1 as in 2nd period elements.

Elements of second period	Li 3	Be 4	B 5	C 6	N 7	O 8	F 9	Ne 10
Valency with respect to hydrogen	1	2	3	4	3	2	1	0

The valency of elements with respect to oxygen increases from 1 to 7 for 3rd period elements.

Elements of third period	Na 11	Mg 12	Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
Valency with respect to oxygen	1	2	3	4	5	6	7	0

(b) (i) 2nd group (ii) 3rd period

(c) In a group all elements have same number of electrons in their outermost shell. So they have same valency.

6. A part of Modern Periodic Table is given below. Answer the following questions based on this table.

H						He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar

(a) Why do H, Li and Na show similar properties?

(b) Atomic size of Mg is bigger than Be, Why?

(c) Why are He, Ne and Ar called noble gases?

(d) Write a common name of the family to which F and Cl belong.

(e) Write the trend of non-metallic character in the horizontal row from Na to Cl.

(f) How does the atomic size vary as we move from Li to F in the second period of periodic table? [**2011 (T-II)]**

Ans. (a) H, Li and Na are in 1st group of periodic table because they all have same number of electrons in their valence shell. Due to same valency they show similar properties.

(b) Be (4) have electronic configuration 2, 2 while Mg (12) have 2, 8, 2. So Mg have one more shell than Be. Hence, it is bigger than Be.

(c) He, Ne and Ar have their outermost shell complete, they don't react with any other element. So they are called noble gases.

(d) F and Cl belongs to halogen family

(e) Non-metallic character from Na to Cl increases.

(f) Atomic size decreases from Li to F in second period of periodic table.

7. A part of the periodic table has been shown below :

Group →	1	2			13	14	15	16	17	18
Period ↓										
1										
2	A	C							E	G
3	B					D			F	

Answer the following questions on the basis of position of elements in the above table.

(a) Which element is a noble gas? Give reason.

(b) Which element is most electronegative? Give reason.

(c) Write the electronic configuration of (i) B and (ii) E. **[2011 (T-II)]**

Ans. (a) G is a noble gas because group 18 elements have their outermost shell complete and do not accept or gain electrons to complete their shell.

(b) E is most electronegative because in a period from left to right electronegative character increases and in a group it decreases.

(c) (i) B = 2, 8, 1 (ii) E = 2, 7

8. The position of four elements A, B, C and D in the periodic table are shown below.

Group I	Group 17
	B
D	
A	C

(a) Name most electronegative element.

(b) Name most reactive metal.

(c) State whether B is a metal or a non-metal.

(d) Which one of the given elements is expected to have largest atomic radius?

(e) How many electrons are present in the outermost shell of elements B and C?

(f) What will be the nature of the bond formed between D and B? **[2011 (T-II)]**

Ans. (a) B (b) D (c) Non-metal (d) A (e) Seven (7) (f) Electrovalent bond

9. (a) Name an element you would expect to show chemical reactions similar to sodium. State the reason in support of your answer.

(b) Write electronic configuration of the element belonging to 3^{rd} period and 13^{th} group of the periodic table. Predict whether it is a metal or a non-metal. Give reason. **[2011 (T-II)]**

Ans. (a) Potassium (K) will show similar chemical properties to sodium because both have same valency. Number of electrons in their outermost shell is same hence they are placed in 1st group of periodic table.

(b) 2, 8, 3. The element is aluminium which is a metal because it has a tendency to loose electrons to acquire their octet structure.

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

Group →	I	II	III	IV	V	VI	VII
Period ↓							
1	B						
2							A
3						C	

Give reasons, explain the following :

(a) Element A is non-metal.

(b) Atom of element C has a larger size than atom of element A.

(c) Element B has a valency of 1. **[2011 (T-II)]**

Ans. (a) Element A is a non-metal because it gain electron to complete their octet. It has 7 electrons in their outermost shell and acept one electron to complete its octet.

(b) Atom of element C has one more shell than A because it is placed in 3^{rd} period of periodic table. Hence, it has a larger size than atom of element A.

(c) Element B is placed in I group of periodic table hence it has a valency of 1.

11. The table given below shows a part of the periodic table.

H							He
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar

Using this table explain, why

(a) Li and Na are considered as active metals

(b) Atomic size of Mg is less than that of Na

(c) Fluorine is more reactive than chlorine. **[2009, 2011 (T-II)]**

Ans. (a) Li and Na have one electron in their valence shell. They can easily lose this electron and hence enter into a chemical reaction with other elements. Thus, they are considered as active metals.

(b) As we move across a period, there is an increase in the nuclear charge which tends to pull the electrons closer to the nucleus. Due to this, the atomic size of Mg is less than that of Na.

(c) The number of electron shells in chlorine is more than that in fluorine. Therefore, the nucleus in chlorine loses its power to attract more electrons, so as to complete its outermost orbit. This in turn lowers the reactivity of chlorine.

12. (a) What is meant by periodicity in properties of elements with reference to the periodic table?

(b) Why do all the elements of the same group have similar properties?

(c) How will the tendency to gain electrons change as we go from left to right across a period? Why? **[2009]**

Ans. (a) The repetition of physical and chemical properties of elements after a certain interval or period is called periodicity of elements in the periodic table.

(b) The elements in a group have the same number of valence electrons and hence, have the same chemical properties, which are however, graded.

(c) The tendency to gain electrons increases as we move from left to right across a period. It is because the nuclear positive charge of the elements gradually increases.

13. (a) Which two criteria did Mendeleev use to classify the elements in his periodic table?

(b) State Mendeleev's Periodic Law.

(c) Why could no fixed position be given to hydrogen in Mendeleev's Periodic Table? **[2009]**

Ans. (a) (i) Increasing order of atomic masses of elements.

(ii) Similarities in the chemical and physical properties of elements.

(b) The physical and chemical properties of all elements are the periodic function of their atomic masses.

(c) Hydrogen has a single electron in its valence shell and forms a positively charged ion having valency +1. Thus, on the basis of electronic configuration hydrogen is placed in group IA of the periodic table.

On the other hand, like halogens, hydrogen also exists as a diatomic molecule and forms covalent compounds with metals and non-metals. Thus, hydrogen is also placed in group VII B of the periodic table.

14. State any three limitations of Mendeleev's classification. **[2009]**

Ans. Limitations:

(i) Hydrogen is not given a definite position. It was placed in group I A and group VII B.

(ii) Mendeleev's original periodic table is silent about isotopes.

(iii) Mendeleev's concept of transition element was defective. He regarded the elements of group VIII as transition elements.

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

Group VI	Group VII
–	–
–	A
–	–
B	C

Giving reasons , explain the following :

(a) Element A is a non-metal.

(b) Element B has a larger atomic size than element C.

(c) Element C has a valency of 1. **[2008]**

Ans. (a) The elements belonging to group V, VI and VII are non-metals.

(b) The increased nuclear charge in C tends to pull the electrons closer to the nucleus and reduces the size of the atom. Thus, C is smaller in size than B.

(c) Element C has seven electrons in its valence shell. Therefore it can gain one more electron to form an octet. Thus, its valency is one.

Other Important Questions

1. Write the symbols of three elements each, which belong to the following families :

(i) Alkali, (ii) Alkaline earth metal, (iii) Halogen.

Cl, Li, Ca, Br, Na, Sr, I, K and Ba.

From the list above make three triads and name the family of each triad.

Ans. (i) Alkali family : [Li, Na and K] Triad of alkali metals.

(ii) Alkaline earth metal family : [Ca, Sr, Ba] Triad of alkaline earth metals.

(iii) Halogen family : [Cl, Br, I] Triad of halogens.

2. Lithium, sodium and potassium are put in the same group on the basis of similar properties.

(i) What is the similarity in their properties? **(Imp.)**

(ii) If the atomic mass of lithium is 7 and potassium is 39, calculate the atomic mass of sodium.

Ans. (i) Lithium, sodium and potassium, catch fire in air to form their respective basic oxides. They react with water at room temperature, to form their respective alkali solutions and displace hydrogen.

(ii) Atomic mass of sodium $= \frac{7+39}{2} = \frac{46}{2} = 23$

3. How were the following defects of original Mendeleev's Periodic Table resolved in modified Mendeleev's Periodic Table? **(V.Imp.)**

(i) Problem of anomalous pairs

(ii) Position of rare earths

(iii) Positions of isotopes

Ans. (i) In original Mendeleev's Periodic Table, the elements were arranged on the basis of atomic masses. There were three pairs of elements in which atomic mass of the preceding element was higher than that of the following element as follows.

Preceding element	*Following element*
Argon (39.9)	Potassium (39.1)
Cobalt (58.9)	Nickel (58.6)
Tellurium (127.6)	Iodine (126.9)

The above pairs go against Mendeleev's Periodic Law. However, with the modern classification of elements on the basis of atomic numbers, this anomaly was removed.

(ii) A group of 15 elements, after barium are placed in group III A. Thus, these elements were not given proper places in the periodic table.

This problem has been removed in the Modern Periodic Table, by putting these elements outside the table.

(iii) Mendeleev's original periodic table is silent about isotopes. However, with the modern classification on the basis of atomic numbers, this defect is removed as all isotopes have the same atomic number and hence same place for a particular element.

4. Why do metallic properties change to non-metallic properties as one moves from left to right in the long form of the periodic table? Explain. **(V.Imp.)**

Ans. The elements which donate 1 to 3 electrons from their valence shell are called metals, whereas the elements which share or accept (gain) 4 to 1 electrons in their valence shell are called non-metals.

The elements of groups 1, 2 and 3 have 1 to 3 electrons in their valence shell, therefore, they are metals.

The elements of groups 14 to 17 have four to seven electrons in their valence shell. Thus, they tend to accept/share electrons in their valence shell and hence, show non-metallic properties.

5. Explain, why the reducing power of an element decreases on moving from left to right in a period of the periodic table. **(V.Imp.)**

Ans. Reducing power of an element is determined by the degree of ease with which it can lose electrons from its valence shell.

Thus, the element on the extreme left hand side of the periodic table, which have only one electron in its valence shell can lose it with maximum ease and hence have the highest reducing power. However, as we move from left to right in a period, this degree of ease of losing electrons gradually decreases and hence the reducing power also decreases.

6. Explain, why the metallic character of elements increases while moving down a group. **(V.Imp.)**

Ans. The metallic character of an element is a function of the ease with which valence electron/ electrons are lost (donated).

As we move down a group, the number of electron shells increases around the nucleus, with the result that the distance of the valence electrons from the nucleus increases, but the nuclear pull of the nucleus on the valence electrons decreases. This on the whole makes the valence electrons relatively less bound to the nucleus. Thus, these valence electrons are easily lost, which in turn makes the elements, lower in a group, more metallic in character.

7. By giving reasons, state which amongst the elements given below does not belong to the same period: **(Imp.)**

$$^{16}_{8}A,\ ^{19}_{9}B,\ ^{20}_{10}C, \text{ and } ^{23}_{11}D$$

Ans. Electronic configuration of $^{16}_{8}A$ = 2(K), 6 (L)

Electronic configuration of $^{19}_{9}B$ = 2 (K), 7(L)

Electronic configuration of $^{20}_{10}C$ = 2 (K), 8(L)

Electronic configuration of $^{23}_{11}D$ = 2(K), 8(L), 1(M)

The elements A, B and C has 2 electron shells therefore, they belong to the 2nd period. However element D has 3 electron shells, therefore, it belongs to the 3rd period.

8. Table below shows three elements P, Q and R along with their electronic configuration. **(Imp.)**

Elements	P	Q	R
Electronic Configuration	2, 6	2,8,6	2,8

(i) Which elements belong to the same period?

(ii) Which element belongs to group 18?

(iii) Which elements belong to the same group?

(iv) Which element amongst P and Q is less reactive?

Ans. (i) Elements P and R belong to the same period.

(ii) Element R belongs to the group 18.

(iii) Elements P and Q belong to the same group.

(iv) Element Q is less reactive than P.

9. Table below represents three elements P, Q and R along with their atomic numbers. Which elements belong to : (i) same group and (ii) same period? **(Imp.)**

Elements	P	Q	R
Atomic number	2	11	18

Ans. Let us write the electronic configuration of the above elements.

Elements	P	Q	R
Atomic number	2	11	18
Electronic Configuration	2(K)	2(K),8(L),1(M)	2(K),8(L),8(M)

(i) Element P has only two electrons in its only shell. This element is helium and, hence is a noble gas. Thus, it belongs to group 18.

Element R has 8 electrons in its valence shell and hence, it belongs to group 18.

Thus, P and R belong to the same group, i.e. group 18.

(ii) Elements Q and R have three electron shells. Thus, elements Q and R belong to the 3rd period.

10. Properties of the elements are given below. Where would you locate the following elements in the periodic table?

(a) A soft metal stored under kerosene.

(b) An element with variable (more than one) valency stored under water.

(c) An element which is tetravalent and forms the basis of organic chemistry.

(d) An element which is an inert gas with atomic number 2.

(e) An element whose thin oxide layer is used to make other elements corrosion resistant by the process of "anodising". **[HOTS]**

Ans. (a) Sodium (Na) Group 1 and period 3 or Potassium (K) Group 1 and period 4.

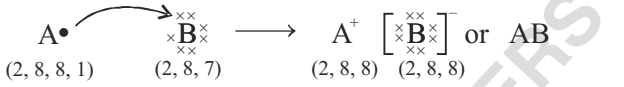
(b) Phosphorus (P) Group 15 and period 3.

(c) Carbon (C) Group 14 and Period 2.

(d) Helium (He) Group 18 and Period 1.

(e) Aluminium (Al) Group 13 and Period 3.

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

Ans. 

Ionic bond

A = K (Potassium) B = Cl (Chlorine)

12. Give an account of the process adopted by Mendeleev for the classification of elements. How did he arrive at the "Periodic Law"? **[HOTS]**

Ans. When Mendeleev started his work, 63 elements were known

(i) Compounds of these elements with oxygen and hydrogen (formation of oxides and hydrides) were studied.

(ii) Elements with similar properties were arranged in a group.

(iii) Mendeleev observed that the elements were automatically arranged in the order of their increasing atomic masses.

13. Which group of elements could be placed in Mendeleev's Periodic Table without disturbing the original order? Give reason. **[HOTS]**

Ans. Noble gases

According to Mendeleev's classification, the properties of elements are the periodic function of their atomic masses and there is a periodic reocurrence of elements with similar physical and chemical properties. Noble gases being inert, could be placed in a separate group without disturbing the original order.

D. Long Answer Questions [5 Marks]

Previous Years' Questions

1. On the basis of Mendeleev's Periodic Table given below, answer the questions that follow the table.

Groups →	I	II	III	IV	V	VI	VII	VIII
Oxide : Hydride :	R_2O RH	RO RH_2	R_2O_3 RH_3	RO_2 RH_4	R_2O_3 RH_3	RO_3 RH_2	R_2O_7 RH	RO_4
Periods ↓	A B	A B	A B	A B	A B	A B	A B	Transition series
1	H 1.008							
2	Li 6.939	Be 9.012	B 10.81	C 12.011	N 14.007	O 15.999	F 18.998	
3	Na 22.99	Mg 24.31	Al 29.98	Si 28.09	P 30.974	S 32.06	Cl 35.453	
4 First series : Second series :	K 39.102 Cu 63.54	Ca 40.08 Zn 65.37	Sc 44.96 Ga 69.72	Ti 47.90 Ge 72.59	V 50.94 As 74.92	Cr 50.20 Se 78.96	Mn 54.94 Br 79.909	Fe 55.85 Co 58.93 Ni 58.71
5 First series : Second series :	Rb 85.47 Ag 107.87	Sr 87.62 Cd 112.40	Y 88.91 In 114.82	Zr 91.22 Sn 118.69	Nb 92.91 Sb 121.95	Mo 95.94 Te 127.60	Tc 99 I 126.90	Ru 101.07 Rh 102.91 Pd 106.4
6 First series : Second series :	Cs 132.90 Au 196.97	Ba 137.34 Hg 200.59	La 138.91 Tl 204.37	Hf 178.49 Pb 207.19	Ta 180.95 Bi 208.98	W 183.85		Os 190.2 Ir 192.2 Pt 195.09

(a) Name the element which is in : **[2008]**

(i) 1st group and 3rd period.

(ii) 7th group and 2nd period.

(b) Suggest the formula of the following :

(i) oxide of nitrogen (ii) hydride of oxygen

(c) In group VIII of the periodic table, why does cobalt with atomic mass 58.93 appear before nickel having atomic mass 58.71?

(d) Besides gallium, which two other elements have since been discovered for which Mendeleev had left gaps in his periodic table?

(e) Using atomic masses of Li, Na and K, find the average atomic mass of Li and K and compare it with the atomic mass of Na. State the conclusion drawn from this activity.

OR

(a) Why do we classify elements?

(b) What were the two criteria used by Mendeleev in creating his periodic table?

(c) Why did Mendeleev leave some gaps in his periodic table?

(d) In Mendeleev's periodic table, why was there no mention of noble gases like Helium, Neon and Argon?

(e) Would you place the two isotopes of chlorine, Cl–35 and Cl–37 in different slots because of their different atomic masses or in the same slot because their chemical properties are the same? Justify your answer. **[2011 (T-II)]**

Ans. (a) (i) Sodium (Na) (ii) Fluorine (F)

(b) (i) Formula of the oxide of nitrogen is N_2O_5.

(ii) Formula of the hydride of oxygen is H_2O.

(c) It is because the chemical properties of cobalt are more close to Rh (102.91) and Ir (192.2) in the sub group.

(d) (i) Germanium (Eka-silicon), (ii) Scandium (Eka-boron).

(e) Average atomic mass of Li and K = $\frac{6.939 + 39.102}{2}$ = 23.021

Atomic mass of sodium = 22.19.

Conclusion : The atomic mass of the middle element of a group of three elements (triad) is roughly equal to the arithmetic mean (average atomic mass) of the other two elements.

OR

(a) (i) Classification of elements leads to co-relation of properties of elements with some fundamental properties and characteristics of all elements.

(ii) Classification reveals relationship between one element with other elements.

(iii) Classification helps in the better study of elements.

(b) (i) He arranged elements in a tabular form on the basis of increasing order of their atomic masses.

(ii) He arranged elements on the basis of their chemical properties, such that elements in the same vertical column have similar chemical properties.

(c) Gaps were left for unknown elements, because no other known elements could fit these gaps on the basis of their chemical properties.

(d) Noble gases were not discovered when Mendeleev formulated his table.

(e) We will place Cl-35 and Cl-37 in the same set. It is because, Mendeleev based his periodic table not only on the basis of increasing atomic masses but also on similar chemical properties.

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

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

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

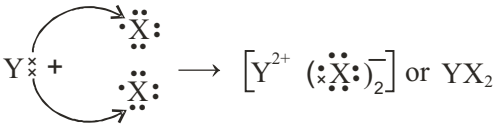
(c) What will be the nature of the oxide of element Y? Identify the nature of bonding in the compound formed.

(d) Draw the electron dot structure of the divalent halide. **[2011 (T-II)]**

Ans. (a) X belongs to Group 17 and 3rd period.
Y belongs to Group 2 and 4th period.

(b) X—Non-metal, Y—Metal

(c) Basic oxide; Ionic bonding

(d)  or YX_2

3. Atoms of seven elements A, B, C, D, E, F and G have a different number of electronic shells but have the same number of electrons in their outermost shells. The elements A and C combine with chlorine to form an acid and common salt respectively. The oxide of element A is a liquid at room temperature and is a neutral substance, while the oxides of the remaining six elements are basic in nature. Based on the above information answer the following questions.

(i) What could the element A be?

(ii) Will elements A to G belong to the same period or same group of the periodic table?

(iii) Write the formula of the compound formed by the reaction of element A with oxygen.

(iv) Show the formation of the compound by a combination of element C with chlorine with the help of an electronic structure.

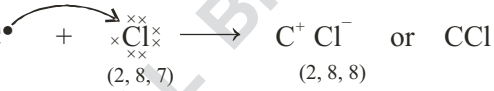
(v) What would be the ratio of the number of combining atoms in a compound formed by the combination of element A with carbon?

(vi) Which one of the given elements is likely to have the smallest atomic radius? **[2010]**

Ans. (i) Hydrogen

(ii) Elements A to G belong to the same group of the periodic table since they contain the same number of electrons in their outermost shells.

(iii) $2H_2 + O_2 \rightarrow 2H_2O$ (Since A is hydrogen)

(iv) 

or CCl

(v) Ratio = 4 : 1

(vi) Hydrogen (represented by A) is likely to have the smallest atomic radius amongst all the elements in a group. This is because the atomic radius increases while moving down the group.

Other Important Questions

1. Answer the following questions regarding modified Mendeleev's Periodic Table:

(i) How many groups are in this table and how are they numbered?

(ii) What is the number of the new group which was not present in the original Mendeleev's periodic table? Name the first three elements of this group.

(iii) Which groups are subdivided into subgroups A and B?

(iv) How many periods are in this table?

(v) Name a period which has : (a) least number of elements, (b) maximum number of elements.

Ans. (i) There are 9 groups in all.
The groups are numbered from 0 to 8.

(ii) The number of the new group is Zero. First three elements of this group are helium, neon and argon.

(iii) Group number 1 to 7 are subdivided into subgroup A and subgroup B.

(iv) There are 7 periods in this table.

(v) First period has the least number of elements, *i.e.*, it has two elements. Sixth period has the maximum number of elements, i.e. 32 elements.

2. How could the Modern Periodic Table remove various anomalies of Mendeleev's periodic table? **(V. Imp)**

Ans. The classification of elements in the Modern Periodic Table is based on atomic numbers. This removes the anomalies such as :

(i) Anomalous pairs of elements and the position of isotopes in Mendeleev's Periodic Table.

(ii) The Modern Periodic Table relates position of elements to their electronic configuration whereas Mendeleev's Periodic Table is silent about electronic configuration.

(iii) Transition elements are placed in the middle of the Periodic Table in a far better position as compared to Mendeleev's Periodic Table.

(iv) The Modern Periodic Table provides a clear demarcation of different kinds of elements, such as (i) Active metals, (i) Non-metals, (iii) Transition metals, (iv) Metalloids, (v) Inert gases, (vi) Lanthanides, (vii) Actinides.

(v) The Modern Periodic Table clearly explains variation in properties of the elements on the basis of electronic configuration, which is not possible in case of Mendeleev's Periodic Table.

3. Answer the following questions regarding the long form of the Periodic Table. **(V. Imp)**

(i) What do you understand by the term period? How many periods are there?

(ii) Which period is the shortest? Name the elements of this period.

(iii) How many periods are called short periods? Give their period numbers and name one element in each of them.

(iv) How many periods are called long periods? How many elements are there in the long periods?

(v) How many periods are called very long periods? Give their period numbers and state which amongst them is incomplete. How many elements are there in the very long incomplete period?

Ans. (i) Horizontal rows in the periodic table are called periods.
There are 7 periods in all.

(ii) First period is the shortest. It has only two elements, i.e., hydrogen and helium.

(iii) There are two short periods. Their period numbers are 2 and 3. Magnesium belongs to period 2.

(iv) There are two long periods. Their period numbers are 4 and 5.
There are 18 elements in each long period.

(v) There are two very long periods. Their period numbers are 6 and 7. Period number 7 is incomplete. It has 29 elements.

4. An element P belongs to group 2 and element Q belongs to group 17 of the long form of the periodic table. **(V. Imp.)**

(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 the compound of P and Q?

Ans. (i) Valence electrons are always equal to the group number. Thus, **P has 2 valence electrons.**

(ii) The valency of an element is equal to number of valence electrons, for elements of group 1, 2 and 13. For elements of group 14 to 17, valency is equal to ''group number-18''. As all elements in groups 1, 2 and 13 are metals, therefore, P is a metal and hence, its valency is **+ 2.**

(iii) Valence electrons are always equal to the group number – 10. Thus, **Q has 7 valence electrons.**

(iv) Elements in group numbers 14 to 17 are non-metals. As Q belongs to group number 17, therefore, it is a non-metal. The valency of a non-metal is given by the formula "group number – 18".

The valency of Q is 17 – 18 = –1.

(v) As the valency of P is + 2 and that of Q is –1, formula of the compound of P and Q is $\mathbf{PQ_2}$.

5. The table shows a part of the long form of the periodic table. Answer the following questions regarding the element strontium (Sr) :

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

(ii) Is it more reactive or less reactive than magnesium?

(iii) What is its valency?

(iv) What is the formula of its (a) chloride and (b) sulphate?

(v) How does its atomic volume compare with (a) rubidium and (b) barium?

Group I	***Group II***
H (1)	
Li (3)	Be (4)
Na (11)	Mg (12)
K (19)	Ca (20)
Rb (37)	Sr (38)
Cs (55)	Ba (56)

Ans. (i) Strontium is a metal. It is because all elements in groups 1, 2 and 13 are metals.

(ii) It is more reactive than magnesium. It is because, the chemical reactivity increases as one moves down a group.

(iii) The valency of strontium is +2. It is because, the electronic configuration of strontium is (2, 8, 18, 8, 2). As it has two valence electrons, therefore, its valency is +2.

(iv) (a) Formula of strontium chloride is $SrCl_2$.

(b) Formula of strontium sulphate is $SrSO_4$.

(v) (a) Atomic volume of strontium is less than rubidium, because atomic volume decreases as one moves from left to right across a period.

(b) Atomic volume of strontium is less than barium. As one moves from top to bottom in a group, atomic volume increases.

6. Answer the following questions regarding element $^{31}_{15}X$: **(V.Imp.)**

(i) What is its electronic configuration?

(ii) To which group does it belong?

(iii) To which period does it belong?

(iv) How many electrons are there in its valence shell?

(v) What is its valency?

(vi) Is it a metal or a non-metal?

(vii) What is the formula of its compound with sodium?

Ans. (i) Atomic number of X is 15.

$\therefore$ Electronic configuration of X is (2, 8, 5).

(ii) As X has 5 electrons in its valence shell, therefore, it belongs to group 15.

(iii) As X has 3 electron shells, therefore, it belongs to the 3rd period.

(iv) It has 5 valence electrons.

(v) The valency of X

= Number of valence electrons – 8 = 5 – 8 = – 3.

(vi) X is a non-metal. It is because all elements with valence electrons 4 to 7 are non-metals.

(vii) The formula of its compound with sodium is $Na_3^+X^{3-}$.

7. (I) Electropositive nature of the element(s) increases down the group and decreases across the period.

(II) Electronegativity of the element decreases down the group and increases across the period.

(III) Atomic size increases down the group and decreases across a period (left to right).

(IV) Metallic character increases down the group and decreases across a period.

On the basis of the above trends of the periodic table, answer the following about the elements with atomic numbers 3 to 9.

(a) Name the most electropositive elements among them.

(b) Name the most electronegative element

(c) Name the element with smallest atomic size

(d) Name the element which is a metalloid

(e) Name the element which shows maximum valency **[HOTS]**

Ans. (a) Lithium (b) Fluorine

(c) Fluorine (d) Boron

(e) Carbon

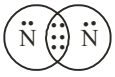
8. An element X of group 15 exists as a diatomic molecule and combines with hydrogen at 773 K in the presence of a catalyst to form a compound, ammonia which has a characteristic pungent smell. **[HOTS]**

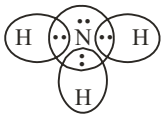
(a) Identify the element X. How many valence electrons does it have?

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

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

Ans. (a) Nitrogen (atomic no.7) 2, 5; it has 5 valence electrons.

(b)  triple covalent bonds

(c)  3 single covalent bonds

9. An element placed in the 2nd group and 3rd period of the periodic table, burns in the presence of oxygen to form a basic oxide.

(a) Identify the element.

(b) Write the electronic configuration.

(c) Write the balanced equation when it burns in the presence of air.

(d) Write a balanced equation when this oxide is dissolved in water.

(e) Draw the electron dot structure for the formation of this oxide. **[HOTS]**

Ans. (a) Magnesium (Mg)

(b) K, L, M

2, 8, 2

(c) $2\ Mg_{(s)} + O_{2(g)} \rightarrow 2\ MgO_{(s)}$

(d) $MgO_{(s)} + H_2O_{(l)} \rightarrow Mg(OH)_{2(aq)}$

(e)  or MgO

10. Atomic number of a few elements are given below :

10, 20, 7, 14

(a) Identify the elements.

(b) Identify the group number of these elements in the periodic table.

(c) Identify the periods of these elements in the periodic table.

(d) What would be the electronic configuration of each of these elements?

(e) Determine the valency of these elements. **[HOTS]**

Ans. (a) Elements — Neon (Ne), Calcium (Ca), Nitrogen (N), Silicon (Si)

(b) Group — 18, 2, 15, 14

(c) Period — 2, 4, 2, 3

(d) Electronic configuration — (2,8); (2,8, 8,2) ; (2,5); (2,8,4)

(e) Valency — 0, 2, 3, 4

11. An element X which is a yellow solid at room temperature shows catenation and allotropy. X forms two oxides which are also formed during the thermal decomposition of ferrous sulphate crystals and are the major air pollutants.

(a) Identify the element X.

(b) Write the electronic configuration of X.

(c) Write the balanced chemical equation for the thermal decomposition of ferrous sulphate crystals?

(d) What would be the nature (acidic/basic) of oxides formed?

(e) Locate the position of the element in the Modern Periodic Table. **[HOTS]**

Ans. (a) Element X is sulphur (atomic no.16)

(b) K, L, M

2, 8, 6

(c) $2\ FeSO_{4(s)} \xrightarrow{Heat} Fe_2O_{3(s)} + SO_{2(g)} + SO_{3(g)}$

(d) Acidic

(e) 3rd period, group 16

II. FORMATIVE ASSESSMENT

A. Charts

1. Make a multicoloured chart of the modern version of the periodic table of elements showing clearly the mass numbers and atomic numbers of the elements.

2. Make a multicoloured chart of the long form of the periodic table, showing clearly, the metals, non - metals and metalloids.

3. Make a chart of elements from lithium to bromine for normal elements arranged in groups and periods in the increasing order of their atomic number and showing the distribution of electrons around their nucleus.

4. Make a multicoloured chart showing five elements of group no. 1, 2, 13, 14, 15, 16, 17 and 18, showing the distribution of electrons around their nucleus, as shown on next page for group 1.

Period	*Group 1*	*Group 2*	*Group 13*	*Group 14*	*Group 15*	*Group 16*	*Group 17*	*Group 18*
2	$_{3}$Li 2,1							
3	$_{11}$Na 2, 8, 1							
4	$_{19}$K 2, 8, 8,1							
5	$_{37}$Rb 2, 8, 18 8, 1							
6	$_{55}$Cs 2, 8, 18 18, 8, 1							