

Chapter – 5 Periodic Classification of Elements

Multiple Choice Questions

Q1. Up-to which element, the law of octaves was found to be applicable?

- a) Oxygen
- b) Calcium
- c) Cobalt
- d) Potassium

Answer: Option b)

Newland's law of octaves was applicable to only those elements which have masses up-to 40 u, that is, up-to calcium.

Q2. According to Mendeleev's periodic law, the elements were arranged in the periodic table in the order of

- a) Increasing atomic number
- b) Decreasing atomic number
- c) Increasing atomic masses
- d) Decreasing atomic masses

Answer: Option c)

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

Q3. In Mendeleev's periodic table, gaps were left for the elements to be discovered later. Which of the following elements found a place in the periodic table later?

- a) Germanium
- b) Chlorine
- c) Oxygen
- d) Silicon

Answer: Option a)

Germanium was the element which was found later in the modern periodic table.

Q4. Which of the following statement(s) about the modern periodic table are incorrect?

- i) The element in the modern periodic table are arranged on the basis of their decreasing atomic numbers.
- ii) The elements in the modern periodic table are arranged on the basis of their increasing atomic masses.
- iii) Isotopes are placed in adjoining group(s) in the periodic table.
- iv) The elements in the modern periodic table are arranged on the basis of their increasing atomic number.

- a) Only i)
- b) i), ii) and iii)
- c) i), ii) and iv)
- d) Only iv)

Answer: Option b)

All the elements in modern periodic table are in increasing atomic number and isotopes are placed at one place in the same group of periodic table.

Q5. Which of the following statements about the modern periodic table correct?

- a) It has 18 horizontal rows known as periods.
- b) It has 7 vertical columns rows known as periods.
- c) It has 18 vertical columns known as groups.
- d) It has 7 horizontal rows known as groups.

Answer: Option c)

Modern periodic table consists of 18 vertical columns called as groups and 7 horizontal rows, called as periods.

Q6. Which of the given elements A, B, C, D and E with atomic number 2, 3, 7, 10 and 30 respectively belong to the same period?

- a) A, B, C
- b) B, C, D
- c) A, D, E
- d) B, D, E

Answer: Option b)

Second period contains those elements which have atomic number 3 (Li), 7 (N), 10 (Ne). Second period have atomic number 3 to 10.

Q7. The elements A, B, C, D and E have atomic number 9, 11, 17, 12 and 13 respectively. Which pair of elements belong to the same group?

- a) A and B
- b) B and D
- c) A and C
- d) D and E

Answer: Option c)

Electronic configuration of element A (atomic number 9) is 2, 7.

Electronic configuration of element B (atomic number 11) is 2, 8, 1.

Electronic configuration of element C (atomic number 17) is 2, 8, 7.

Electronic configuration of element D (atomic number 12) is 2, 8, 2.

Electronic configuration of element E (atomic number 13) is 2, 8, 3.

So, the elements which differ in atomic number by 8, that is, element A (fluorine) and element C (Chlorine) lies in the same group, that is, group 17 (halogens).

Q8. Where would you locate the element with electronic configuration 2, 8 in the modern periodic table?

- a) Group B
- b) Group 2
- c) Group 18
- d) Group 10

Answer: Option c)

The element which has electronic configuration 2, 8 is an inert gas that is, Neon hence it belongs to group 18.

Q9. An element which is an essential constituent of all organic compounds belongs to

- a) Group 1
- b) Group 14
- c) Group 15
- d) Group 16

Answer: Option b)

Carbon is an essential constituent of all organic compounds and it belongs to group 14.

Q10. Which of the following is the outermost shell for elements of period 2?

- a) K shell
- b) L shell
- c) M shell
- d) N shell

Answer: Option b)

The outermost shell for elements of period 2 is L shell, since there are only two shell K and L.

Q11. Which one of the following elements exhibits maximum number of valence electrons?

- a) Na
- b) Al
- c) Si
- d) P

Answer: Option d)

P has maximum number of valence electrons, that is 5 since P belongs to the group of 15.

Q12. Which of the following gives the correct increasing order of the atomic radii of O, F and N?

- a) O, F, N
- b) N, F, O
- c) O, N, F
- d) F, O, N

Answer: Option d)

On moving from left to right across a period, the atomic number of each succeeding element increases by 1. Hence, the electrons attached close to the nucleus and atomic size decreases along a period from left to right.

So, the increasing order of radii is F, O, N as atomic number of F, O and N are 9, 8, 7 respectively. Also, F belongs to 17th group, O belongs to 16th group and N belongs to 15th group.

Q13. Which among the following element has the largest atomic radii?

- a) Na
- b) Mg
- c) K
- d) Ca

Answer: Option c)

We have Na and K in the same group but K is below compared to Na, hence K will have higher atomic radius, that is, $K > Na$. The atomic radius of K will be greater than Ca, since K and Ca belongs to same period but K is from group 1 and Ca is from group 2. Hence, $K > Ca$. Also, $N > Mg$, since N and Mg are in same period but N is from group 1 and Mg is from group 2. So overall we can say that, $K > Na > Mg > Ca$ and $K > Ca > Mg$.

So, atomic radius of K is the largest from all.

Q14. Which of the following elements would lose an electron easily?

- a) Mg
- b) Na
- c) K
- d) Ca

Answer: Option c)

Elements K and N will lose electron to achieve stable configuration, since the electronic configuration of

Na = 2, 8, 1 and K = 2, 8, 8, 1

Also, the force of attraction on valence electron of K is least.

The atomic radius of K has the largest atomic radius, so it can lose its valence electron more easily.

Q15. Which of the following elements does not lose an electron easily?

- a) Na
- b) F
- c) Mg
- d) Al

Answer: Option b)

Lesser the atomic radius of an element, more difficult it will be to lose electron. F has the smallest size and it also contains 7 electrons in its valence shell and it is most electronegative element. So, it will gain an electron rather than losing.

Q16. Which of the following are the characteristics of isotopes of an element?

- i) Isotopes of an element have same atomic masses.
- ii) Isotopes of an element have same atomic element.
- iii) Isotopes of an element show same physical properties.
- iv) Isotopes of an element show same chemical properties.

- a) i), iii) and iv)
- b) ii), iii) and iv)
- c) ii) and iii)
- d) ii) and iv)

Answer: Option d)

It will have similar chemical properties but different atomic masses, since isotopes are the atoms which have same element having same atomic number.

Q17. Arrange the following elements in the order of their decreasing metallic character Na, Si, Cl, Mg, Al.

- a) $Cl > Si > Al > Mg > Na$
- b) $Na > Mg > Al > Si > Cl$
- c) $Na > Al > Mg > Cl > Si$
- d) $Al > Na > Si > Ca > Mg$

Answer: Option b)

In periodic table, metals lie on the extreme left side and its character decreases from left to right in a period. Metals Na, Si, Cl, Mg, Al belong to same period in the order Na, Mg, Al, Si, Cl .

So, the order of decreasing metallic character is

$$Na > Mg > Al > Si > Cl$$

Q18. Arrange the following elements in order of their increasing non-metallic character Li, O, C, Be, F.

- a) $F < O < C < Be < Li$
- b) $Li < Be < C < O < F$
- c) $F < O < C < Be < Li$
- d) $Al > Na > Si > Ca > Mg$

Answer: Option b)

Li, O, C, Be, F belong to same second period. On moving from left to right across a period, non-metallic character increases. Hence, the order of increasing non-metallic character is;



Q19. What type of oxide would Eka-aluminium form?

- a) EO_3
- b) E_3O_2
- c) E_2O_3
- d) EO

Answer: Option c)

Gallium has a valency of 3, it also forms an oxide which has molecular formula E_2O_3 .

Q20. Three elements B, Si and Ge are

- a) Metals
- b) Non-metals
- c) Metalloids
- d) Metal, non-metal and metalloid respectively

Answer: Option c)

Elements such as boron (B), silicon (Si) and germanium (Ge) are metalloids. Metals have been separated by non-metals by some elements called as metalloids in the periodic table. The metalloids are Si, Ge, As, Sb, Te and Po.

Q21. Which of the following elements will form an acidic oxide?

- a) An element with atomic number 7
- b) An element with atomic number 3
- c) An element with atomic number 12
- d) An element with atomic number 19

Answer: Option a)

Generally, non-metals form acidic oxides. Non-metals also have 4 to 8 electrons in the valence shell. The electronic configuration of given elements as:

$$7 = 2, 5$$

$$3 = 2, 1$$

$$12 = 2, 8, 2$$

$$19 = 2, 8, 8, 1$$

Element with atomic number 7 which is non-metal (N) will form acidic oxide.

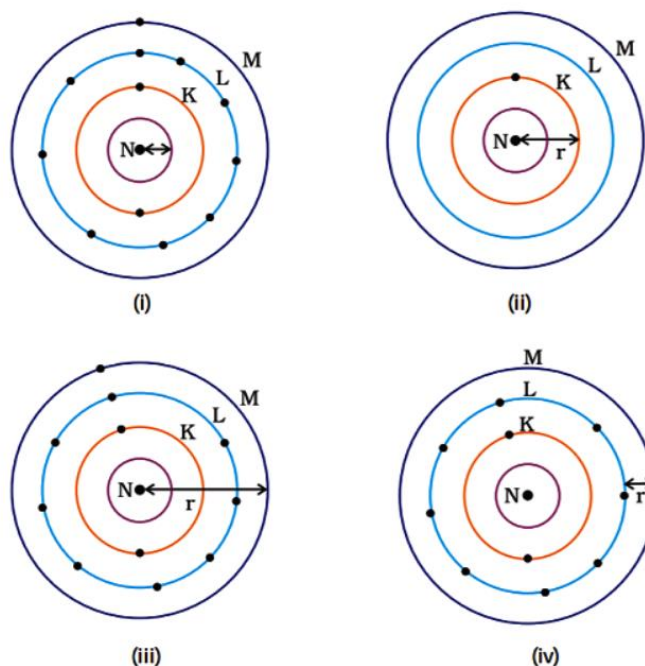
Q22. The element with atomic number 14 is hard and forms acidic acid oxide and a covalent halide. To which of the following categories does the element belong?

- a) Metal
- b) Metalloid
- c) Non-metal
- d) Left-hand side element

Answer: Option c)

Non-metal has valence shell with 4 electrons. Also, they form acidic oxide and by sharing of electrons with halogen, it will form covalent halide.

Q23. Which one of the following depict the correct representation of atomic radius (r) of an atom?



- a) (i) and (ii)
- b) (ii) and (iii)
- c) (iii) and (iv)
- d) (i) and (iv)

Answer: Option b)

The Figure (i) and (ii) are correct representation of atomic radius from nucleus to outermost shell, since atomic radius is the distance between the centre of the nucleus and the outermost shell.

Q24. Which one of the following does not increase while moving down the group of the periodic table?

- a) Atomic radius
- b) Metallic character
- c) Valence
- d) Number of shells in an element

Answer: Option c)

Elements of a group in periodic table have the same number of valence electrons, for example; elements of group one have 1 valence electron.

All elements of group 18 will have 8 valence electrons each in their atoms, except for helium which 2 valence electrons only in its atom. Rest all the three properties increases down in the group.

Q25. On moving from left to right in a period in the periodic table, the size of the atom

- a) Increases
- b) Decreases
- c) Does not change appreciably
- d) First decreases and then increases

Answer: Option b)

The nucleus has large number of positive charges so, the electron is being pulled in closer to the nucleus and the size of the atom decreases.

Q26. Which of the following set of elements is written in order of their increasing metallic character?

- a) Be, Mg, Ca
- b) Na, Li, K
- c) Mg, Al, Si
- d) C, O, N

Answer: Option a)

The metallic character increases down a group and decreases along a period. Hence, metallic character increases in order Be, Mg, Ca since they belong to the same group.

Short Answer Type Question

Q27. The three elements A, B and C with similar properties have atomic masses X, Y and Z respectively. The mass of Y is approximately equal to the average mass of X and Z. What is such an arrangement of elements called as? Give one example of such a set of elements.

Answer:

The arrangement of elements where the atomic mass of middle element is the mean of atomic masses of first and third elements is called as Dobereiner's triads.

Example:

Ca (40), Sr (88), Ba (137)

$$\text{Atomic mass of Sr} = \frac{40 + 137}{2} = 88.5$$

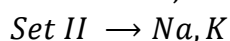
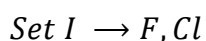
More examples are Li (7), Na (23), K (39)

Q28. Elements have been arranged in the following sequence on the basis of their increasing atomic masses. F, Na, Mg, Al, Si, P, S, Cl, Ar, K.

- a) Pick two sets of elements which have similar properties.
- b) The given sequence represents which law of classification of elements?

Answer:

- a) The elements are arranged in the order of increasing atomic masses. So, as per the Newland's law of octaves there is a repetition of every 8th element when compared to the given element. elements with similar properties are:



In the given sequence, F and Cl are the 1st and the 8th element so, they have similar properties. Na and K also have similar properties but they are not 1st and 8th element in the given sequence.

- b) The given sequence is according to Newland's law of octaves.

Q29. Can the following groups of elements be classified as Dobereiner's triad?

- a) Na, Si, Cl
b) Be, Mg, Ca

Atomic mass of Be 9; Na 23; Mg 24; Si 28; Cl 35; Ca 40

Explain by giving reason.

Answer:

- a) Na, Si, Cl have different properties and do not form Dobereiner's triad even if the atomic mass of the middle atom (Si) is average of the atomic masses of Na and Cl,
Na (23); Si (28); Cl (35)

$$\text{Atomic mass of Si} = \frac{23 + 35}{2} = \frac{58}{2} = 29$$

- b) Be, Mg and Ca have many similar properties also the atomic mass of the middle element Mg is approximately the average of the atomic masses of Be and Ca, that is

Be (9); Mg (24); Ca (40)

$$\text{Atomic mass of Mg} = \frac{9 + 40}{2} = \frac{49}{2} = 24.5$$

Hence, they form Dobereiner's triad.

Q30. In Mendeleev's periodic table, the elements were arranged in the increasing order of their atomic masses. However, cobalt with atomic mass of 58.93 amu was placed before nickel having an atomic mass of 58.71 amu. Give reason for the same.

Answer:

Cobalt (Co) with atomic mass 58.93 u is before nickel (Ni) in the Mendeleev's periodic table, because;

- i) Properties of cobalt are similar to that of rhodium (Rh) and iridium (Ir), and
- ii) Properties of nickel are similar to palladium (Pd) and platinum (Pt).

Q31. 'Hydrogen occupies a unique position in modern periodic table', justify the statement.

Answer:

The reason behind why hydrogen occupies a unique position in modern periodic table:

- i) Alkali metals and hydrogen have similar outer electronic configuration since they have one electron in the valence shell. Also, some properties of hydrogen and alkali metals are similar hence, it can be placed in group 1 with alkali metals.
- ii) Hydrogen and halogens both have similar outer electronic configuration, also some of the properties of hydrogen are similar to those of halogens hence it can be placed in group 17 with halogens.
- iii) Some properties of hydrogen and halogens, example, oxide of hydrogen, that is, H_2O is neutral but the oxides of alkali metal are basic whereas those of halogens are acidic in nature.

Q32. Write the formulae of chlorides of Eka-silicon and Eka-aluminium, the elements predicted by Mendeleev.

Answer:

Eka-silicon is a germanium (Ge), which lies in group 4 of the Mendeleev's periodic table and has a valency of 4.

Formula of its chloride is $GeCl_4$

Eka-aluminium is gallium (Ga), which lies in group 3 of the Mendeleev's periodic table and has a valency of 3.

Formula of its chloride is $GaCl_3$

Q33. Three elements A, B and C have 3, 4 and 2 electrons respectively in their outermost shell. Give the group number to which they belong in the modern periodic table. Also, give their valences.

Answer:

- i) Element A has 3 valence electrons, so, its valency is 3 it belongs to group 13 (3+10). It could be one of the elements: B, Al, Ga, In or Tl.
- ii) Element B has 4 valence electrons, so, its valency is 4 it belongs to group 14 (4+10). The element B could be: C, Si, Ge, Sn or Pb.

- iii) Element C has 2 valence electrons, its valency is 2 it belongs to group 2.
The element C could be: Be, Mg, Ca, Sr, Ba or Ra.

Q34. If an element X is placed in group 14, what will be the formula and the nature of bonding of its chloride?

Answer:

element X is of group 14 with electronic configuration 2, 8, 4.

Hence, number of valence electrons is 4.

It is difficult to lose all the 4 valence electrons or gain 4 more electrons, so, it is preferable to share these four electrons to acquire the stable electronic configuration of nearest inert gas.

So, chloride of element X is covalent, that is $XC l_4$.

Q35. Compare the radii of two species X and Y. Give reasons for your answer.

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

Answer:

Y has 12 protons and electrons each, so it is electrically neutral. Species Y has 12 protons and 10 electrons, so, it has 2 units of positive charge.

The electronic configuration of species X; K = 2, L = 8 and M = 2.

The electronic configuration of species Y; K = 2, L = 8.

Species X has 3 shells and species Y has 2 shells, so, species Y has smaller radius than species X.

Q36. Arrange the following elements in increasing order of their atomic radii.

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

Answer:

- a) Atomic radii will decrease along a period from left to right because there will be increase in nuclear charge. Li, Be, F, N belong to the same period. Hence, the radii of Li, Be, F and N increases in the order: $F < N < Be < Li$.
b) Atomic radii will increase in a group from top to bottom because the corresponding increases in the number of filled electronic shells. Cl, At, Br, I

belong to the same group. So atomic radii of Cl, At, Br and I will increase in the order: $Cl < Br < I < At$.

Q37. Identify and name the metal out of the following elements whose electronic configurations are given below:

- a) 2, 8, 2
- b) 2, 8, 1
- c) 2, 8, 7
- d) 2, 1

Answer:

The electronic configuration of given elements is: -

Electronic configuration	Number of valence electrons	Metal/Non-metals	Atomic number	Name of the element
2, 8, 2	2	Metal	$2 + 8 + 2 = 12$	Magnesium
2, 8, 1	1	Metal	$2 + 8 + 1 = 11$	Sodium
2, 8, 7	7	Non-metal	$2 + 8 + 7 = 17$	Chlorine
2, 1	1	Metal	$2 + 1 = 3$	Lithium

Hence, element with electronic configuration 2, 8, 7 is non-metal and rest are metals.

Q38. Write the formula of the product formed when the element A (atomic number 19) combines with the element B (atomic number 17). Draw its electronic dot structure. What is the nature of the bond formed?

Answer:

Atomic number of element A = 19

Electronic configuration of element A is 2, 8, 8, 1

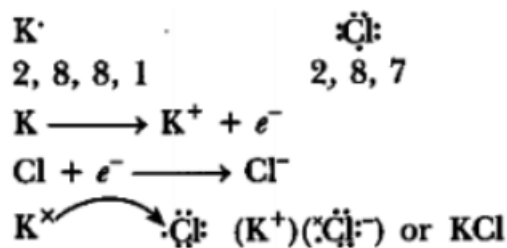
So, element A is metal potassium (K).

Atomic number of element B = 17

Electronic configuration of element B is 2, 8, 7

So, it's a non-metal, Chlorine (Cl).

Hence, the electron dot structure of KCl is



The ionic bond is formed between K^+ and Cl^- and the formula is KCl .

Q39. Arrange the following elements in the increasing order of their metallic character Mg, Ca, K, Ge, Ga.

Answer:

After arranging all the given elements in increasing atomic number.

Group number 1 2 13 14

Third period: -- Mg -- --

Fourth period: K Ca Ga Ge

The metallic character increases in the order: $\text{Ge} < \text{Ga} < \text{Ca} < \text{K}$

On comparing Ca and Mg, Ca is more metallic than Mg as metallic character increases down the group .

So, the overall metallic character increases in order: $\text{Ge} < \text{Ga} < \text{Mg} < \text{Ca} < \text{K}$.

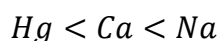
Q40. Identify the elements with the following property and arrange them in increasing order of their reactivity.

- An element which is a soft and reactive metal.
- The metal which is an important constituent of limestone.
- The metal which exists in liquid state at room temperature.

Answer:

- Sodium (Na) and Potassium (K) are alkali metals which are soft and reactive.
- The main constituent of limestone is calcium (Ca).
- Mercury (Hg) is a metal which exists in liquid state at room temperature.

Hence, increasing order of their reactivity



Q41. Properties of the elements are given below. Where would you locate the following elements in the periodic table?

- a) A soft metal under kerosene.
- b) An element with variable (more than one) valency stored under water.
- c) An element which is tetravalent and forms the basis of organic chemistry.
- d) An element which is an inert gas with atomic number 2.
- e) An element whose thin oxide layer is used to make other elements corrosion resistant by the process of “anodising”.

Answer:

- a) Alkali metals are soft to air and moisture. Example: Sodium and Potassium. Sodium (Na) is in group 1 and period 3 or potassium (K) is in group 1 and period 4.
- b) Phosphorus is reactive towards air not water also it shows variable valency of 3 and 5. So, it is stored underwater. Phosphorous is placed in group 15 and period 3.
- c) Carbon (C) is the element and tetravalent which is the basis of organic compounds, it is placed in group 14 and period 2.
- d) The lightest is Helium with atomic number 2, it is placed in group 18 and period 1.
- e) Al_2O_3 is the thin oxide layer metal used to make other elements corrosion resistant by anodising, Aluminium (Al), is in group 13 and period 3.

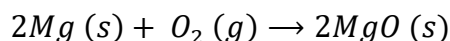
Long Answer Type Question

Q42. An element is placed in 2nd group and 3rd period of the periodic table, burns in presence of oxygen to form a basic oxide.

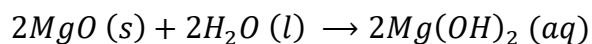
- a) Identify the element.
- b) Write the electronic configuration.
- c) Write a balanced equation when it burns in the presence of air.
- d) Write a balanced equation when this oxide is dissolved in water.
- e) Draw the electron dot structure for the formation of this oxide.

Answer:

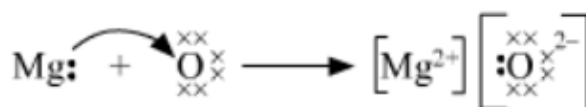
- a) The element lies in group 2, it is an alkaline earth metal. Also, it lies in 3rd period, so it has to be magnesium (Mg).
- b) Atomic number of Mg is 12, its electronic configuration is K = 2, L = 8 and M = 2.
- c) When Mg burns in air, it forms a basic oxide, MgO .



d) When MgO is dissolved in water, it will form magnesium hydroxide



e) Mg has 2 and oxygen has 6 valence electrons. So, the dot structure of magnesium oxide.



Q43. An element X (atomic number 17) reacts with an element Y (atomic number 20) to form a divalent halide.

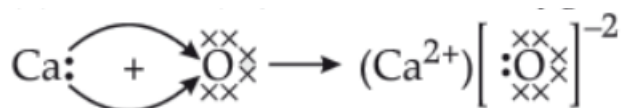
- Where in the periodic table are elements X and Y placed?
- Classify X and Y as metal (s), non-metals (s) or metalloids (s).
- What will be the nature of oxide of element Y? Identify the nature of bonding in the compound formed.
- Draw the electron dot structure of the divalent halide.

Answer:

- a) The electronic configuration of element 'X' with atomic number 17 is 2, 8, 7. So, it lies in group 17 (10 + 7). Since, in element X, third shell is being filled, it lies in 3rd period. So, we can say that X is a Chlorine.

The electronic configuration of element 'Y' with atomic number 20 is 2, 8, 8, 2. It lies in group 2, its 4th shell is being filled, so it lies in 4th period. So we can say that Y is calcium.

- Element X is a non-metal, since it has 7 electrons in valence shell and it needs one more electron to complete its octet. Element Y is a metal, since it has 2 electrons in valence shell, it can easily lose to achieve the stable configuration of the nearest inert gas.
- Element Y is a metal, that is Calcium, so, its oxide CaO must be basic in nature. Since metal and non-metals form ionic compounds, so, the nature of bonding in calcium oxide is ionic.
- The dot structure of divalent metal halide, that is, $CaCl_2$ is



Q44. Atomic number of few elements are given below 10, 20, 7, 14

- Identify the elements.
- Identify the group number of these elements in the periodic table.
- Identify the periods of these elements in the periodic table.
- What would be the electronic configuration of each of these elements?
- Determine the valency of these elements.

Answer:

Atomic number	Electronic configuration	Group number	Period number	Valency	Element
10	2, 8	18	2 nd	Zero	Neon
20	2, 8, 8, 2	2	4 th	2	Calcium
7	2, 5	15	2 nd	3	Nitrogen
14	2, 8, 4	14	3 rd	4	Silicon

Q45. Complete the following crossword puzzle given in the Figure.

Across

- An element with atomic number 12.
- Metal used in making cans and member of group 14.
- A lustrous non-metal which has 7 electrons in its outermost shell.

Down

- Highly reactive and soft metal which imparts yellow colour when subjected to flame and is kept in kerosene.
- The first element of second period.
- An element which is used in making fluorescent bulbs and is second member of group 18 in the modern periodic table.
- A radioactive element which is the last member of halogen family.
- Metal which is an important constituent of steel and forms rust when exposed to moist air.

9) The first metalloid in modern periodic table whose fibres are used in making bullet-proof vests.

[illegible]

Answer:

Across

- 1) atomic number 12 is magnesium.
- 2) Metal for making cans and of group 14 is tin.
- 3) A lustrous non-metal has 7 valence electrons is iodine.

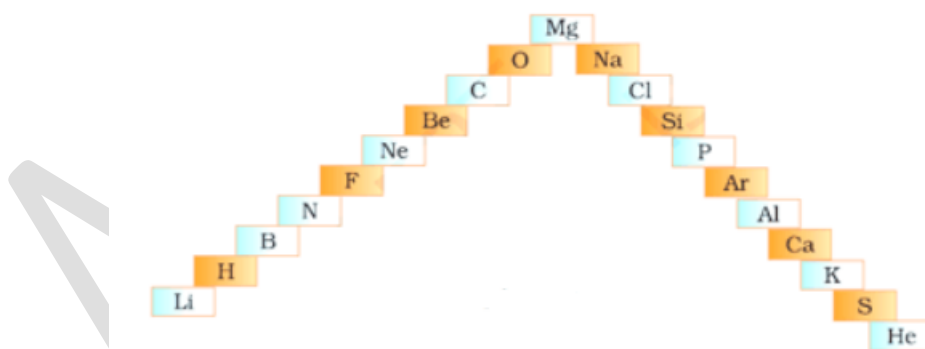
Down

- 2) Sodium is the highly reactive and soft metal which imparts yellow colour when subjected to flame and it is kept in kerosene.
- 5) Lithium is the first element of second period.
- 6) An element that is used for making fluorescent bulb it is the second member of group 18 in the modern periodic table is Neon.
- 7) Astatine is the radioactive element which is the last member of halogen family.
- 8) Iron is that metal which is an important constituent of steel and it forms rust when exposed to moist air.
- 9) Boron is the first metalloid in the modern periodic table whose fibres are used in making bullet-proof vests.

	¹ M	⁷ A	G	N	E	² S	I	U	M		
		S				O					
		³ T	⁸ I	N		D	⁹ B		⁵ L		
		A	R			⁴ I	O	D	I	⁶ N	E
		T	O			U	R		T	E	
		I	N			M	O		H	O	
		N					N		I	N	
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Q46. a) In this ladder (Figure) symbols of elements are jumbled up. Rearrange these symbols of elements in the increasing order of their atomic numbers in the periodic table.

b) Arrange them in the order of their group also.



Answer:

a) The arrangement of elements in the increasing order of their atomic numbers:

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

b) Group 1 – *H, Li, Na, K*

Group 2 – *Be, Mg, Ca*

Group 13 – *B, Al*

Group 14 – *C, Si*

- Group 15 – *N, P*
Group 16 – *O, S*
Group 17 – *F, Cl*
Group 18 – *He, Ne, Ar*

Q47. Mendeleev predicted the existence of certain elements not known at that time and named two of them as Eka-silicon and Eka-aluminium.

- Name the elements which have taken the place of these elements.**
- Mention the group and the period of these electron in the modern periodic table.**
- Classify these elements as metals, non-metals or metalloids.**
- How many valence electrons are present in each one of them?**

Answer:

- Germanium has taken the place of Eka-silicon and gallium has taken the place of Eka-aluminium.
- Germanium (Ge) belongs to group 14 and period 4.
Gallium (Ga) belongs to group 13 and period 4.
- Gallium is a other metal whereas germanium is a metalloid.
- As gallium lies in group 13, therefore it has 3 valence electrons.
As germanium lies in group 14, therefore it has 4 valence electrons.

Q48.

- Electropositive nature of the element (s) increases down the group and decreases across the period.**
- Electronegativity of the element decreases down the group and increases across the period.**
- Atomic size increases down the group and decreases across a period.**
- 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 electron with atomic numbers 3 to 9.

- Name the most electropositive element among them.**
- Name the most electronegative element.**
- Name of the element with smallest atomic size.**
- Name the element which is a metalloid.**
- Name the element which shows maximum valency.**

Answer:

The name and symbols of elements having atomic numbers ranging from 3 – 9:

Atomic number	3	4	5	6	7	8	9
Name	Lithium	Beryllium	Boron	Carbon	Nitrogen	Oxygen	Fluorine
Symbol	Li	Be	B	C	N	O	F

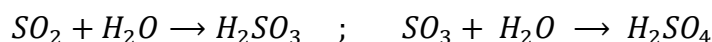
- Lithium is the most electropositive element.
- Fluorine is the most electronegative element.
- Fluorine has smallest atomic size.
- Boron is the metalloid element.
- Carbon shows the maximum valency, that is, 4.

Q49. 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.

- Identify the element X.
- Write the electronic configuration of X.
- Write the balanced chemical equation for the thermal decomposition of ferrous sulphate crystals?
- What would be the nature (acidic/basic) of oxides formed?
- Locate the position of the element in the modern periodic table.

Answer:

- Element X is a yellow solid at room temperature, which shows catenation and allotropy is sulphur (S). It will form 2 oxides SO_2 and SO_3 which are formed during thermal decomposition of ferrous sulphate crystals and are the major air pollutants.
- Sulphur atomic number = 16 also, its electronic configuration is K = 2, L = 8, m = 6.
- $2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$
- Sulphur is a non-metal, so both SO_2 and SO_3 are acidic oxides. They dissolve in water to form the corresponding acids.



- Sulphur has 6 valence electrons, so, it will lie in group 16. Also, since atomic number of Sulphur is 16, electronic configuration is K = 2, L = 8, M = 6. Hence it lies in 3rd period.

Q50. An element X of group 15 exists as diatomic molecule and combines with hydrogen at 773 K in presence of the catalyst to form a compound, ammonia which has a characteristic pungent smell.

- Identify the element X. How many valence electrons does it have?
- Draw the electron dot structure of the diatomic molecule of X. What type of bond is formed in it?
- Draw the electron dot structure for ammonia and what type of bond is formed in it?

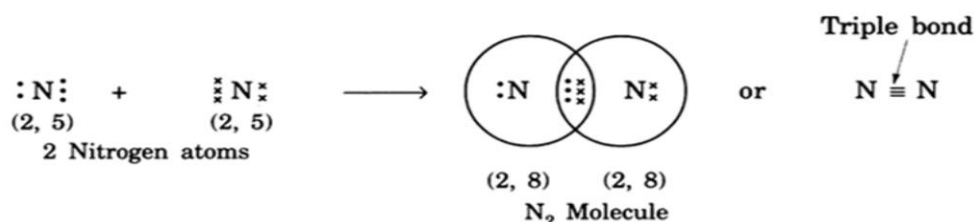
Answer:

Element X of group 15 is a diatomic molecule and it combines with hydrogen at 773 K in the presence of a catalyst to form ammonia which has a characteristic of smell, so, the element X is a nitrogen (N).

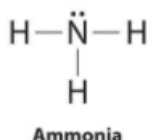


- The nitrogen's atomic number is 7. So, its electronic configuration is 2, 5. So, it has 5 electrons.
- Nitrogen has five valence electrons, and requires three more electrons for its octet. So, it requires to share the 3 of its electrons with other nitrogen atom to form a diatomic molecule of N_2 gas.

Hence, three covalent bonds are formed between two nitrogen atoms and each nitrogen atom is left with one pair of electrons.



- Electron dot structure for ammonia:



There are three $N - H$ single covalent bonds in NH_3 molecule, and one pair of electron on nitrogen atom.

Q51. Which group of elements could be placed in Mendeleev's periodic table without distributing the original order? Give reason.

Answer:

Noble gases can be placed without disturbing the original order in the new group since they are present in extremely low concentrations in the atmosphere.

Noble gases such as Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr) and radon (Rn) were not known when Mendeleev presented his periodic table and when these gases came into existence later, they were placed in new group which is called as zero group.

Q52. Give an account of the process adopted by Mendeleev for the classification of elements. How did he arrive at "periodic law"?

Answer:

When Mendeleev started his work at that time 63 elements were known. He analysed the relationship between the atomic masses of the elements and their physical and chemical properties. From chemical properties, he concentrated on the compounds formed by elements with oxygen and hydrogen because they were reactive and formed compound with most of the elements. Formulae of oxides and hydrides formed by elements were treated as the basic property of the elements for their classification.

He wrote properties of one element on 63 cards and sorted out the elements with similar properties and paired card together on a wall. Then he saw that most of the elements get a place in a periodic table and are arranged in order of increasing atomic masses.

He observed that they occur as a periodic recurrence of elements with similar physical and chemical properties, this is the base on which Mendeleev created a periodic law.

It states that "the properties of elements are the periodic function of their atomic masses".