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TEXTBOOK QUESTIONS SOLVED

Question 1. What is the basic theme of organisation in the periodic table?
Answer: The basic theme of organisation of elements in the periodic table is to simplify and systematize the study of the properties of all the elements and millions of their compounds. This has made the study simple because the properties of elements are now studied in form of groups rather than individually.

Question 2. Which important property did Mendeleev use to classify the elements in this periodic table and did he stick to that?
Answer: Mendeleev used atomic weight as the basis of classification of elements in the periodic table. He did stick to it and classify elements into groups and periods.

Question 3. What is the basic difference in approach between Mendeleev's Periodic Law and the Modem Periodic Law?
Answer: The basic difference in approach between Mendeleev's Periodic Law and Modem Periodic Law is the change in basis of classification of elements from atomic weight to atomic number.

Question 4. On the basis of quantum numbers, justify that the sixth period of the periodic table should have 32 elements.
Answer: The sixth period corresponds to sixth shell. The orbitals present in this shell are 6s, 4f, 5p, and 6d. The maximum number of electrons which can be present in these sub¬shell is 2 + 14 + 6 + 10 = 32. Since the number of elements in a period corresponds to the number of electrons in the shells, therefore, sixth period should have a maximum of 32 elements.

Question 5. In terms of period and group where will you locate the element with z = 114?
Answer: Period - 7 and Group -14 Block-p.

Question 6. Write the atomic number of the element present in the third period and seventeenth group of the periodic table.
Answer: The element is chlorine (Cl) with atomic number (Z) = 17.

Question 7. Which element do you think would have been named by
(i) Lawrence Berkeley Laboratory
(ii) Seaborg's group?
Answer:
(i) Lawrencium (Lr) with atomic number (z) = 103
(ii) Seaborgium (Sg) with atomic number (z) = 106.

Question 8. Why do elements in the same group have similar physical and chemical properties?
Answer: The elements in a group have same valence shell electronic configuration and hence have similar physical and chemical properties.

Question 9. What does atomic radius and ionic radius really mean to you?
Answer: Atomic radius. The distance from the centre of nucleus to

the outermost shell o electrons in the atom of any element is called its atomic radius. It refers to both covalen or metallic radius depending on whether the element is a non-metal or a metal.
Ionic radius. The Ionic radii can be estimated by measuring the distances between cations and anions in ionic crystals.

Question 10. How do atomic radius vary in a period and in a group? How do you explain the variation?
Answer: Within a group Atomic radius increases down the group.
Reason. This is due to continuous increases in the number of electronic shells or orbit numbers in the structure of atoms of the elements down a group.
Variation across period.
Atomic Radii. From left to right across a period atomic radii generally decreases due
to increase in effective nuclear charge from left to right across a period.

Question 11. What do you understand by isoelectronic species? Name a species that tvill be iso electronic with each of the following atoms or ions.
(i) F^- (ii) Ar (iii) Mg^{2+} (iv) Rb^+
Answer: Isoelectronic species are those species (atoms/ions) which have same number of electrons. The isoelectronic species are:
(i) Na^+ (iii) Na^+
(ii) K^+ (iv) Sr^{2+}

Question 12. Consider the following species:
N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+}, Al^{3+}
(a) What is common in them?
(b) Arrange them in order of increasing ionic radii?
Answer:
(a) All of them are isoelectronic in nature and have 10 electrons each.
(b) In isoelectronic species, greater the nuclear charge, lesser will be the atomic or ionic radius.
$Al^{3+} < Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$

Question 13. Explain why cation are smaller and anions larger in radii than their parent atoms?
Answer: A cation is smaller than the parent atom because it has fewer electrons while its nuclear charge remains the same. The size of anion will be larger than that of parent atom because the addition of one or more electrons would result in increased repulsion among the electrons and a decrease in effective nuclear charge.

Question 14. What is the significance of the terms - isolated gaseous atom and ground state while defining the ionization enthalpy and electron gain enthalpy?[Hint: Requirements for comparison purposes]
Answer:

- Significance of term ‘isolated gaseous atom’. The atoms in the gaseous state are far separated in the sense that they do not have any mutual attractive and repulsive interactions. These are therefore regarded as isolated atoms. In this state the value of ionization enthalpy and electron gain enthalpy are not influenced by the presence of the other atoms. It is not possible to express these when the atoms are in the ; liquid or solid state due to the presence of inter atomic forces.
- Significance of ground state. Ground state of the atom represents the normal - energy state of an atom. It means electrons in a particular atom are in the lowest energy state and they neither lose nor gain electron. Both ionisation

enthalpy and I electron gain enthalpy are generally expressed with respect to the ground state ofan atom only.

Question 15. Energy of an electron in the ground state of the hydrogen atom is- 2.18×10^{-18} J.Calculate the ionization enthalpy of atomic hydrogen in terms of $JMol^{-1}$.[Hint: Apply the idea of mole concept to derive the answer],
Answer:
The ionisation enthalpy is for 1 mole atoms. Therefore, ground state energy of the , atoms may be expressed as E (ground state) = (-2.18×10^{-18} J) x(6.022×10^{23} mol^{-1})= -1.312×10^{6} J mol^{-1}
Ionisation enthalpy =E_{∞}-E ground state
= 0-($-1.312 \times 10^{6} mol^{-1}$)
= 1.312×10^{6} J mol^{-1}.

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