How to Find Valency Questions with Solutions

Q1: The chemical formula of Zinc (II) hydroxide is:

a. Zn_2OH
b. ZnOH
c. $Zn(OH)_2$
d. None of the above

Answer: (c)

Explanation: The given oxidation state of Zinc is +2, and the oxidation state of the hydroxide ion is -1 (known). The charges on either ion are exchanged to determine the number of each type of ion present in the chemical formula to determine the chemical formula. This is done because the overall molecule of a chemical compound is neutral. Hence, the positive and the negative charges must be neutralised. The chemical formula of zinc (II) hydroxide is $Zn(OH)_2$.

Q2. What is the difference between Valency and Oxidation State?

Answer: Valency is determined by the number of electrons present in the valence shell or the outermost shell of a neutral atom. It is the number of electrons that must be added to or removed from an atom's outermost shell to complete its octet. This number is fixed for an atom in a particular reaction, whereas the oxidation state is the number of electrons gained or lost by an atom to undergo chemical bonding. This number varies depending on the type of bond and the type and number of atoms with which bonding is to be done.

Q3. How is the Oxidation State equal to the charge on an atom in the compound?

Answer: The Oxidation State or Oxidation Number refers to the number of electrons gained or lost during the time of chemical bonding. The species that gain electrons acquire a negative charge; the species that lose electrons acquire a positive charge. Hence, the number of electrons gained or lost equals the amount of positive or negative charge acquired by the chemical species. Therefore, the oxidation state equals the charge on an atom in the compound.

Q4. In which reactions do the Valency of elements change?

Answer: The valencies of various elements change in a redox reaction.
For example: $2FeSO_4 + \text{heat} \rightarrow Fe_2O_3 + SO_2 + SO_3$
The valencies of Fe and S change on undergoing the redox reaction.

Q5. The empirical formula is the:

a. Simplest formula of the compound

b. Molecular formula of the compound
c. Chemical formula of the compound
d. None of the above

Answer: (a)

Explanation: In an empirical formula, the atoms are represented in their simplest whole number ratios.

Q6. How can Valency be defined in terms of hydrogen atoms?

Answer: Valency can be determined by the number of hydrogen atoms that combine directly or indirectly with an atom.
For example, oxygen combines with two hydrogen atoms to form water; therefore, its Valency is 2. Similarly, nitrogen combines with three atoms of hydrogen; therefore, its Valency is three.

Q7. What is a Free Valency?

Answer: Free Valency is a surface phenomenon. Surface phenomena such as catalysis and adsorption on a solid surface result from Free Valency. This happens because the particles in the bulk of the solid have their Valency satisfied from all sides in bulk. However, the particles on the surface of the solid have their valencies satisfied from all directions except the open side (surface side) of the solid. This unsatisfied Valency is termed Free Valency. Due to Free Valency, the particles of the solids make bonds with the adsorbates and help with the process of adsorption.

Q8. The radical that does not has a Valency of 2 is:
a. $MgCO_3$
b. NH_4
c. CO_3
d. SO_4

Answer: (b)

Explanation: Both the radicals CO_3 and SO_4 have a Valency of -2. The radicals present in $MgCO_3$ also have a Valency of +2 and -2, respectively. NH_4 does not have a Valency of 2.

Q9. The Valency of copper in copper oxide is:
a. +1
b. +2
c. -1
d. -2

Answer: (b.)

Explanation: The chemical formula of copper oxide is CuO. As known, the Valency of oxide ion is -2. Therefore, according to the given chemical formula, the Valency of copper must be equal to and opposite to that of the oxide ion. So, the Valency of copper is +2.

Q10. Covalency is the number of _____ of electrons involved in the formation of covalent bonds.

Answer: Shared pair

Explanation: Covalency is defined as the number of electrons shared by an atom with another atom, either of the same or the different elements, in order to form a covalent bond.

Q11. How can the Valency of an atom be determined?

Answer: The Valency of an atom can be determined by the number of valence electrons. The ground rule of stability of atoms is that all atoms must attain an octet in their valence shells to achieve a state of minimum possible energy. Thus, for this purpose, the atoms sometimes gain or sometimes lose some electrons during bonding.
For an atom whose valence shell contains less than 4 electrons, the Valency is equal to the number of the valence shell electrons. However, if the number of electrons in the valence shell is greater than 4, Valency would be (8 - no. of valence shell electrons). For atoms with the number of valence electrons equal to 4, the Valency is 4.
For example, an element with the atomic number 9 will have a Valency of 1. This is because the valence shell of the element has 7 electrons; the Valency of atoms having the number of valence electrons greater than 4 is (8- no. of valence shell electrons). Therefore, the Valency of the element with the atomic number 9 is (8-1) = 1.

Q12. State whether the given statement is true or false:
The Valency of an atom is always equal to its Oxidation State.

Answer: False

Explanation: The Valency of an atom may sometimes be equal to its Oxidation State but not always.

Q13. Why is the Valency of all the alkali metals 1?

Answer: This is because the general electronic configuration of all the alkali metals is: [noble gas configuration] ns^1. Hence, by removing an electron, the alkali metals get a noble gas core. This gives extra stability to the alkali metals.

Q14. What is the Valency of oxygen?

Answer: The atomic number of oxygen is 8. So, the number of valence electrons in oxygen is 6. Oxygen cannot lose 6 electrons to get the nearest noble gas configuration because a huge amount of energy will be required to lose 6 electrons. By adding two more electrons, the oxygen atom gets a noble gas configuration. Therefore, the Valency of oxygen is 2.

Q15. The Valency of sodium (Na) is:

a. 1
b. 2
c. 3
d. 4

Answer: (a)

Explanation: The electronic configuration of sodium is [Ne] $3s^1$. Hence, by losing an electron, sodium gains the nearest noble gas configuration, which is the most stable electronic configuration. Thus, sodium will tend to lose an electron to participate in the reaction. Hence, the Valency of sodium is 1.

Practice Questions on How to Find Valency

Q1. What is the common Valency of f and d-block elements?

Answer: The f and d-block elements have various valencies depending on their electronic configuration. The common Valency for all the f and d-block elements is either 2 or 3.

Q2. Hydrogen forms only one bond. The Valency of hydrogen is:

a. 1
b. -1
c. 2
d. -2

Answer: (a.)

Explanation: It is easier for hydrogen to lose an electron rather than to gain an electron to gain stability. Hence, hydrogen loses an electron and forms a cation. Therefore, the Valency of hydrogen is 1.

Q3. Fluorine is the most electronegative element. What is the Valency of fluorine?

Answer: The atomic number of fluorine is 9. This means that the valence shell of fluorine has 7 electrons. Therefore, fluorine needs only 1 more electron to complete its octet. Thus, the Valency of fluorine is always one.

Q4. Why do the elements of f-block show variable Valency?

Answer: This is due to the incomplete filling of the f-orbitals. The Valency is due to both- the ns orbitals and the incompletely filled f-orbitals. This is why the f-block elements have variable Valency.

Q5. What are the valencies of nitrogen, oxygen and fluorine?

Answer: Nitrogen has two valencies. The atomic number of nitrogen is 7; therefore, it has 5 valence electrons. Thus, the nitrogen atom must gain 3 more electrons to complete its octet. So, the nitrogen atom shows a Valency 3. Also, in some cases, such as while bonding with a highly electronegative element, nitrogen shows a Valency 5. For example, in NF_4^+, the Valency of nitrogen is 5.
Oxygen has 6 valence electrons. So, the Valency of oxygen is 2. Similarly, the number of valence electrons in fluorine is 7. Thus, the Valency of fluorine is 1.