Chemistry Worksheets Class 12 on Chapter 6 General Principles and Processes of Isolation of Elements with Answers - Set 3

Q1. The iron produced in the blast furnace is called-

a.) pig iron
b.) wrought iron
c.) cast iron
d.) steel

Correct Answer– (a.) pig iron

Q2. 100% copper is obtained from crude copper by:

a.) zone refining method
b.) electrorefining
c.) liquation
d.) None of the above

Correct Answer– (b.) electrorefining

Q3. Commercial zinc is refined by:

a.) amalgamation
b.) poling
c.) carbon reduction
d.) All of the above

Correct Answer– (c.) carbon reduction

Q4. Unwanted material with ore is called as ____.

a.) Gangue
b.) Rust
c.) Slag
d.) Silica

Correct Answer– (a.) Gangue

Q5. Cinnabar is an ore of:

a.) Hg
b.) Cu
c.) Pb
d.) Zn

Correct Answer– (a.) Hg

Q6. Give equations for the industrial extraction of zinc from calamine.

Answer.
Zinc is extracted from calamine by Calcination:
$ZnCO_3 \rightarrow ZnO + CO_2$

Then, Zinc oxides heated with carbon and zinc metal is produced.
$ZnO + C \rightarrow Zn + CO$

Q7. (a) Give one example of each of the following:
(i) Acid flux
(ii) Basic flux

(b) What happens when-
(i) Cu_2O undergoes self-reduction in a silica line converter.
(ii) Haematite oxidises carbon to carbon monoxide.

Answer.
(a) (i) Acid flux: SiO_2
(ii) Basic flux: CaO

(b) (i) Cu_2O undergoes self-reduction in a silica line converter to form blister copper as:
$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$
(ii) Haematite oxidises carbon to carbon monoxide forming iron.
$Fe_2O_3 + 3C \rightarrow 3CO + 2Fe$

Q8. Differentiate between flux and slag.

Answer. Flux is the material or substance that is added to molten metals to bond with impurities that can be readily removed whereas slag is the waste material that is removed. Fluxes are used during the refining of metals. examples are acid silica, basic lime, rosins etc. The choice of flux depends on the material involved in the given operation. The substance that is added to the charge in the furnace to remove the gangue (impurities) is known as flux. Metallurgy deals with the process of purification of metals and the formation of alloys.

Slag is an impure residue that contains a large amount of calcium, magnesium silicate, iron, aluminium etc derived during the process of pig iron and steel production and during the smelting of metals such as copper, lead and nickel. The extraction of iron from its ore is a long and subdued process, that helps in separating the useful components from the waste materials such as slag.

Q9. What are froth stabilizers? Give two examples.

Answer. Froth stabilizers are the chemical substances used to stabilise the froth formed during the froth flotation process of sulphide ores.
Examples are cresol and aniline.

Q10. Define leaching.

Answer. Leaching is a chemical method of concentration and is useful in case the ore is stable in a suitable solvent. In this method, the powdered ore is treated with certain reagents which can selectively dissolve the ore but not the impurities. The impurities left undissolved are removed by filtration. The leaching method is used for concentrating ores of aluminium, silver, gold, etc.

Q11. State the principles of the following methods of refining crude metals-
(i) Zone refining
(ii) Liquation method
(iii) Chromatographic method

Answer.
(i) Zone refining: Metals such as germanium, silicon, gallium, indium and boron are made free from impurities using this method. In this process the impure metal is attached to a circular mobile heater at one end. As the heater is moved, the pure metal crystallizes out and the impurities pass on to the adjacent part of the metal. This way the impurities get accumulated at the other end of the rod which is cut in order to obtain the pure metal.

(ii) Liquation: In this method, the melting point of the metals are taken into consideration. Metals with low melting points are purified using this process. The melting point of the impurities is higher than the metal. The metals are converted into a liquid state by supplying heat at a temperature slightly above their melting point. Pure metal melts and flows down from the furnace leaving the impurities behind.

(iii) Chromatographic method: In this method, the crude mixture is put into a liquid or gaseous medium. This medium is moved through an adsorbent. Different components of the mixture are adsorbed at different levels of the column. These components of the mixture are removed by using suitable solvents.

Q12. Give reasons:
a) Copper matte is put in silica lined converter.
b) Cryolite is added to alumina during electrolytic reduction.

c) Pine oil is used in the froth floatation process.

Answer.
(i) Copper matte mainly contains Cu_2S and FeS. For removing the gangue FeS, silica present in the lining of the Bessemer's converter acts as a flux and forms slag (iron silicate) on reaction with FeO.
$2Fe + 3O_2 \rightarrow 2FeO + 2SO_2$
$FeO + SiO_2 \rightarrow FeSiO_3$
(ii) The addition of cryolite to alumina electrolysis lowers the melting point of alumina while increasing the melt electrical conductivity.
(iii) Pine oil is added in the froth floatation method because it enhances the non-wettability of mineral particles.

Q13. Why are the graphite electrodes in the extraction of 'aluminium' by the Hall-Heroult process need to be changed frequently?

Answer. As they oxidise, the anode is periodically renewed. At the positive anode, oxygen gas is formed, and at the high temperature of the electrolysis cell, it burns and oxidises the carbon electrodes, resulting in toxic carbon monoxide or carbon dioxide. As a result, the carbon graphite electrode is replaced on a regular basis.

Q14. Copper can be extracted by hydrometallurgy but not zinc. Explain?

Answer. Hydrometallurgy can extract copper but not zinc because zinc's reduction potential is lower than copper's. As a result, zinc can reduce copper from its solution.
$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$
However, to remove zinc from its solution, we need a more reactive metal with a lower reduction potential than zinc, such as Al, Mg, Ca, K. However, these metals readily react with water, resulting in the formation of H_2 gas. As a result, these metals cannot be used to remove zinc ion from the solution.
$2K + 2H_2O \rightarrow KOH + H_2$

Q15. What is German silver? Write its use.

Answer. The usual formulation of German silver is 60% copper, 20% nickel and 20% zinc. It is also named as Nickel silver due to its silvery appearance, but it contains no elemental silver unless plated. Some of the uses are as follows-

- It is used to make decorative items such as utensils, tableware, cutlery, and ornaments.
- It is also used to make coins.
- Contact springs in telephone exchanges are made from an alloy containing 18% Ni.
- It serves as the foundation for electroplated articles.

Q16. The choice of a reducing agent in a particular case depends on the thermodynamic factor. How far do you agree with this statement? Support your opinion with two examples.

Answer. The thermodynamic factor helps us in choosing a suitable reducing agent for the reduction of a particular metal oxide to metal. The feasibility of thermal reduction can be predicted on the basis of $\Delta_f G°$ vs T plots for the formation of oxides, known as Ellingham diagram. From the diagram, it can be predicted that metals for which the standard free energy of formation of their oxides is more negative can reduce those metal oxides for which the standard free energy of formation of their respective oxide is less negative. In other words, a metal will reduce the oxides of other metals which lie above it in the Ellingham diagram because the standard energy free energy change $\Delta_f G°$ of the combined redox reaction will be –ve by an amount equal to the difference in $\Delta_f G°$ of the two metal oxides.
For example, both Al and Zn can reduce FeO to Fe but Fe cannot reduce Al_2O_3 to Al or ZnO to Zn. Similarly, C can reduce ZnO to Zn but not CO. Thus, the choice of a particular reducing agent depends in the thermodynamic factor.

Q17. Describe the principle controlling each of the following processes :
(i) Preparation of cast iron from pig iron.
(ii) Preparation of pure alumina (Al_2O_3) from bauxite ore.

Answer.
(i) Pig iron: Pig iron is the iron obtained from blast furance. It is an impure form of iron that contains 4% carbon and trace amounts of S, P, Si, and Mn. It can be shaped in a variety of ways.

(ii) Bauxite $Al_2O_3.xH_2O$ is the primary ore of aluminium.
Alumina leaching from bauxite: Impurities in bauxite include SiO_2, iron oxides, and titanium oxide (TiO_2). Concentration is accomplished by degassing the powdered ore with a concentrated NaOH solution at 473 – 523 K and 35 – 36 bar pressure. The Al_2O_3 is leached out in the form of sodium aluminate.
$Al_2O_3 + NaOH + 3H_2O \rightarrow 2Na[Al(OH)_4]$
By passing CO2 gas and hydrated Al_2O_3, the sodium aluminate solution is neutralised.
$Al_2O_3.H_2O \rightarrow Al_2O_3 + xH_2O$

Q18. (i) The extraction of gold by leaching with NaCN involves both oxidation and reduction. Justify giving chemical equations.
(ii) Name the method used for removing gangue from sulphide ores.
(iii) How is wrought iron different from steel?

Answer. (i) The extraction of gold involves leaching the metal with NaCN.
Oxidation : $4Au + 8NaCN + O_2 + 2H_2O \rightarrow 4Na\,[AU(CN)_2] + 4NaOH$
In this reaction Au is oxidised to Au^+ ions.
Reduction : $2Na\,[Au(CN)_2] + Zn \rightarrow Na_2[Zn(CN)_4] + 2Au$
In this reaction Au^+ ions are reduced to Au.

(ii) For removing gangue from sulphide ores, the Froth Floatation method is used.

(iii) Wrought iron is the purest form of commercial iron, containing approximately 0.2 – 0.5 % carbon, whereas steel contains approximately (0.5 – 1.5) % carbon.

Q19. In the extraction of aluminium-
(i) Name the process of concentration of bauxite.
(ii) Write the cathode reaction in electrolytic reduction of alumina.
(iii) Write the function and chemical formula of cryolite.
(iv) Write a chemical equation for the action of heat on aluminium hydroxide.
(v) Why is it necessary to replace anodes from time to time?

Answer.
(i) The concentration of ore is done by Baeyer's process using the chemical method.
(ii) Hall Heroult's process is used for the electrolytic reduction of alumina. The reaction at the cathode is as follows:
At the cathode, pure aluminium metal is formed.
(iii) Cryolite is a sodium aluminium fluoride (Na_3AlF_6) compound. It is an aluminium ore. To lower the melting point and increase electrical conductivity, cryolite and fluorspar are added to the molten alumina mixture.
(iv) $2Al(OH)_3 \rightarrow Al_2O_3 + 3H_2O$
(v) The anode's oxygen escapes as gas or reacts with the carbon anode. As a result, the anode is oxidised to carbon monoxide, which either burns to produce CO_2 or escapes. As a result, the anode must be replaced on a regular basis.

Q20. Mention the role of the following:
(i) SiO_2 in the extraction of Cu from copper matte.
(ii) $CaCO_3$ in the metallurgy of Fe.
(iii) CO in the metallurgy of iron.
(iv) I_2 in the purification of zirconium.
(v) NaCN in the extraction of gold from gold ore.

Answer.
(i) SiO_2 reacts with iron oxide to form ferrous silicate slag, which is removed during copper extraction from copper matte.
(ii) $CaCO_3$ decomposes to calcium oxide first which acts as a flux.
(iii) CO acts as a reducing agent which acts as a flux in the metallurgy of iron.
(iv) I_2 forms a volatile complex with zirconium.
(v) NaCN is used as a depressant in the froth floatation process to separate PbS and ZnS from ores. It selectively prevents ZnS from entering the froth and removes PbS along with it.