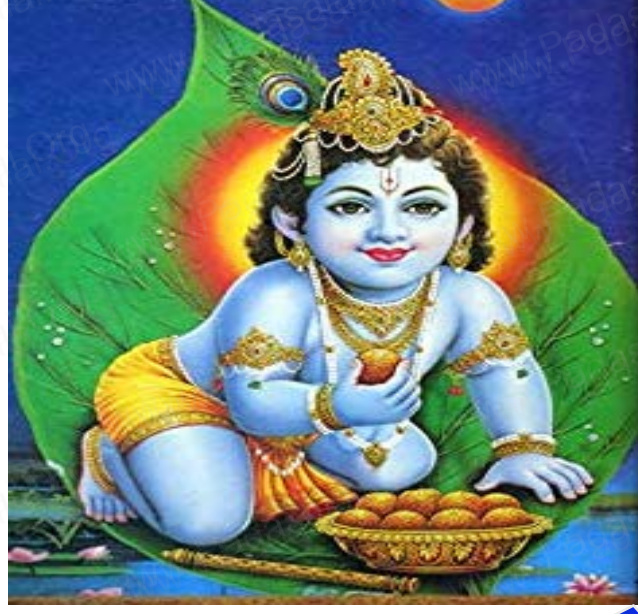




Padalsalai's Telegram Groups!

(தலைப்பிற்கு கீழே உள்ள லிங்கை கிளிக் செய்து குழுவில் இணையவும்!)

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SHRI KRISHNA ACADEMY

CHEMISTRY-MINIMUM MATERIAL 2019-2020

சிறப்பம்சங்கள்

- அரசுப் பொதுத்தேர்வு விடைக்குப்புகள் அடிப்படையில் கற்றல் கையேடு(Minimum Material) உருவாக்கப்பட்டுள்ளது.
- மெல்லக் கற்கும் மாணவர்கள் விரைவாகக் கற்று அதிக மதிப்பெண் பெறும் வகையில் இவ்விடைக்களஞ்சியம் அமைக்கப்பட்டுள்ளது.
- அரசுப் பொதுத்தேர்வு தேர்வில் கட்டாயமாகக் கேட்கப்படும் வினாக்களுக்கு(அகவய வினாக்கள்) விடைகள் கொடுக்கப்பட்டுள்ளது.
- கற்பதற்கு எளிய நடைமையில் வடிவமைக்கப்பட்டுள்ளது.
- புறவய வினாக்கள் மற்றும் அகவய வினாக்கள் விடைக்குறிப்புகளுடன் அமைந்துள்ளது.

CONTACT:9965531727,9443231727

LN-1 METALLURGY

ONE MARKS BOOK BACK

- Bauxite has the composition
a) Al_2O_3 **b) $\text{Al}_2\text{O}_3 \cdot n\text{H}_2\text{O}$** c) $\text{Fe}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ d) None of these
- Roasting of sulphide ore gives the gas (A). (A) is a colourless gas. Aqueous solution of (A) is acidic. The gas (A) is
a) CO_2 b) SO_3 **c) SO_2** d) H_2S
- Which one of the following reaction represents calcinations?
a) $2\text{Zn} + \text{O}_2 \rightarrow 2\text{ZnO}$ b) $2\text{ZnS} + 3\text{O}_2 \rightarrow 2\text{ZnO} + 2\text{SO}_2$
c) $\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2$ d) Both (a) and (c)
- The metal oxide which cannot be reduced to metal by carbon is
a) PbO **b) Al_2O_3** c) ZnO d) FeO
- Which of the metal is extracted by Hall-Heroult process?
a) Al b) Ni c) Cu d) Zn
- Which of the following statements, about the advantage of roasting of sulphide ore before reduction is not true?
a) ΔG_f° of sulphide is greater than those for CS_2 and H_2S .
b) ΔG_r° is negative for roasting of sulphide ore to oxide
c) Roasting of the sulphide to its oxide is thermodynamically feasible.
d) Carbon and hydrogen are suitable reducing agents for metal sulphides.
- Match items in column - I with the items of column - II and assign the correct code.

Column-I		Column-II	
A	Cyanide process	(i)	Ultrapure Ge
B	Froth floatation process	(ii)	Dressing of ZnS
C	Electrolytic reduction	(iii)	Extraction of Al
D	Zone refining	(iv)	Extraction of Au
		(v)	Purification of Ni

- | | |
|------------------------------------|-----------------------------|
| A B C D | A B C D |
| a) i ii iii iv | b) iii iv v i |
| c) iv ii iii i | d) ii iii i v |

- Wolframite ore is separated from tinstone by the process of
a) Smelting b) Calcination c) Roasting **d) Electromagnetic separation**

9. Which one of the following is not feasible
- a) $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)} + \text{Zn}^{2+}(\text{aq})$ **b) $\text{Cu(s)} + \text{Zn}^{2+}(\text{aq}) \rightarrow \text{Zn(s)} + \text{Cu}^{2+}(\text{aq})$**
- c) $\text{Cu(s)} + 2\text{Ag}^{+}(\text{aq}) \rightarrow 2\text{Ag(s)} + \text{Cu}^{2+}(\text{aq})$ d) $\text{Fe(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)} + \text{Fe}^{2+}(\text{aq})$
10. Electrochemical process is used to extract
- a) Iron b) Lead **c) Sodium** d) silver
11. Flux is a substance which is used to convert
- a) Mineral into silicate **b) Infusible impurities to soluble impurities**
- c) Soluble impurities to infusible impurities d) All of these
12. Which one of the following ores is best concentrated by froth – floatation method?
- a) Magnetite b) Haematite **c) Galena** d) Cassiterite
13. In the extraction of aluminium from alumina by electrolysis, cryolite is added to
- a) Lower the melting point of alumina** b) Remove impurities from alumina
- c) Decrease the electrical conductivity d) Increase the rate of reduction
14. Zinc is obtained from ZnO by
- a) Carbon reduction** b) Reduction using silver
- c) Electrochemical process d) Acid leaching
15. Cupellation is a process used for the refining of
- a) Silver** b) Lead c) Copper d) iron
16. Extraction of gold and silver involves leaching with cyanide ion. silver is later recovered by
- a) Distillation b) Zone refining **c) Displacement with zinc** d) liquation
17. Considering Ellingham diagram, which of the following metals can be used to reduce alumina?
- a) Fe b) Cu **c) Mg** d) Zn
18. The following set of reactions are used in refining Zirconium
- $$\text{Zr (impure)} + 2\text{I}_2 \xrightarrow{523\text{K}} \text{ZrI}_4$$
- $$\text{ZrI}_4 \xrightarrow{1800\text{K}} \text{Zr(pure)} + 2\text{I}_2$$
- This method is known as
- a) Liquation **b) van Arkel process** c) Zone refining d) Mond's process
- 19.** Which of the following is used for concentrating ore in metallurgy?
- a) Leaching b) Roasting c) Froth floatation **d) Both (a) and (c)**
20. The incorrect statement among the following is
- a) Nickel is refined by Mond's process
- b) Titanium is refined by Van Arkel's process
- c) Zinc blende is concentrated by froth floatation
- d) In the metallurgy of gold, the metal is leached with dilute sodium chloride solution**
21. In the electrolytic refining of copper, which one of the following is used as anode?
- a) Pure copper **b) Impure copper** c) Carbon rod d) Platinum electrode

22. Which of the following plot gives Ellingham diagram

a) ΔS Vs T

b) ΔG^0 Vs T

c) ΔG^0 Vs $1/T$

d) ΔG^0 Vs T^2

23. In the Ellingham diagram, for the formation of carbon monoxide

a) $\left(\frac{\Delta S^0}{\Delta T}\right)$ is negative

b) $\left(\frac{\Delta G^0}{\Delta T}\right)$ is positive

c) $\left(\frac{\Delta G^0}{\Delta T}\right)$ is negative

d) initially $\left(\frac{\Delta T}{\Delta G^0}\right)$ is positive, after 700°C ,
 $\left(\frac{\Delta G^0}{\Delta T}\right)$ is negative

24. Which of the following reduction is not thermodynamically feasible?

a) $\text{Cr}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Cr}$

b) $\text{Al}_2\text{O}_3 + 2\text{Cr} \rightarrow \text{Cr}_2\text{O}_3 + 2\text{Al}$

c) $3\text{TiO}_2 + 4\text{Al} \rightarrow 2\text{Al}_2\text{O}_3 + 3\text{Ti}$

d) none of these

25. Which of the following is not true with respect to Ellingham diagram?

a) Free energy changes follow a straight line. Deviation occurs when there is a phase change.

b) The graph for the formation of CO_2 is a straight line almost parallel to free energy axis.

c) Negative slope of CO shows that it becomes more stable with increase in temperature.

d) Positive slope of metal oxides shows that their stabilities decrease with increase in temperature.

ANSWER THE FOLLOWING QUESTIONS

1. What are the differences between minerals and ores?

MINERALS	ORES
A naturally occurring substance obtained by mining which contains the metal in free state or in the form of compounds like oxides, sulphides etc... is called a mineral .	minerals that contains a high percentage of metal from which metal can be extracted conveniently and economically.
All minerals are not ores	All ores are minerals

2. What are the various steps involved in extraction of pure metals from their ores?

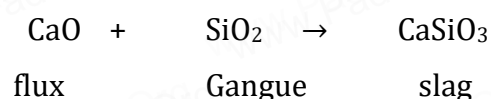
(i) concentration of the ore

(ii) extraction of crude metal

(iii) refining of crude metal

3. What is the role of Limestone in the extraction of iron from its oxide Fe_2O_3 ?

In this extraction, a basic flux, limestone (CaO) is used. Since the silica gangue present in the ore is acidic in nature, the limestone combines with it to form calcium silicate (slag).



4. Which type of ores can be concentrated by froth floatation method? Give two examples for such ores.

Concentrate sulphide ores such as

- i) galena (PbS),
- ii) zinc blende (ZnS) etc...

5. Out of coke and CO, which is better reducing agent for the reduction of ZnO? Why?

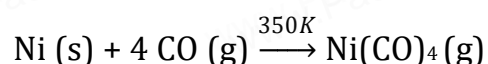
C is better reducing agent than CO for ZnO reduction .

CO line lies above the Zn line but C line lies below to the Zn line.

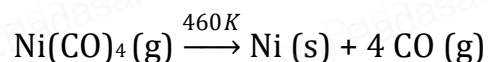
$\therefore \Delta G^0$ values are lower for C than CO

6. Describe a method for refining nickel.

Mond's process:



On heating the nickel tetracarbonyl around 460 K, the complex decomposes to give pure metal.



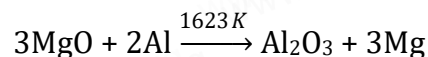
7. Explain zone refining process with an example using the Ellingham diagram given below.

- i) ***fractional crystallisation.***
 - ii) impurities are more soluble in the molten state than in the solid state metal.
 - iii) impure metal is taken in the form of a rod.
 - iv) One end of the rod is heated using a mobile induction heater which results in melting of the metal on that portion of the rod.
 - v) When the heater is slowly moved to the other end the pure metal crystallises while the impurities will move on to the adjacent molten zone formed due to the movement of the heater.
 - vi) The process is repeated several times by moving the heater in the same direction again and again to achieve the desired purity level.
 - viii) This process is carried out in inert gas atmosphere to prevent the oxidation of metals .
- Ex: Elements such as germanium (Ge), silicon (Si) and gallium (Ga) that are used as semiconductor are refined using this process.

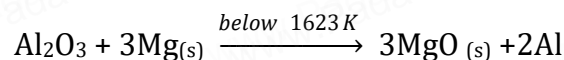
8. (A) Predict the conditions under which

(i) Aluminium might be expected to reduce magnesia.

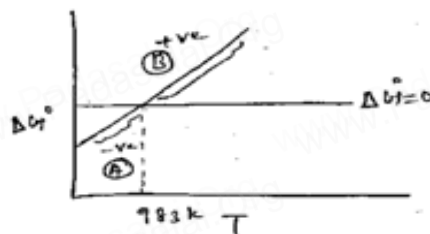
Above 1623K, Al can reduce MgO to Mg, so that $\Delta_r G^\circ$ becomes negative and the process becomes thermodynamically feasible.



(ii) Magnesium could reduce alumina.



(B) Carbon monoxide is more effective reducing agent than carbon below 983K but, above this temperature, the reverse is true -Explain.

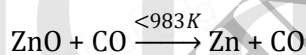
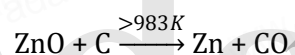


A part : $\text{M} + \text{O}_2 \rightarrow \text{MO}$ $\Delta G = -ve$ spontaneous

B part : $\text{M} + \text{O}_2 \rightarrow \text{MO}$ $\Delta G = +ve$ non-spontaneous

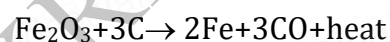
So Below 983K

the CO is better reducing agent than C but above 983K the C is better reducing agent than CO



(C) it is possible to reduce Fe_2O_3 by coke at a temperature around 1200K

Carbon lines below the iron line in Ellingham diagram.



Thus CO is more effective agent than carbon.

9. Give the uses of zinc.

1. Metallic zinc is used in **galvanising** metals such as iron and steel structures to protect them from rusting and corrosion.
2. Zinc is also used to produce die-castings in the automobile, electrical and hardware industries

10. Explain the electrometallurgy of aluminium.

Hall-Herold process:

Cathode : Iron tank lined with carbon.

Anode: Carbon blocks

Electrolyte: 20% alumina, cryolite + CaCl_2 . It helps to lower the melting point of the mixture.

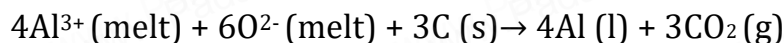
Ionization of alumina $\text{Al}_2\text{O}_3 \rightarrow 2\text{Al}^{3+} + 3\text{O}^{2-}$

SHRI KRISHNA ACADEMY - NAMAKKAL

Reaction at cathode $2\text{Al}^{3+} (\text{melt}) + 6\text{e}^- \rightarrow 2\text{Al} (\text{l})$

Reaction at anode $6\text{O}^{2-} (\text{melt}) \rightarrow 3\text{O}_2 + 12\text{e}^-$

Since carbon acts as anode the following reaction also takes place on it.



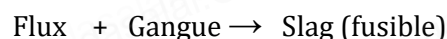
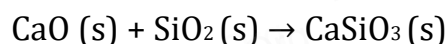
11. Explain the following terms with suitable examples.

(i) Gangue

(ii) slag

(i) Gangue : The ores are associated with nonmetallic impurities, rocky materials and siliceous matter which are collectively known as gangue. **Eg: SiO_2**

(ii) slag : Slag is the fusible product formed when flux reacts with gangue during extraction of metal



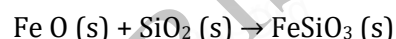
12. Give the basic requirement for vapour phase refining.

- The metal is treated with a suitable reagent which can form a volatile compound with the metal.
- volatile compound is decomposed to give the pure metal.

13. Describe the role of the following in the process mentioned.

a. Silica in the extraction of copper.

Acidic Flux - Silica is used to remove slag during the process of roasting



b. Cryolite in the extraction of aluminium.

Lowers the melting point of the mixture

c. Iodine in the refining of Zirconium.

To form a volatile compound which further heating decomposes to give pure Zn.



d. Sodium cyanide in froth floatation.

Depressing agent - Sodium cyanide

14. Explain the principle of electrolytic refining with an example.

The Crude metal is refined by electrolysis

Cathode : Pure silver

Anode : Impure silver rods

Electrolyte : Acidified aqueous solution of silver nitrate.

Reaction at anode $\text{Ag(s)} \rightarrow \text{Ag}^+(\text{aq}) + 1\text{e}^-$

Reaction at cathode $\text{Ag}^+(\text{aq}) + 1\text{e}^- \rightarrow \text{Ag(s)}$

15. The selection of reducing agent depends on the thermodynamic factor: Explain with an example.

- i) A suitable reducing agent is selected based on the thermodynamic considerations.
- ii) For a spontaneous reaction, the change in free energy (ΔG) should be negative.
- iii) Thermodynamically, the reduction of metal oxide with a given reducing agent can occur if the free energy change for the coupled reaction is negative.
- iv) Hence, the reducing agent is selected in such a way that it provides a large negative ΔG value for the coupled reaction

16. Give the limitations of Ellingham diagram.

1. It does not tell anything about the rate of the reaction. Moreover, it does not give any idea about the possibility of other reactions that might be taking place.
2. The interpretation of ΔG is based on the assumption that the reactants are in equilibrium with the products which is not always true.

17. Write a short note on electrochemical principles of metallurgy.

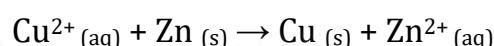
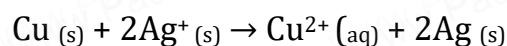
- 1) In this technique, the metal salts are taken in a fused form or in solution form.
- 2) The metal ion present can be reduced by treating it with some suitable reducing agent or by electrolysis.

Gibbs free energy change for the electrolysis process is given by the following expression

$$\Delta G^\circ = -nFE^\circ$$

Where n is number of electrons involved in the reduction process, F is the Faraday and E° is the electrode potential of the redox couple.

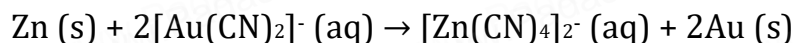
If E° is positive then the ΔG is negative and the reduction is spontaneous.



ADDITIONAL QUESTIONS

1. What is Cementation

Gold can be recovered by reacting the deoxygenated leached solution with zinc. In this process the gold is reduced to its elemental state (zero oxidation state) and the process is called **cementation**.



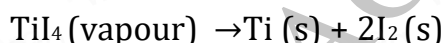
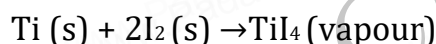
2. What is misawite compound?

Misawite is a compound of iron, oxygen and hydrogen

3. Give the uses of gold.

1. Gold, one of the expensive and precious metals. It is used for coinage, monetary systems in some countries.
2. It is used extensively in jewellery in its alloy form with copper. It is also used in electroplating to cover other metals with a thin layer of gold which are used in watches

4. Describe the Van -Arkel method for refining Titanium



5. What is the role of using depressing agent.

A sulphide ore of a metal of interest contains other metal sulphides as impurities, depressing agents such as sodium cyanide, sodium carbonate etc are used to selectively prevent other metal sulphides from coming to the froth.