

Topic : Metallurgy

Type of Questions

Type of Questions	M.M., Min.
Single choice Objective ('-1' negative marking) Q.1 to Q.6	(3 marks 3 min.) [18, 18]
Multiple choice objective ('-1' negative marking) Q.7	(4 marks 4 min.) [4, 4]
Assertion and Reason (no negative marking) Q.8 to Q.9	(3 marks 3 min.) [6, 6]

Integer Answer Type

Subjective Questions ('-1' negative marking) Q.10 to Q.12	(4 marks 5 min.) [12, 15]
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- 1.(a)_ The substance which is used as flux in the extraction of iron from haematite ore is :
(A) silica (B) borax (C) lime stone (D) salt cake
- 1.(b)_ The composition of matte is :
(A) Cu_2S and FeS (B) CuS and Fe_2S_3 (C) Cu_2S and FeO (D) Cu_2O and FeO
- 2.(a)_ Cyanide solution is used in the extraction of :
(A) Mg (B) Sn (C) Zn (D) Ag
- 2.(b)_ In the extractive metallurgy of iron, the highest temperature in the blast furnace is found :
(A) in the upper most part where reduction takes place.
(B) in the lower part where fusion takes place.
(C) in the middle part where slag formation takes place.
(D) in the lower most part where combustion of carbon takes place.
- 3.(a)_ Al is obtained in large quantity by :
(A) heating cryolite
(B) reduction of Al_2O_3 with carbon
(C) reduction of Al_2O_3 with potassium
(D) electrolytic reduction of Al_2O_3 dissolved in molten cryolite.
- 3.(b)_ Chemical reduction method is not used for :
(A) the extraction of Mg from anhydrous magnesium chloride.
(B) the extraction of Cu from cuprite.
(C) the extraction of Fe from haematite.
(D) the extraction of Zn from zincite.
- 4.(a)_ In the electrolytic reduction of fused mixture of Al_2O_3 and Na_3AlF_6 gas liberated at graphite anode is :
(A) F_2 (B) OF_2 (C) O_2 (D) O_3
- 4.(b)_ Which of the following statements is incorrect?
(A) Silver glance mainly contains silver sulphide.
(B) Copper pyrites mainly contains CuFeS_2 .
(C) Zinc blende mainly contains ZnSO_4 .
(D) Magnetite is the mixed oxide of FeO and Fe_2O_3 i.e. Fe_3O_4 .
- 5.(a)_ In which of the following metallurgical processes leaching is not involved ?
(A) Al from Al_2O_3 (B) Ag from Ag_2S
(C) Mg from MgCl_2 (anhydrous) (D) From low grade copper ore and scrapes



- 5(b)._ Which of the following statements is incorrect?
 (A) Beneficiation of ores involve the processes which are used for the removal of unwanted impurities.
 (B) In metallurgy, flux is a substance which is used to convert infusible impurities to fusible mass.
 (C) Aluminium is extracted by the electrolysis of alumina.
 (D) In smelting processes the metal is obtained in fused state.
- 6._ Which of the following processes are used for the extraction of Mg and Ag respectively?
 (A) Carbon reduction and cyanide process. (B) Cyanide process and electrolytic reduction.
 (C) Electrolytic reduction and cyanide process. (D) Carbon monoxide reduction and cyanide process.
- 7.* Which of the following pair(s) of metals is/are correctly matched with their purification methods?
 (A) Si, B – Zone refining (B) Ni, Zr – Vapour phase refining
 (C) Zn, Hg – Distillation (D) Cu, Ag – Electrolytic refining
8. **Statement-1:** $\text{Ag}_2\text{S} + 4 \text{KCN} \xrightleftharpoons{\text{O}_2} 2\text{K} [\text{Ag}(\text{CN})_2] + \text{K}_2\text{S}$
Statement-2 : The reaction is carried out in presence of air or O_2 so that K_2S is oxidised to K_2SO_4 thereby shifting the equilibrium in forward direction.
 (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
 (C) Statement-1 is True, Statement-2 is False
 (D) Statement-1 is False, Statement-2 is True
9. **Statement-1 :** Oxide ores of iron are haematite, limonite and magnetite.
Statement-2 : Pig iron is obtained by carbon monoxide reduction of calcined haematite.
 (A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.
 (B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
 (C) Statement-1 is True, Statement-2 is False
 (D) Statement-1 is False, Statement-2 is True

Integer Answer Type

This section contains 4 questions. The answer to each of the questions is a single digit integer, ranging from 0 to 9.

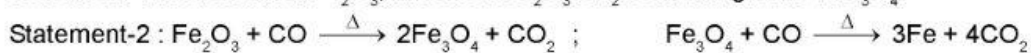
10. How many of the following ores are oxide ores?
 haematite, limonite, magnetite, magnesite, cuprite, argentite, bauxite, sphalerite, zincite
- 11._ How many of the following metallurgies involve leaching?
 $\text{Al}_2\text{O}_3 \longrightarrow \text{Al}$; $\text{Ag}_2\text{S} \longrightarrow \text{Ag}$; $\text{Au} \longrightarrow \text{Au}$; $\text{CuFeS}_2 \longrightarrow \text{Cu}$; $\text{PbS} \longrightarrow \text{Pb}$
 $\text{MgCl}_2 \longrightarrow \text{Mg}$; $\text{FeCO}_3 \longrightarrow \text{Fe}$; Low grade copper ore $\longrightarrow \text{Cu}$; $\text{HgS} \longrightarrow \text{Hg}$
12. What is the coordination number of aluminium in mineral cryolite ?

Answer Key

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- (a) $\text{CaCO}_3 \xrightarrow{\Delta} \text{CaO} + \text{CO}_2$
 (b) Matte mostly contains Cu_2S and a little FeS .
- (a) $\text{Ag} + 2\text{CN}^- \longrightarrow [\text{Ag}(\text{CN})_2]^-$; $2[\text{Ag}(\text{CN})_2]^- + \text{Zn} \longrightarrow [\text{Zn}(\text{CN})_4]^{2-} + 2\text{Ag} \downarrow$
 (b) Highest temperature 2170 K is found in the lower most part of the blast furnace, where carbon burns to form CO_2 . $\text{C} + \text{O}_2 \longrightarrow \text{CO}_2$
- (a) Cathode : $\text{Al}^{3+}(\text{melt}) + 3\text{e}^- \longrightarrow \text{Al}$
 Anode : $\text{C} + \text{O}^{2-}(\text{melt}) \longrightarrow \text{CO} + 2\text{e}^-$; $\text{C} + 2\text{O}^{2-}(\text{melt}) \longrightarrow \text{CO}_2 + 4\text{e}^-$
 (b) Mg being strong reducing agent cannot be obtained by any chemical reduction method.
- (a) $\text{O}^{2-}(\text{melt}) \longrightarrow \frac{1}{2}\text{O}_2(\text{g}) + 2\text{e}^-(\text{melt})$
 (b) Zinc blende or sphalerite is ZnS .
- (a) (A) $\text{Al}_2\text{O}_3(\text{s}) + 2\text{NaOH}(\text{aq}) + 2\text{H}_2\text{O}(\ell) \xrightarrow{\Delta} 2\text{NaAlO}_2(\text{aq}) + 3\text{H}_2\text{O}(\ell)$
 (B) $\text{Ag}_2\text{S}(\text{s}) + 4\text{CN}^-(\text{aq}) \longrightarrow [\text{Ag}(\text{CN})_2]^- (\text{aq}) + \text{S}^{2-}(\text{aq})$
 (C) MgCl_2 (anhydrous) – No leaching is required.
 (D) $\text{Cu}_2\text{O}(\text{s}) + 4\text{H}_2\text{SO}_4 + \text{O}_2 \longrightarrow 4\text{CuSO}_4 + 4\text{H}_2\text{O}$
 (b) It is extracted by the electrolysis of alumina mixed with molten cryolite.
6. $\text{MgCl}_2 \rightleftharpoons \text{Mg}^{2+} + 2\text{Cl}^-$
 At cathode : $\text{Mg}^{2+} + 2\text{e}^- \longrightarrow \text{Mg}$
 At anode : $2\text{Cl}^- \longrightarrow \text{Cl}_2 + 2\text{e}^-$
 $4\text{Ag} + 8\text{CN}^- + 2\text{H}_2\text{O} + \text{O}_2 \longrightarrow 4[\text{Ag}(\text{CN})_2]^- + 4\text{OH}^-$
 $2[\text{Ag}(\text{CN})_2]^- + \text{Zn} \longrightarrow 2\text{Ag} \downarrow + [\text{Zn}(\text{CN})_4]^{2-}$
7. All are correctly matched.
8. $\text{Ag}_2\text{S} + 4\text{KCN} \xrightleftharpoons{\text{O}_2} 2\text{K}[\text{Ag}(\text{CN})_2] + \text{K}_2\text{S}$
 $4\text{K}_2\text{S} + 5\text{O}_2 + 2\text{H}_2\text{O} \longrightarrow 2\text{K}_2\text{SO}_4 + 4\text{KOH} + 2\text{S} \downarrow$

9._ Statement-1 : Haematite : Fe_2O_3 , limonite : $\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ and magnetite : Fe_3O_4 .



10._ Haematite : Fe_2O_3 ; Limonite : $\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$; Magnetite : Fe_3O_4
Magnesite : MgCO_3 ; Cuprite : Cu_2O ; Argentite : Ag_2S
Bauxite : $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$; Sphalerite: ZnS ; Zincite : ZnO

11._ $\text{Al}_2\text{O}_3 + 2\text{NaOH} + 2\text{H}_2\text{O} \xrightarrow{\Delta} 2\text{NaAlO}_2 + 3\text{H}_2\text{O}$; $\text{Ag}_2\text{S} + 2\text{CN}^- \longrightarrow [\text{Ag}(\text{CN})_2]^- + \text{S}^{2-}$
 $\text{Au} + 2\text{CN}^- + 2\text{H}_2\text{O} + \text{O}_2 \longrightarrow [\text{Au}(\text{CN})_2]^- + 4\text{OH}^-$; $\text{CuFeS}_2 \longrightarrow$ No leaching
 $\text{PbS} \longrightarrow$ No leaching ; $\text{MgCl}_2 \longrightarrow$ No leaching ; $\text{FeCO}_3 \longrightarrow$ No leaching
 $2\text{Cu}_2\text{O} (\text{s}) + 4\text{H}_2\text{SO}_4 (\text{aq}) + \text{O}_2 (\text{g}) \longrightarrow 4\text{CuSO}_4 (\text{aq}) + 4\text{H}_2\text{O} (\ell)$; $\text{HgS} \longrightarrow$ No leaching

12. Cryolite is $3\text{NaF} \cdot \text{AlF}_3$ or $\text{Na}_3[\text{AlF}_6]$. It gives that coordination number of aluminium is six. It can expand its covalency by using empty d-orbitals.

