4 Metallurgy

SECTION – I : STRAIGHT OBJECTIVE TYPE

1.1 Which of the following statements is incorrect?
(A) calamine and siderite are carbonates (B) argentite and cuprite are oxides
(C) zinc blende and pyrites are sulphides. (D) malachite and azurite are ores of copper

4.2 Match the column (I) and (II) and select the correct answer using the codes given below.

Column-I	**Column-II**
(a) Argentite	(1)Halide ore
(b) Cuprite	(2) Carbonate ore
(c) Siderite	(3) Oxide ore
(d) Carnallite	(4) Sulphide ore

Codes :

	a	b	c	d		a	b	c	d
(A)	4	3	2	1	(B)	1	2	3	4
(C)	2	3	4	1	(D)	3	4	1	2

4.3 Select the correct statement.
(A) In the decomposition of an oxide into oxygen and gaseous metal, entropy increases.
(B) Decomposition of an oxide is an endothermic change.
(C) To make ΔG^o negative, temperature should be high enough so that $T\Delta S^o > \Delta H^o$.
(D) All are correct statements.

4.4 NaCN is sometimes added in the froth floatation process as a depressant when mineral contains ZnS and PbS because,
(A) $Pb(CN)_2$ is precipitated while there is no effect of ZnS.
(B) ZnS forms soluble complex $Na_2[Zn(CN)_4]$ while PbS forms froth.
(C) PbS forms soluble complex $Na_2[Pb(CN)_4]$ while ZnS forms froth.
(D) silicious impurities settle down on the bottom.

4.5 Which does not represent correct method?
(A) $TiCl_2 + 2Mg \rightarrow Ti + 2MgCl_2$: Kroll
(B) $Ni(CO)_4 \rightarrow Ni + 4CO$: Mond
(C) $Ag_2CO_3 \rightarrow 2Agc + CO_2 + \frac{1}{2} O_2$: Van Arkel
(D) $ZrI_4 \rightarrow Zr + 2I_2$: Van Arkel

4.6 Main source of lead is galena (PbS). It is converted to Pb by :

(A) : $PbS \xrightarrow[\Delta]{air} PbO + SO_2$, $PbO \xrightarrow{C} Pb + CO_2$

(B) : $PbS \xrightarrow[\Delta]{air} PbO + Pbs$, $PbO + Pbs \rightarrow Pb + SO_2$

(A) A (B) B (C) both (D) none

4.7 For which of the following metals Bessemerisation process is important?
I : Fe, II : Cu, III : Al, IV : Silver :
(A) I, II (B) II , III (C) I, III (D) all

4.8 The chemical processes in the production of steel from haematite ore involve:

(A) Reduction (B) Oxidation
(C) Reduction followed by oxidation (D) Oxidation followed by reduction

4.9 The chemical composition of "slag" formed during the smelting process in the extracton of copper is :
(A) Cu_2 + FeS (B) FeSiO (C) CuFeS (D) Cu_2S + FeO

4.10 Which of the following statement is incorrect about the extractive metallurgy of copper ?
(A) Matte chiefly consists of cuprous sulphide and some ferrous sulphide.
(B) Most of the impurity of iron sulphide is removed as fusible slag during roasting.
(C) The copper pyrites is concentrated by froth floatation process.
(D) self reduction and electrolysis respectively.

4.11 Pb and Sn are extracted from their chief ore by:
(A) carbon reduction and self reduction respectively.
(B) self reduction and carbon reduction respectively.
(C) electrolysis and self reduction respectively.
(D) self reduction and self reduction respectively.

4.12 Which of the following statements is incorrect?
(A) Cassiterite ore of tin contains the impurities of Wol-framite which are separated by electromagnetic separator.
(B) Tin metal is obtained by the carbon reduction of black tin.
(C) In the extraction of lead from galena, the roasting and self-reduction are carried in the same furnace at different temperatures.
(D) Reducing agent of haematite in blast-furnace is coke in upper part and CO in lower part of furnace.

4.13 Which of the following process is used in the extractive metallurgy of magnesium?
(A) Fused salt electrolysis (B) Self reduction
(C) Aqueous solution electrolysis (D) Thermite process.

4.14 White bauxite is purified by :
(A) Baeyer's process (B) Hoop's process (C) Serpeck's process (D) Hall's process

4.15 Which of the following statements is incorrect?
(A) In Hall-Heroult process, the electrolyte used is a molten mixture of alumina, sodium hydroxide and cryolite.
(B) Lead is extracted form its chief ore by both carbon reduction and self reduction.
(C) Tin is extracted from its chief ore by carbon monoxide reduction.
(D) Siderite, cassiterite and argentite are carbonate ores.

4.16 Match column (I) with column (II) and select the correct answer using codes given below in the lists.

Column - I	**Column – II**
(i) Cynide process	(a) Extraction of Al
(ii) Self reduction	(b) Extraction of Ag
(iii) Electrolytic reduction	(c) Extraction of Cu
(iv) Carbon reduction	(d) Extraction of Cu

(A) (i)- (b), (ii) – (c), (iii) – (a), (iv) – (d) (B) (i)- (b), (ii) – (d), (iii) – (a), (iv) – (c)
(C) (i)- (d), (ii) – (a), (iii) – (c), (iv) – (b) (D) (i)- (c), (ii) – (b), (iii) – (d), (iv) – (a)

SECTION – II : MULTIPLE CORRECT ANSWER TYPE

4.17 Which of the following is(are) correctly matched?
(A) Copper – Bessemer converter. (B) Iron – Blast furnace
(C) Chromium – Aluminothermic process (D) Tin – Electrolytic reduction

4.18 In which of the following pair(s), the minerals are converted in to metals by self-reduction process?
(A) Cu_2S, PbS (B) Pbs, Hgs (C) Pbs, Zns (D) Ag_2S, Cu_2S

4.19 The reaction(s) which does (do) not occur in the reduction zone in the extraction of iron from haematite ore is(are):
(A) $Fe_2O_3 + CO \rightarrow 2FeO + CO_2$ (B) $FeO + CO \rightarrow Fe + CO_2$
(C) $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$ (D) $CaO + SiO_2 \rightarrow CaSiO_3$

4.20 Which of the following statement(s) is (are) true?
(A) In the process of the precipitation of silver from sodium dicyano argentite (I), the zinc acts as reducing agent.
(B) In the process of roasting, the copper pyrites is converted into a mixture of Cu_2S & FeS which, in turn, are partially oxides.
(C) Limonite, haematite and magnesite are ores or iron.
(D) Tin and lead both are extracted from their ores by self- reduction.

4.21 Why lime stone is added in the extraction of lead from galena?
(A) It stops the formation of $PbSO_4$ (B) It remove the impurity of silica as fusible slag.
(C) It converts lead silicate to lead oxide. (D) It remove the impurity of iron oxide as fusible slag.

4.22 The role of fluorspar (CaF_2) which is added in the electrolytic reduction of alumina dissolved in fused cryolite is(are):
(A) To acts as a catalyst.
(B) To make the fused mixture very conducting.
(C) To increase the temperature of the melt.
(D) To decrease the rate of oxidation of carbon at anode.

4.23 Which of the following statement(s) is (are) correct about slag?
(A) The chemical composition of slag obtained in the extraction of copper from copper pyrites is $PbSiO_3$.
(B) The calcium silicate, $CaSiO_3$ is obtained in slag formation zone in the extraction of iron from haematite ore.
(C) In blast furnace / Bessemer converter, the upper layer of molten liquid (i.e. molten metal) is of slag.
(D) The slag is fusible matter.

4.25 **Statement-1 :** The reduction of a metal oxide is easier if the metal formed is in liquid state at the temperature of reduction.
Statement-2 : The value of entropy change +S of the reduction process is more on +ve side when the metal formed is in liquid state and the metal oxide being reduced is in solid state. Thus the value of $+G_o$ becomes more on negative side.
(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.

4.26 **Statement- 1:** Extraction of gold from its native ore involves leaching the metal with dilute solution of NaCN in presence of air.
Statement-2 : This is an oxidation reaction and leads to the formation of a soluble comoplex.
(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.

4.27 **Statement- 1:** Silica is added as a flux in reverberatory furnace, in the extraction of copper from copper pyrites.
Statement-2 : Silica decreases the melting point of the ore and remove the impurity of lead sulphide as $PbSiO_3$.
(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.

4.28 **Statement- 1:** Cast iron is different from pig iron.
Statement-2 : Cast iron is made by melting pig iron with scrap iron and coke using hot air blast and has about 3% carbon content.
(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.

4.29 **Statement- 1:** In the Hoop's process of aluminium purification, the fused materials remain in three different layers. These layers remain intact even in electrolytic reduction.
Statement-2 : This is an oxidation reaction and leads to the formation of a soluble complex.
(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.

4.30 **Statement- 1:** Sodium chloride is added during electrolysis of fused anhydrous magnesium chloride.
Statement-2 : Anhydrous magnesium chloride is obtained by heating hydrated magnesium chloride, $MgCl_2.6H_2O$.
(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.

SECTION – IV : TRUE AND FALSE TYPE

4.31 **S1:** In extraction of iron from haematite ore, the reduction reactions, take place in the lower temperature range and in the higher temperature range, in the blast furnace.
S2: Sphalerite is a carbonate ore of zinc.
S3: The principal ore of aluminium, bauxite, usually contains silica, iron oxides and titanium oxide as impurities.
S4 : Solidified copper obtained from silica lined convertor (Bessemer converter) has blistered apprearance due to the evolution of SO2.
(A) T F T T (B) F T F F C) F F T T (D) T F F T

4.32 **S1:** Culprite, Limonite and Zincite are oxide ores.
S2: Magnesite and carnallite are magnesium ores
S3: Chalcocyte and azurite are ores of copper
S4 : Felspar and mica minerals contain aluminium.
(A) T T T T (B) F T F F (C) F F T T (D) T T F T

4.33 **S1:** In the aluminothermite process, aluminium acts as reducing agent.
S2: The process of extraction of gold involves the formation of $[Au(CN)_4]^-$.
S3: In the extractive metallurgy of zinc, partial fusion of ZnO with coke is called sintering and reduction of ore to the molten metal is called smelting.
S4 : Extractive metallurgy of silver from its ore argentite involves complex formation and displacement by more electropositive metal.
(A) T F F T (B) T T T T (C) T T F T (D) T F T F

SECTION – V : COMPREHENSION TYPE

Comprehension # 1

Minerals from which metals can be extracted economically and easily are called ores. The extraction of metals from their ores involves the following processes.
(i) Concentration
(ii) Calcination | roasting | leaching.
(iii) Reduction.
It is carried out by one of the following methods.
(A) Carbon | out by one of the following methods
(B) Self reduction.
(C) Electrolytic reduction.
(D) Reduction by more electropositive metal (i.e. displacement method).

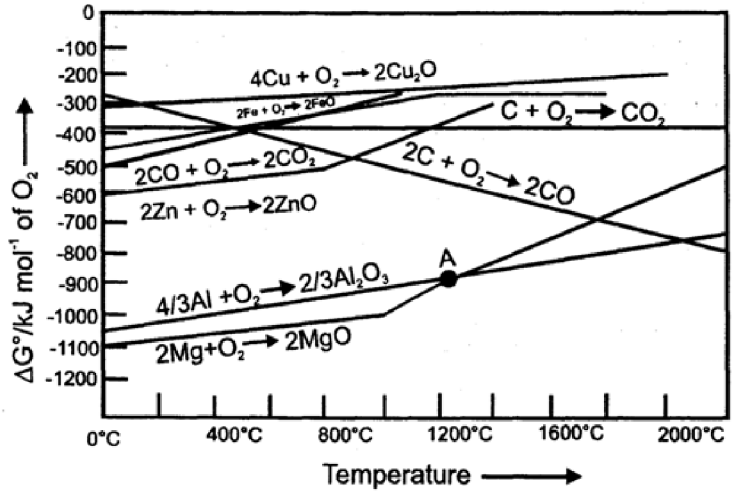
4.34 Which of the following reactions does not occur in Bessemer converter in the extraction of copper from chalcopyrites?
(A) 1 $CuFeS_2 + O_2$ '! Cu2S + 2FeS + SO_2 (B) FeO + SiO_2 '! $FeSiO_2$
(C) 2FeS + $3O_2$ '! 2FeO + $2SO_2$ (D) $Cu_2S + 2Cu_2O$ '! 6Cu + SO_2

4.35 Silver is extracted from its native ore by;
(A) Formation of soluble complex by dilute solution of NaCN in presence of air followed by the reduction with zinc.
(B) Formation of soluble complex by dilute solution of NaCN in absence of air followed by the reduction with zinc.
(C) Roasting followed by the self reduction.
(D) Roasting followed by electrolytic reduction.

4.36 Which of the following is not correctly method?
(A) Red Bauxite — Purification by Serpeck's method.
(B) Iron from haematitE — Carbon monoxide reduction.
(C) Calamine — Carbonate ore.
(D) $FeSiO_3$ — Slag obtained in the extraction of copper.

Comprehensin # 2

Go through the following graph and answer the following questions.



4.37 At what approximate temperate, zinc and carbon have equal affinity for oxygen?
(A) 1000°C (B) 1500°C (C) 500°C (D) 1200°C

4.38 To make the following reduction process spontaneous, temperature should be :
$ZnO + C \rightarrow Zn + CO$
(A) 1000°C (B) > 1000°C (C) < 500°C (D) > 500°C but < 1000°C

4.39 Which of the following statement is true?
(A) Reduction of calcined / roasted haematite ore to pig iron in blast furnace takes place in the lower temperature range and in the higher temperature range by CO and C respectively.
(B) The reduction of zinc oxide using coke takes place at higher temperature than that in case of copper.
(C) It is quite easy to reduce oxide ores of copper directly to the metal by heating with coke after 5-00 – 600K.
(D) All of these

Comprehesion # 3

Metallic gold frequently is found in aluminosilicate rocks and it is finely dispersed among other minerals. It may be extracted by treating the crushed rock with aerate potassium cyanide solution. During this process metallic gold is slowly converted to $[Au(CN)_2]^-$, which is soluble in water. After equilibrium has been reached the aqueous phase is umped off and the metallic gold is recovered from it by reacting the gold complex with zinc, which is converted to $[Zn(CN)_4]^{2-}$. Gold in nature is frequently alloyed with silver which is also oxidized by aerated sodium cyanide solution. Silver occurs as native as well as sulphurised ore.

4.40 The correction reaction involved in the leaching of gold with dilute solution of NaCN is :
(A) $4Au + 8C^- + 2H_2O + O_2(air) \rightarrow 4[Au(CN)_2]^- + 4OH^-$
(B) $Au + 2CN^- \rightarrow Au\ [(CN)_2]^-$
(C) $Zn^+ + 2CN^- \rightarrow Zn\ [(CN)_2]^-$
(D) $Zn^+ + 4CN^- \rightarrow Zn\ [(CN)_4]2^-$

4.41 Which of the following statements is correct?
(A) Leaching of gold with CN- is an oxidation reaction.
(B) Argentite is oxide ore of silver.
(C) In the precipitation of gold from the soluble complex, zinc acts as a complexing and reducing agent.
(D) (A) and (C) both.

4.42 The process described above in the passage is regarding :
(A) Ore dressing (B) Pyrometallurgical extraction
(C) Hydrometallurgical extraction (D) Purification of metal

Comprehesion # 4

Amongst the various ores of a metal (M) (sulphide, carbonates, oxides, hydraed or hydroxides) two ores [X] and [Y] show the following reactivity.
(i) [X] On calcinations gives a black solid (S), carbon dioxide and water.
(ii) [X] Dissolved in dil. HCl on reaction with KI gives a white precipitate (P) and iodine.
(iii) [Y] On roasting gives metal (M) and a gas (G1) which turns acidified $K_2Cr_2O_7$ solution green.
(iv) [Y] On reaction with dil. HCl gives a white precipitate (Q) and another gas (G_2) which turns lead acetate solution black and also reacts with gas (G_1) to precipitate colloidal sulphur in presence of moisture. The M, S [X] and [Y] gives greenish blue flame.

4.43 The metal ores [X] and [Y] are respectively;
(A) Carbonate and sulphide ores (B) Sulphide and carbonate ores
(C) Carbonate and hydroxide ores (D) Carbonate and oxide ores

4.44 Which of the following statements is correct about [Y]?
(A) [Y]is converted to metal (M) by self reduction.
(B) Carbonate extract of [Y] gives yellow precipitate with suspension of $CdCO_3$.
(C) [Y] is chalcocites of chalcopyrites
(D) All of thEse

4.45 The gas (G1) acts as
(A) Oxidising agent (B) REducing agent
(C) Oxidising and reducing agent (D) Fluxing agent

4.46 The white precipitate (P) is of:
(A) Cu_2I_2 (B) Cu_2I_2 (C) $K_2[CuI_4]$ (D) None

SECTION – VI – MATRIX – MATCH TYPE

4.47 Match the pair of ores given in Column-I with type(s) of ores given in Column-II.

Column – I	**Column-II**
(A) Limonite, Cuprite	(p) Sulphate ore
(B) Calamine, Cerussite	(q) Carbonate ore
(C) Pyragyrite, Zinc blende	(r) Oxide ore
(D) Anglesite, Langbeinite	(s) Sulphide ore.
	(t) Halide ore.

4.48 Match the ores listed in column (I) with the appropriate process(es) listed in column (II).

Column-I	**Column-II**
(A) Haematite	(p) Slag formation during both roasting/smelting and bessemerisation.
(B) Copper pyrites	(q) Reduction by carbon monoxide (mainly)
(C) Carnallite	(r) Electrolytic reduction
(D) Bauxite	(s) Calcination.
	(t) Leaching

4.49 Match the reactions given in column (I) with the appropriate method(s) listed in column (II).

Column-I	**Column-II**
(A) $4Au + 8NaCN + 2H_2O + O_2$ (air) $\rightarrow 4Na[Au(CN)_2] + 4NaOH$	(p) Leaching
(B) $CuFeS_2 + 2H_2SO_4 \rightarrow CuSO_4 + FeSO_4 + 2H_2S$	(q) Smelting
(C) $Fe_3O_4 + 4CO \xrightarrow{823K} 3Fe + 4CO_2$	(r) Roasting
(D) $MgCl_2.6H_2O \xrightarrow{\Delta} MgCl_2 + 6H_2O$	(s) Calcination

4.50 Match the following metals given in column I with the appropriate metal extraction process(es) listed below in column II.

Column – I	**Column-II**
(A) Silver	(p) Fused salt electrolysis
(B) Lead	(q) Cyanide process.
(C) Iron	(r) Carbon monoxide reduction
(D) Magnesium	(s) Self reduction

SECTION – VII : SUBJECTIVE ANSWER TYPE

SHORT SUBJECTIVE

4.51 What is the coordination number of aluminium in mineral cryolite?

4.52 How many water of crystallization is(are) present in the ore carnallite?

4.53 The number of reducing agents involved in the extraction of iron (as pig iron) using blast furnace from ore haematite is(are).

4.54 Among the following metals how many metals are extracted by self-reduction method from their respective ores. (Give total number). Hg, Zn, Cu, Al, Mg, Pb, Fe, Sn.

4.55 The number of different metals present in the ore copper pyrites is(are), (Give total number)