PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 56

Total Marks : 44

Max. Time : 44 min.

Topic : Metallurgy

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]
Comprehension ('–1' negative marking) Q.8 to Q.10	(3 marks 3 min.)	[9, 9]
Assertion and Reason (no negative marking) Q.11	(3 marks 3 min.)	[3, 3]
Match the Following (no negative marking) Q.12	(8 marks 10 min.)	[8, 10]

1. Which one of the following statements is incorrect ?
(A) Tin is extracted by carbon reduction (smelting)
(B) Aluminium is extracted by Hall's process which involves carbon reduction.
(C) Extraction of lead does not involve bessemerisation
(D) Silver is extracted by cyanide process

2. In purification of bauxite ore, it is mixed with coke and heated at 1800 °C in presence of nitrogen. this is :
(A) Hall's process (B) Serpeck's process
(C) Baeyer's process (D) Electrolytic reduction.

3. Reducing agent of haematite in blast-furnace is
(A) Coke in furnace (B) Coke in upper part and CO in lower part of furnace.
(C) CO in most parts of the furnace (D) CO in the furnace.

4. $PbS \xrightarrow[\Delta]{air} X$, $X + PbS \longrightarrow Pb + SO_2$

'X' is :
(A) PbO (B) PbO_2 (C) PbO and $PbSO_4$ (D) PbO_2 and PbO

5. Select the incorrect statement
(A) Carbon is a better reducing agent below 983K than carbon monoxide.
(B) Sulphide ores generally roasted to oxide for the extraction of metals instead of being directly reduced.
(C) Zinc not extracted from zinc oxide through reduction using CO but instead coke is used.
(D) Leaching of native ores of silver/gold or of their sulphide ores and the extraction of metals (silver/gold), is an example of hydrometallurgy.

6. Consider the following metallurgical processes
(i) Heating impure metal with CO and distilling the resulting volatile carbonyl (boiling point 43ºC) and finally decomposing at 150ºC to 200ºC to get the pure metal.
(ii) Heating the sulphide ore in air until a part is converted to oxide and then further heating in the absence of air to let the oxide react with unchanged sulphide.
(iii) Electrolysing the molten electrolyte containing approximately equal amounts of the metal chloride and $CaCl_2$ to obtain the metal.
The process used for obtaining sodium, nickel and copper are, respectively,
(A) (i), (ii) and (iii) (B) (ii), (iii) and (i) (C) (iii), (i) and (ii) (D) (ii), (i) and (iii)

7.* Calcium silicate (slag) formed in the slag formation zone in extraction of iron from haematite ore :
(A) does not dissolve in molten iron (B) being lighter floats on the molten iron
(C) is used in cement industry (D) prevents the re-oxidation of molten iron

Comprehension # (Q.8 to Q.10)

Electrolytic purification of copper is required since the product of the Bessemer converter is impure. Sheets of pure copper are made the cathodes and blister copper is used as the anodes. The bath contains $CuSO_4$, H_2SO_4 and NaCl. Metallic copper goes into solution as Cu^{+2} ions at the anode and deposited at the cathode. Zinc and iron go into solution and do not deposit at the cathode alongwith copper. Silver goes into solution as Ag^+ ions, but forms a sludge in the electrolysis cell. The noble metals such as gold and platinum do not dissolve; they fall to the bottom when released from the copper anode. They help to pay for the copper refining process.

8. The different chemical behaviour of various metal ions (for example only Cu is deposited on the cathode) involved are explainable best using

(A) their amounts in impure copper
(B) the electrochemical series
(C) their ionization potentials
(D) their hydration energies

9. The voltage is kept low enough during the operation. This is to ensure that

(A) Fe^{+2} and Zn^{+2} ions are kept in solution only
(B) there is no risk of electric shock to the plant operators
(C) gold and platinum do not dissolve in solution and are recovered as solids
(D) temperature control is maintained to effect reaction rate control

10. The most important role of various electrolytes added to the electrorefining bath in this case is

(A) to reduce the temperature of bath
(B) to result in good electrical connectivity so as to have high production rates
(C) so that the anode acts as an attackable electrode
(D) to enhance the viscosity of electrolyte thus preventing leakage from bath.

11. **Statement-1 :** Haematite ore containing a small quantity of siderite ore is always calcined in presence of a limited supply of air.

Statement-2 : $FeCO_3 \longrightarrow FeO + CO_2$; $FeO + O_2 \longrightarrow Fe_2O_3$

Prevents the loss of iron as $FeSiO_3$.

(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.

12.

Column – I	**Column – II**
(A) Chalcopyrites	(p) Self – reduction
(B) Galena	(q) Sulphur containing ore
(C) Argentite	(r) Carbon reduction
(D) Malachite	(s) Leaching followed by displacement method.

Answer Key

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1.	(B)	**2.**	(B)	**3.**	(C)	**4.**	(C)	**5.**	(A)
6.	(C)	**7.***	(ABCD)	**8.**	(B)	**9.**	(A)	**10.**	(B)
11.	(A)	**12.**	(A → p,q, r) ; (B → p, q, r) ; (C → q, s) ; (D → r).						

Hints & Solutions

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1. Aluminium is extractecd by Hall-Heroult process (electrolytic reduction).

2. Serpeck's method is

$$Al_2O_3.2H_2O + 3C + N_2 \xrightarrow{1800^\circ C} 2AlN + 3CO + 2H_2O$$

$$2AlN + 3H_2O \longrightarrow Al(OH)_3 \downarrow + NH_3$$

$$2Al(OH)_3 \xrightarrow{1473K} Al_2O_3 + 3H_2O$$

4. $PbS + O_2 \longrightarrow PbO + SO_2$

$PbS + 2O_2 \longrightarrow PbSO_4$

6. Carbon monoxide is better reducing agent than carbon below 983 K.

8. SRP zinc = – 0.76 ; SRP iron = – 0.44 ; SRP copper = + 0.34 (highest)
Hence only copper deposits, others do not.

9. Increasing voltage would cause deposition of Fe^{+2} and Zn^{+2} also to occur.

10. Water (pure) is a poor electrical conductor.

12. (A) $CuFeS_2$; $Cu_2S + 2\,Cu_2O \longrightarrow 6\,Cu + SO_2$; $Cu_2O + C \longrightarrow 2\,Cu + CO$

(B) PbS ; $PbS + 2PbO \longrightarrow 3Pb + SO_2$; $PbO + C \longrightarrow Pb + CO$; $PbO + CO \rightarrow Pb + CO_2$

(C) Ag_2S; Cyanide process, leaching with alkali metal cyanide followed by displacement with zinc dust.

(D) $CuCO_3.Cu(OH)_2$; Calcination $\longrightarrow CuO + C \longrightarrow Cu + CO$