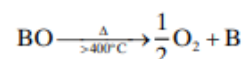


Metallurgy

SINGLE CORRECT CHOICE TYPE QUESTIONS

- Which form of iron has the highest carbon content?
(A) Steel (B) Pig iron
(C) Cast iron (D) Wrought iron
- Which of the following statements is incorrect?
(A) Combination of tin stone and wolframite is non-magnetic.
(B) No external reducing agent is required for the extraction of Hg from HgO.
(C) For extraction of copper in Bessemer converter, the process like slag formation, oxidation, and reduction take place.
(D) Poling method is mainly used when impure metal has its oxide as impurity.
- Which of the following is not correctly matched?

Method	Used for refining
(A) Van Arkel	Zr and Ti
(B) Zone refining	Ge, Si, Ga, In
(C) Liquation	Zn and Hg
(D) Mond's	Ni
- If formula of muscovite (white mica) is $\text{KAl}_2(\text{OH})_2\text{Si}_3\text{AlO}_{10}$ and formula of pyrophyllite is $\text{Al}_2(\text{OH})_2\text{Si}_4\text{O}_{10}$, then select the correct statement.
(A) Mica is formed when one quarter of the Si^{IV} in pyrophyllite are replaced by Al^{3+} and the resulting negative charge is balanced by K.
(B) Mica is formed when half of the Si^{IV} in pyrophyllite are replaced by Al^{3+} and the resulting negative charge is balanced by K.
(C) Mica is formed when one third of the Si^{IV} in pyrophyllite are replaced by Al^{3+} and the resulting negative charge is balanced by K.
(D) None of the above
- Read the following statements:
(I) Al has greater affinity than Fe, for oxygen.
(II) Cast iron has impurity of zinc and lead.
(III) Refining of nickel is done by vapour phase refining.
(IV) In cyanide process, oxygen and zinc dust are used as oxidizing agent and reducing agent, respectively.
Choose the correct set of statements.
(A) I, III
(B) II, III, IV
(C) I, III, IV
(D) I, IV
- Spiegel (or spiegeleisen) used in the manufacture of steel by the Bessemer process is an alloy of
(A) iron, nickel and carbon.
(B) iron, manganese and carbon.
(C) iron, tungsten and carbon.
(D) iron, chromium and carbon.



If A and B are metals, then ore of B would be

- (A) Siderite. (B) Cinnabar.
(C) Malachite. (D) Horn silver.
- In bauxite $\text{AlO}_x(\text{OH})_{3-2x}$ the value of x is
(A) $0 < x < 1$ (B) $x = 1$
(C) $x = 0$ (D) $1 < x < 0$
 - From the Ellingham graphs of carbon, which of the following statements is false?
(A) CO_2 is more stable than CO at less than 983 K.
(B) CO reduces Fe_2O_3 to Fe at less than 983 K.
(C) CO is less stable than CO_2 at more than 983 K.
(D) CO reduces Fe_2O_3 to Fe in the reduction zone of blast furnace.
 - Before introducing FeO in blast furnace, it is converted to Fe_2O_3 by roasting so that
(A) it may not be removed as slag with silica.
(B) it may not evaporate in the furnace.
(C) presence of it may increase the melting point of charge.
(D) None of these.
 - Match the processes with the element for which they are used.

Column-I	Column-II
(P) Bessemerisation	(1) Ti
(Q) Van Arkel Method	(2) Cast iron
(R) Carbon reduction	(3) Sn
(S) Cupellation	(4) Ag

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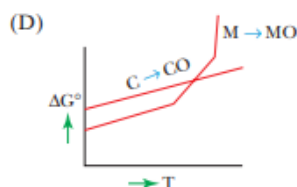
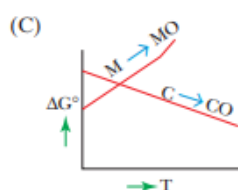
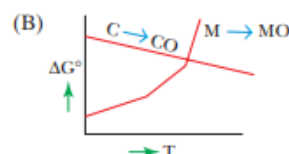
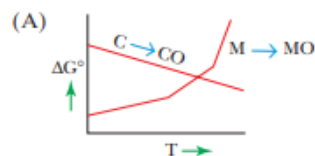
	P	Q	R	S
(A)	2	1	3	4
(B)	3	1	2	4
(C)	2	4	3	1
(D)	1	2	3	4

- Which of the following statements is correct?
(A) Anthracite and chalcocite are both ores of copper.
(B) Anthracite and chalcocite are both sulphide ores.
(C) Both German silver and horn silver have zero percent silver content.
(D) Malachite and azurite are both basic copper carbonates.
- Which of the following statements is correct regarding self reduction?
(A) Partial roasting and self reduction occur together.
(B) First self reduction occurs followed by partial roasting.
(C) First partial roasting occurs followed by self reduction.
(D) Partial roasting is done in the reverberatory furnace first, and then self reduction is done in the blast furnace.

14. Which is not an ore of copper?

- (A) Atacamite
- (B) Copper glance
- (C) Chalcopyrite
- (D) Cerrusite

15. Which of the following curves assures that the metal obtained by carbon reduction is in the vapour state?



16. In the froth floatation process, pine oil

- (A) increases the surface tension of the solution.
- (B) decreases the surface tension of the solution.
- (C) does not affect the surface tension of the solution.
- (D) acts as a collector.

17. Which of the following activities is not related to poling?

- (A) Metallic impurities having higher oxidation potential than the metal to be refined are oxidized first.
- (B) Non-volatile oxides are removed in the form of scum.
- (C) Metallic impurities having lower oxidation potential than the metal to be refined settle down at the bottom of the furnace.
- (D) Green poles of wood are used as stirrers.

18. Which of the following options is incorrectly matched?

Column I (Metal)	Column II (Electrolyte used for electrowinning)
(A) Al	$\text{Al}_2(\text{SO}_4)_3$ aqueous solution
(B) Cu	$(\text{CuSO}_4 + \text{H}_2\text{SO}_4)$ aqueous solution
(C) Zn	$(\text{ZnSO}_4 + \text{H}_2\text{SO}_4)$ aqueous solution
(D) Sn	$(\text{SnSO}_4 + \text{H}_2\text{SO}_4)$ aqueous solution

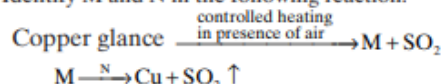
19. Fe cannot be extracted commercially by thermite reduction process because

- (A) very high temperature is associated.
- (B) Fe is more electropositive than Al.
- (C) Al has very high affinity towards oxygen.
- (D) it is very expensive.

20. Which of the following ores can be considered as an ore of both Ca and Mg?

- (A) Dolomite
- (B) Calcite
- (C) Magnesite
- (D) Magnetite

21. Identify M and N in the following reaction.



- (A) $\text{M} = \text{Cu}_2\text{O}$; $\text{N} = \text{Self reduction}$
- (B) $\text{M} = \text{Cu}_2\text{O} + \text{Cu}_2\text{S}$; $\text{N} = \text{only heating}$
- (C) $\text{M} = \text{Cu}_2\text{O}$; $\text{N} = \text{carbon reduction}$
- (D) $\text{M} = \text{Cu}_2\text{O}$; $\text{N} = \text{Electrolytic reduction}$

22. Which of the following reactions does not take place during smelting step in carbon reduction process for extraction of Pb?

- (A) $\text{PbO} + \text{CO} \rightarrow \text{Pb} + \text{CO}_2$
- (B) $\text{PbO} + \text{C} \rightarrow \text{Pb} + \text{CO}$
- (C) $3\text{PbO} + \frac{1}{2}\text{O}_2 \rightarrow \text{Pb}_3\text{O}_4$
- (D) $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$

23. There are different categories of lead pencil like 4B, 3B, 2B, HB, H, 2H, 3H and 4H (where B indicates softness and H indicates hardness). Which of the following statements is correct if all these varieties of lead pencil are made of different kinds of lead?

- (A) Impurity content increases from 4B to 4H.
- (B) Impurity content decreases from 4B to 4H.
- (C) Impurities have no impact on hardness.
- (D) All are incorrect.

24. Which of the following substances is used for making mirrors?

- (A) Pure Sn
- (B) Pure Hg
- (C) Zinc amalgam
- (D) Tin amalgam

25. Choose the reaction which does not indicate slag formation?

- (A) $3\text{MgO} + \text{P}_2\text{O}_5 \rightarrow \text{Mg}_3(\text{PO}_4)_2$
- (B) $\text{SiO}_2 + \text{PbO} \rightarrow \text{PbSiO}_3$
- (C) $\text{Fe}_2\text{O}_3 + \text{P}_2\text{O}_5 \rightarrow \text{FePO}_4$
- (D) None of these

26. In which of the following metal extraction processes, there is no reduction of respective ore of metal in the smelting step?

- (A) Extraction of Fe.
- (B) Extraction of Cu.
- (C) Extraction of Pb.
- (D) Extraction of Sn.

27. Which of the following characteristics of steel are developed by the tempering process?
 (A) Steel becomes hard and brittle.
 (B) Steel becomes soft.
 (C) Steel remains hard but brittleness disappears.
 (D) Only the surface layer becomes hard.
28. The purest variety of iron is called
 (A) cementite.
 (B) wrought iron.
 (C) pig iron.
 (D) steel.

MULTIPLE CORRECT CHOICE TYPE QUESTIONS

1. Which of the following statements is/are correct?
 (A) The mineral $\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ is known as carnallite.
 (B) The chemical composition of malachite is $\text{CuCO}_3 \cdot \text{MgCO}_3$.
 (C) In Bayer's process of purifying aluminium ore, the concentration of ore is done with NaOH .
 (D) Silver and gold are extracted from their ore by the Mc-Arthur-Forrest cyanide process.
2. Which of the following minerals do(es) not contain copper?
 (A) Siderite (B) Malachite
 (C) Limonite (D) Anglesite
3. Which of the following statements is/are correct for both calcination and roasting?
 (A) Both involve thermal decomposition.
 (B) Products of both the processes are porous.
 (C) Impurities of organic compounds are removed in the form of gas.
 (D) Ores used are of similar type in both the processes.
4. $4\text{M(s)} + 8\text{CN}^-(\text{aq}) + 2\text{H}_2\text{O(l)} + \text{O}_2(\text{g}) \rightarrow 4[\text{M(CN)}_2]^{2-}(\text{aq}) + 4\text{OH}^-(\text{aq})$. Here,
 (A) O_2 acts as oxidizing agent.
 (B) CN^- acts as complex forming agent.
 (C) O_2 and CN^- both act as oxidizing agents.
 (D) O_2 and CN^- both act as complex forming agents.
5. Which one of the following is not true for electrolytic refining?
 (A) Cathode is made up of impure metal.
 (B) Anode is made up of impure metal.
 (C) Cathode is of impure metal and anode is of pure metal.
 (D) Both electrodes must be of pure metal.
6. Carbon reduction cannot be employed for the extraction of Al from Al_2O_3 because
 (A) the temperature requirement is very high ($\sim 2000^\circ\text{C}$).
 (B) the Ellingham diagram says Al_2O_3 is impossible to reduce by the carbon reduction process.
 (C) Al obtained in the vapour state is very difficult to handle.
 (D) Al forms its carbide (Al_4C_3) and a lot of it gets wasted.
7. Electrefining may be employed for refining of metals like
 (A) Al and Ni.
 (B) Cu and Zn.
 (C) Sn and Au.
 (D) Pb and Ag.
8. In the Al extraction, the coke powder is used at the top of the electrolyte melt because
 (A) it makes the surface rough by which the radiation loss is minimized.
 (B) it prevents oxidation of the electrolyte by air.
 (C) it reacts with evolved oxygen at the anode and prevents the corrosion of the anode.
 (D) it increases the electrical conductivity of the melt.
9. The magnesium oxide can be reduced to Mg by which of the following reducing agents?
 (A) CaC_2
 (B) Coke powder
 (C) Cr powder
 (D) Si powder
10. In general which of the following substances are used as an electrolyte to extract Mg by electrolytic reduction?
 (A) Aqueous solution of $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$
 (B) Molten carnallite
 (C) Molten anhydrous MgCl_2
 (D) Molten (anhydrous MgCl_2 + anhydrous NaCl)
11. Which of the following reaction(s) takes place in the Bessemer converter for the extraction of Cu?
 (A) $2\text{CuFeS}_2 + 4\text{O}_2 \rightarrow \text{Cu}_2\text{S} + 2\text{FeO} + 3\text{SO}_2$
 (B) $\text{Cu}_2\text{S} + \frac{3}{2}\text{O}_2 \rightarrow \text{Cu}_2\text{O} + \text{SO}_2$
 (C) $\text{Cu}_2\text{S} + 2\text{Cu}_2\text{O} \rightarrow 6\text{Cu} + \text{SO}_2$
 (D) $\text{FeO} + \text{SiO}_2 \rightarrow \text{FeSiO}_3$
12. Which of the following are the byproducts obtained in the extraction of copper?
 (A) SO_2 , which is further used in the manufacture H_2SO_4 by the contact process.
 (B) Gold, silver and platinum obtained as anode mud.
 (C) FeSO_4 , which is used to prepare green vitriol.
 (D) FeSiO_3 , obtained as slag, used in road making.
13. Which of the following terms is related to galvanization?
 (A) Pickling
 (B) Sherardizing
 (C) Metallizing
 (D) Hot galvanizing
14. Which of the following statements are correct regarding roasting?
 (A) Impurities are removed in the form of their elemental vapours.
 (B) Lower oxidation state oxides are oxidized further.
 (C) Sulphide ores are converted into their oxides.
 (D) The temperature of the process is maintained just above the melting point of the mixture.
15. Which are the byproducts of the extraction of iron?
 (A) Pig iron
 (B) Slag
 (C) Wrought iron
 (D) Blast furnace gas

COMPREHENSION TYPE QUESTIONS

Passage *1: For Questions 1–2

Ellingham diagram (Figure 6.39) is the graph between ΔG° and temperature for the metal oxidation reaction. It simply indicates whether a reaction is possible or not, that is, the tendency of reduction with a particular reducing agent. This is so because it is based only on the thermodynamic concepts. It does not say anything about the kinetics of the reduction process.

- Which of the following methods of extraction is/are correctly matched?
 (A) Zn from ZnS: Roasting followed by reduction with coke.
 (B) Al from $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$: Electrolysis of Al_2O_3 dissolved in molten $\text{Na}_3\text{AlF}_6/\text{CaF}_2$.
 (C) Fe from haematite: Reduction of the oxide with CO in blast furnace.
 (D) Cu from copper pyrite or copper glance: Roasting of sulphide partially and self-reduction.

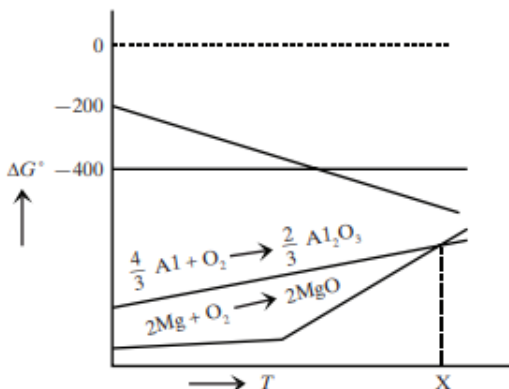


Figure 6.39 Passage 1.

- Which of the following characteristics is/are not correctly matched at given temperature in the following options?
 (A) At temperature X, $\Delta G = 0$ for

$$\text{Al}_2\text{O}_3 + 3\text{Mg} \rightleftharpoons 3\text{MgO} + 2\text{Al}$$

 (B) Below temperature X, Mg can reduce Al_2O_3 .
 (C) Mg is not used for the reduction of alumina above temperature X, although is thermodynamically feasible because the process is uneconomical.
 (D) Below temperature X, Al can reduce MgO.

*One or more than one correct answers.

- Majority of reduction reaction occurs through which of the following reactions?

- $\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 2\text{Fe} + 3\text{CO}$
- $\text{FeO} + \text{C} \rightarrow \text{Fe} + \text{CO}$
- $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2 \uparrow$
- $\text{SiO}_2 + 2\text{C} \rightarrow \text{Si} + 2\text{CO}$

- Which of following flux is more convenient to use in the smelting process?

- Lime
- Limestone
- Mixture of (A) and (B)
- None of these

Passage 2: For Questions 3–5

Consider the flow chart in Figure 6.40.

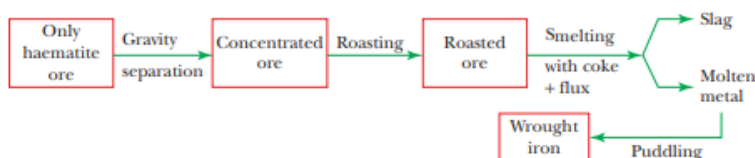


Figure 6.40 Passage 2.

- Which of the following steps is unnecessary in the extraction of Fe as shown in the above flow diagram?
 (A) Gravity separation
 (B) Roasting
 (C) Smelting
 (D) Puddling

Passage 3: For Questions 6–8

In the froth floatation process, finely divided ore, water, pine oil and sodium ethyl xanthate are taken together and air is blown from the bottom of the container. Froth is formed, ore particles float on the top of the froth and are collected into a separate container. These are washed with water to remove sticking impurities. Finally, the ore is separated from impurities.

6. This process is applicable mainly for
 - (A) sulphate ores.
 - (B) sulphite ores.
 - (C) non-sulphide ores.
 - (D) sulphide ores.
7. Sometimes for other kinds of ores also, this process can be employed using a suitable reagent which is called
 - (A) collector.
 - (B) activator.
 - (C) frother.
 - (D) depressant.
8. The overall floating of the ore occurs due to
 - (A) absorption process between ore particle and collector.
 - (B) only adsorption between ore particles and collector.
 - (C) adsorption and lyophilic-lyophobic aptitude of collector.
 - (D) only lyophilic-lyophobic aptitude of collector.

Passage 4: For Questions 9–11

The Ellingham diagram (Figure 6.41) represents the formation of oxides of several metals together with oxides of C (i.e. CO and CO₂). The diagram is not to scale yet it can help in making a lot of predictions.

9. Which is the chief reducing agent if the carbon reduction of iron oxides is carried out below 710 °C?
 - (A) CO
 - (B) C
 - (C) Either C or CO
 - (D) Cannot be predicted on the basis of given information.
10. At ~ 1100 °C, which of the following reactions is thermodynamically most favourable?
 - (A) $\text{TiO}_2 + \text{C} \rightarrow \text{Ti} + \text{CO}_2$
 - (B) $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$
 - (C) $\text{Al}_2\text{O}_3 + 3\text{C} \rightarrow 2\text{Al} + 3\text{CO}$
 - (D) $\text{Cr}_2\text{O}_3 + 3\text{C} \rightarrow 2\text{Cr} + 3\text{CO}$
11. Which of following statements is incorrect?
 - (A) Si cannot reduce MgO at all.
 - (B) Al can reduce MgO at above 1500 °C.
 - (C) Al can reduce Cr₂O₃ as well as TiO₂.
 - (D) Al cannot reduce ZrO₂ but Mg can reduce ZrO₂.

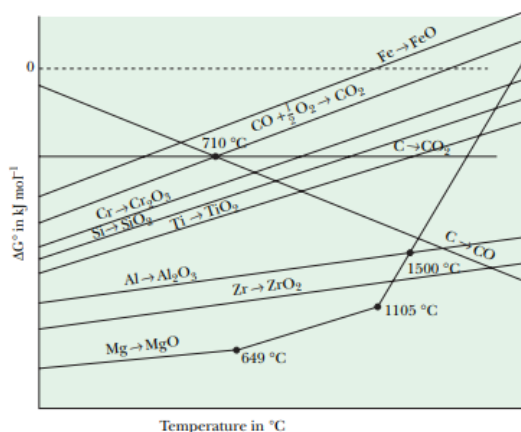


Figure 6.41 Passage 4.

ASSERTION-REASONING TYPE QUESTIONS

In the following set of questions, a Statement I is given and a corresponding Statement II is given below it. Mark the correct answer as:

- (A) If both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.
- (B) If both Statement I and Statement II are true but Statement II is not the correct explanation for Statement I.
- (C) If Statement I is true but Statement II is false.
- (D) If Statement I is false but Statement II is true.

1. **Statement I:** All ores are minerals.

Statement II: All minerals are ores.

2. **Statement I:** Dressing of the ore is an essential step in metal extraction.

Statement II: Dressing is done to improve the physical appearance of the ore.

3. **Statement I:** In the thermite reduction, Al powder is chosen as reducing agent.

Statement II: $2\text{Al} + \frac{3}{2}\text{O}_2 \rightarrow \text{Al}_2\text{O}_3$; ΔH for this reaction is highly negative.

4. **Statement I:** Al cannot reduce MgO below 1500°C while Al can reduce MgO above 1500°C.

Statement II: Mg is a liquid at less than 1500°C and gas at above 1500°C.

5. **Statement I:** Elements present in the anode mud of an electrolytic refining process have higher oxidation potential as compared to that of the metal to be refined.

Statement II: Impurities having higher oxidation potential as compared to the metal to be refined get dissolved in the electrolyte during electrorefining.

6. **Statement I:** If pure haematite is used as an ore for iron extraction, there is no need of the roasting step.

Statement II: Final product of the roasting step is Fe₂O₃ in the extraction of Fe.

7. **Statement I:** Choice of flux depends upon the nature of impurities within the ore.

Statement II: Flux is an impurity which is added from an external source.

8. **Statement I:** Both calamine and siderite are carbonate ores.

Statement II: Both calamine and siderite are the ores of lead.

9. **Statement I:** Sintering is the partial fusion at the contact point of grain boundaries between two grains.

Statement II: Sintering helps keep the mass porous.

10. **Statement I:** In the self reduction process, there is no use of reducing agent from external source, rather part of the sulphide ore acts as the reducing agent.

Statement II: The true reducing agent in the self reduction process is S²⁻ ion.

11. **Statement I:** Anhydrous MgCl₂ cannot be prepared by direct heating of hydrated MgCl₂.

Statement II: During heating, hydrolysis of MgCl₂ takes place producing MgO.

INTEGER ANSWER TYPE QUESTIONS

The answer to each of the following questions is a non-negative integer.

1. Among the following, total number of metals from which metal is extracted by self-reduction method is _____.

Pb, Zn, Cu, Mg, Hg, Fe, Al, Au

2. Find the number of type of metals present in a mixture of ore containing sylvinit, Indian saltpetre, colemanite, dolomite and anglesite.

3. Find the number of ores from the following which can be concentrated by magnetic separation method.

Fe_2O_3 , Fe_3O_4 , FeCO_3 , FeS_2 , CuFeS_2 , Cu_2O , ZnS , ZnCO_3 , ZnO

4. Among the following, number of compounds that would require electrolysis process to get their respective metal is _____.

NaCl , Cr_2O_3 , MgCl_2 , Al_2O_3 , CaCl_2 , Fe_2O_3

5. The oxidation state of Cu in chalcopyrite is _____.

6. In the smelting process of Fe, the ratio of roasting ore to coke used is approximately _____.

7. Among the following elements, number of elements for which zone refining can be used is _____.

Zr, Ga, Ti, Ge, B, Si

8. The value of n in $\text{Be}_3\text{Al}_n(\text{Si}_6\text{O}_{18})$ is _____.

9. The number of steps involved in the extraction of Zn from zinc blende is _____.

Smelting, froth floatation, distillation, electro-refining, electrolytic reduction, magnetic separation

10. The number of ores in which Pb is present is _____.

Galena, limonite, chalcocite, azurite _____.

MATRIX-MATCH TYPE QUESTIONS

In each of the following questions, statements are given in two columns, which have to be matched. The statements in Column I are labelled as (A), (B), (C) and (D), while those in Column II are labelled as (P), (Q), (R), (S) and (T). Any given statement in Column I can have correct matching with one or more statements in Column II.

1. Match the name of processes with corresponding commercial extraction of metals.

Column-I	Column-II
(A) Bessemerisation	(P) Pb
(B) Electrolytic reduction/ refining method	(Q) Cu
(C) Carbon reduction	(R) Zn
(D) Roasting	(S) Mg
	(T) Ag

2. Match the ores with their extraction characteristics.

Column-I	Column-II
(A) Siderite	(P) Carbonate ore.
(B) Galena (with large impurity)	(Q) Ore of Fe.
(C) Calamine	(R) Carbon reduction is used for commercial extraction of metal.
(D) Magnetite	(S) Electrorefining may be used for refining of respective metal.

3. Match the reactions with the nature of process involved.

Column-I	Column-II
(A) $\text{Cu}_2\text{S} \rightarrow \text{Cu}$	(P) Calcination
(B) $\text{CaCO}_3 \rightarrow \text{CaO}$	(Q) Carbon reduction
(C) $\text{Fe}_2\text{O}_3 \rightarrow \text{Fe}$	(R) Roasting
(D) Red Bauxite $\rightarrow [\text{Al}(\text{OH})_4]^-$	(S) Leaching
	(T) Self reduction

4. Match the metals/elements with the refining process employed for their purification.

Column-I	Column-II
(A) Ni	(P) Electrorefining
(B) B	(Q) Distillation
(C) Zn	(R) Vapour phase refining
(D) Sn	(S) Poling

5. Match the ore with its constituting elements.

Column-I	Column-II
(A) Chalcopyrite	(P) Fe or Ca.
(B) Dolomite	(Q) Mg or Cu.
(C) Chromite	(R) O atom.
(D) Carnallite	(S) K or Cr.
	(T) S or Cl.

6. The constituting element of ore in Column I is a component of alloy in Column II.

Column-I	Column-II
(A) Chalcocite	(P) Bronze (Cu or Sn)
(B) Bauxite	(Q) Solder (Pb, Sn)
(C) Cassiterite	(R) Duralumin (Al, Cu, Mg, Mn)
(D) Carnallite	(S) Magnesium (Mg, Al)
	(T) German silver (Cu, Zn, Ni)

ANSWERS

Single Correct Choice Type Questions

- | | | | |
|--------|---------|---------|---------|
| 1. (B) | 8. (A) | 15. (B) | 22. (C) |
| 2. (A) | 9. (C) | 16. (B) | 23. (A) |
| 3. (C) | 10. (A) | 17. (C) | 24. (D) |
| 4. (A) | 11. (A) | 18. (A) | 25. (D) |
| 5. (C) | 12. (D) | 19. (D) | 26. (B) |
| 6. (B) | 13. (C) | 20. (A) | 27. (C) |
| 7. (B) | 14. (D) | 21. (B) | 28. (B) |

Multiple Correct Choice Type Questions

- | | | | |
|------------------|-----------------------|-------------------|------------------------|
| 1. (A), (C), (D) | 5. (A), (C), (D) | 9. (A), (B), (D) | 13. (A), (B), (C), (D) |
| 2. (A), (C), (D) | 6. (A), (C), (D) | 10. (B), (D) | 14. (B), (C) |
| 3. (B), (C) | 7. (A), (B), (C), (D) | 11. (B), (C), (D) | 15. (B), (D) |
| 4. (A), (B) | 8. (A), (C) | 12. (A), (B), (D) | |

Comprehension Type Questions

- | | | | |
|-----------------------|--------|--------|---------|
| 1. (A), (B), (C), (D) | 4. (C) | 7. (B) | 10. (B) |
| 2. (C), (D) | 5. (B) | 8. (C) | 11. (A) |
| 3. (B) | 6. (D) | 9. (A) | |

Assertion–Reasoning Type Questions

- | | | | |
|--------|--------|--------|---------|
| 1. (C) | 4. (C) | 7. (B) | 10. (A) |
| 2. (C) | 5. (D) | 8. (C) | 11. (A) |
| 3. (A) | 6. (A) | 9. (B) | |

Integer Answer Type Questions

- | | | | |
|------|------|------|-------|
| 1. 3 | 4. 4 | 7. 4 | 10. 1 |
| 2. 5 | 5. 1 | 8. 2 | |
| 3. 4 | 6. 2 | 9. 4 | |

Matrix–Match Type Questions

- | | |
|--|--|
| 1. (A) \rightarrow (Q)
(B) \rightarrow (P), (Q), (R), (S), (T)
(C) \rightarrow (P), (R)
(D) \rightarrow (P), (Q), (R) | 4. (A) \rightarrow (P), (R)
(B) \rightarrow (R)
(C) \rightarrow (P), (Q)
(D) \rightarrow (P), (S) |
| 2. (A) \rightarrow (P), (Q), (R)
(B) \rightarrow (R), (S)
(C) \rightarrow (P), (R), (S)
(D) \rightarrow (Q), (R) | 5. (A) \rightarrow (P), (Q), (T)
(B) \rightarrow (P), (Q), (R)
(C) \rightarrow (P), (R), (S)
(D) \rightarrow (Q), (R), (S), (T) |
| 3. (A) \rightarrow (R), (T)
(B) \rightarrow (P)
(C) \rightarrow (Q)
(D) \rightarrow (S) | 6. (A) \rightarrow (P), (R), (T)
(B) \rightarrow (R), (S)
(C) \rightarrow (P), (Q)
(D) \rightarrow (R), (S) |

