

# + 2 CHEMISTRY

**Volume 1 & 2**


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## UNIT- 1: METALLURGY

### Choose the Best Answer

#### EVALUATION

1. Bauxite has the composition **(MAY 22)**  
(a)  $\text{Al}_2\text{O}_3$       (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
2. Roasting of sulphide ore gives the gas (A). (A) is a colourless gas. Aqueous solution of (A) is acidic. The gas (A) is  
(a)  $\text{CO}_2$                       (b)  $\text{SO}_3$                       (c)  $\text{SO}_2$                       (d)  $\text{H}_2\text{S}$
3. 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)
4. The metal oxide which cannot be reduced to metal by carbon is  
(a)  $\text{PbO}$                       (b)  $\text{Al}_2\text{O}_3$                       (c)  $\text{ZnO}$                       (d)  $\text{FeO}$
5. Which of the metal is extracted by Hall-Heroult process? **(MAR 23)**  
(a) Al                      (b) Ni                      (c) Cu                      (d) Zn
6. Which of the following statements, about the advantage of roasting of sulphide ore before reduction is not true?  
(a)  $\Delta G_f^0$  of sulphide is greater than those for  $\text{CS}_2$  and  $\text{H}_2\text{S}$   
(b)  $\Delta G_r^0$  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.
7. Match items in column-I with the items of column-II and assign the correct code.

**(MAR 20, JUNE 23)**

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	B
(a)	(i)	(ii)	(iii)	(iv)
(b)	(iii)	(iv)	(v)	(i)
(c)	(iv)	(ii)	(iii)	(i)
(d)	(ii)	(iii)	(i)	(v)

8. Wolframite ore is separated from tinstone by the process of **(PTA MQ, MAR 20)**  
(a) Smelting      (b) Calcination (c) Roasting (d) Electromagnetic separation
9. Which one of the following is not feasible?  
(a)  $\text{Zn}_{(s)} + \text{Cu}^{2+}_{(aq)} \rightarrow \text{Cu}_{(s)} + \text{Zn}^{2+}_{(aq)}$   
(b)  $\text{Cu}_{(s)} + \text{Zn}^{2+}_{(aq)} \rightarrow \text{Zn}_{(s)} + \text{Cu}^{2+}_{(aq)}$   
(c)  $\text{Cu}_{(s)} + 2\text{Ag}^{+}_{(aq)} \rightarrow \text{Ag}_{(s)} + \text{Cu}^{2+}_{(aq)}$   
(d)  $\text{Fe}_{(s)} + \text{Cu}^{2+}_{(aq)} \rightarrow \text{Cu}_{(s)} + \text{Fe}^{2+}_{(aq)}$

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 the following ores is best concentrated by froth – floatation method?  
(a) Magnetite (b) Hematite (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) Increases the rate of reduction
14. Zinc is obtained from ZnO by **(JULY 22)**  
(a) Carbon reduction (b) Reduction using silver  
(c) Electrochemical process (d) Acid leaching
15. Extraction of gold and silver involves leaching with cyanide ion. Silver is later recovered by **(NEET-2017, Corona-20)**  
(a) Distillation (b) Zone refining  
(c) Displacement with zinc (d) liquation
16. Considering Ellingham diagram, which of the following metals can be used to reduce alumina? **(NEET-2018)**  
(a) Fe (b) Cu (c) Mg (d) Zn
17. The following set of reactions are used in refining Zirconium **(PTA MQ, AUG 21)**  

$$\text{Zr (impure)} + 2\text{I}_2 \xrightarrow{523\text{K}} \text{ZrI}_4$$
 This method is known as  

$$\text{ZrI}_4 \xrightarrow{1800\text{K}} \text{Zr (pure)} + 2\text{I}_2$$
 (a) Liquation (b) van Arkel process (c) zone refining (d) Mond's process
18. Which of the following is used for concentrating ore in metallurgy?  
(a) Leaching (b) Roasting (c) Froth floatation (d) Both (a) and (c)
19. The incorrect statement among the following is **(SEP 20)**  
(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
20. In the electrolytic refining of copper, which one of the following is used as anode? **(MAR 24)**  
(a) Pure copper (b) Impure copper (c) Carbon rod (d) Platinum electrode
21. Which of the following plot gives Ellingham diagram?  
(a)  $\Delta S$  Vs T (b)  $\Delta G^0$  Vs T (c)  $\Delta G^0$  Vs  $\frac{1}{T}$  (d)  $\Delta G^0$  Vs  $T^2$

22. 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  $700^\circ\text{C}$ ,  $\left(\frac{\Delta G^0}{\Delta T}\right)$  is negative
23. Which of the following reduction is not thermodynamically feasible?
- (a)  $\text{Cr}_2\text{O}_3 + 2\text{Al} \longrightarrow \text{Al}_2\text{O}_3 + 2\text{Cr}$
- (b)  $\text{Al}_2\text{O}_3 + 2\text{Cr} \longrightarrow \text{Cr}_2\text{O}_3 + 2\text{Al}$
- (c)  $3\text{TiO}_2 + 4\text{Al} \longrightarrow 2\text{Al}_2\text{O}_3 + 3\text{Ti}$                       (d) none of these
24. 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  $\text{CO}_2$  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.

### ADDITIONAL QUESTIONS

25. The method of zone refining of metals is based on the principle of:
- (a) Greater mobility of the pure metal than that of impurity.
- (b) Higher melting point of the impurity than that of pure metal.
- (c) greater noble character of the solid metal than that of the impurity.
- (d) Greater solubility of the impurity in the molten state than in the solid.
26. Which of the following pairs of metal is purified by Van-Arkel method?
- (a) Ga and In   (b) Ni and Fe   (c) Ag and Au   (d) Zr and Ti
27. Aluminium is extracted from alumina ( $\text{Al}_2\text{O}_3$ ) by electrolysis of molten mixture of?
- (a)  $\text{Al}_2\text{O}_3 + \text{KF} + \text{Na}_3\text{AlF}_6$                       (b)  $\text{Al}_2\text{O}_3 + \text{HF} + \text{NaAlF}_4$
- (c)  $\text{Al}_2\text{O}_3 + \text{Na}_3\text{AlF}_6 + \text{CaF}_2$                       (d)  $\text{Al}_2\text{O}_3 + \text{CaF}_2 + \text{NaAlF}_4$
28. **Assertion (A)** : Pine Oil act as frothing agent in froth floatation.  
**Reason (R)** : Sulphide Ores are concentrated by froth floatation method.
- (a) If A and R both are correct and R is correct explanation of A
- (b) If A and R both are correct and R is not correct explanation of A
- (c) Assertion if true but Reason is false
- (d) Assertion if false but Reason is true

29. Zinc can be coated on iron to produce galvanised iron but the reverse is not possible it is because?
- (a) Zn has lower melting point than iron
  - (b) Zn has lower negative electrode potential than iron
  - (c) Zinc has higher negative electrode potential than iron
  - (d) Zinc is lighter than iron
30. Elements like silicon and Germanium to be used as a semi conductor is purified by **(PTA MQ)**
- (a) heating under vacuum
  - (b) Van-Arkel Method
  - (c) zone refining
  - (d) Electrolysis
31. The process of converting hydrated alumina into anhydrous alumina is called. **(PTA MQ)**
- (a) Roasting
  - (b) Smelting
  - (c) Auto-reduction
  - (d) Calcination
32. Extraction of gold involves leaching with cyanide ion Gold is later recovered by: **(SEP 20)**
- (a) metal displacement with zinc
  - (b) Liquation
  - (c) Distillation
  - (d) Zone refining
33. The metal which is used in packing material for food items **(SEP 20)**
- (a) Zn
  - (b) Zr
  - (c) Al
  - (d) Au

## UNIT-2: p-BLOCK ELEMENTS-I

### Choose the Best Answer

#### EVALUATION

1. An aqueous solution of borax is **(MAY 22)**  
 (a) neutral      (b) acidic                      (c) basic                      (d) amphoteric
2. Boric acid is an acid because its molecule. **(NEET)**  
 (a) contains replaceable  $H^+$  ion                      (b) gives up a proton  
 (c) combines with proton to form water molecule  
 (d) accepts  $OH^-$  from water, releasing proton.
3. Which among the following is not a borane?  
 (a)  $B_2H_6$                       (b)  $B_3H_6$                       (c)  $B_4H_{10}$                       (d) none of these
4. Which of the following metals has the largest abundance in the earth's crust?  
 (a) Aluminium                      (b) calcium                      (c) Magnesium                      (d) Sodium
5. In diborane, the number of electrons that accounts for banana bonds is **(JUNE 23)**  
 (a) Six                      (b) two                      (c) four                      (d) three
6. The element that does not show catenation among the following p-block elements is **(JULY 22)**  
 (a) Carbon                      (b) silicon                      (c) Lead                      (d) germanium
7. Carbon atoms in fullerene with formula  $C_{60}$  have **(MAR 23)**  
 (a)  $sp^3$  hybridised                      (b)  $sp$  hybridised                      (c)  $sp^2$  hybridised  
 (d) partially  $sp^2$  and partially  $sp^3$  hybridised
8. Oxidation state of carbon in its hydrides  
 (a) +4                      (b) -4                      (c) +3                      (d) +2
9. The basic structural unit of silicates is **(NEET, PTA MQ)**  
 (a)  $(SiO_3)^{2-}$                       (b)  $(SiO_4)^{2-}$                       (c)  $(SiO)^-$                       (d)  $(SiO_4)^{4-}$
10. The repeating unit in silicone is  
 (a)  $SiO_2$                       (b)  $\begin{array}{c} R \\ | \\ -Si-O \\ | \\ R \end{array}$   
 (c)  $R-O-\begin{array}{c} | \\ Si \\ | \\ R \end{array}-O$                       (d)  $\begin{array}{c} R \\ | \\ -Si-O-O-R \\ | \\ R \end{array}$
11. Which of these is not a monomer for a high molecular mass silicone polymer?  
 (a)  $Me_3SiCl$                       (b)  $PhSiCl_3$                       (c)  $MeSiCl_3$                       (d)  $Me_2SiCl_2$
12. Which of the following is not  $sp^2$  hybridised? **(SEP 21, MAR 24)**  
 (a) Graphite      (b) Graphene                      (c) Fullerene      (d) Dry ice

13. The geometry at which carbon atom in diamond are bonded to each other is  
(a) Tetrahedral (b) hexagonal (c) Octahedral (d) none of these
14. Which of the following statements is not correct?  
(a) Beryl is a cyclic silicate (b)  $Mg_2SiO_4$  is an orthosilicate  
(c)  $SiO_4^{4-}$  is the basic structural unit of silicates  
(d) Feldspar is not aluminosilicate
15. Match items in column-I with the items of column-II and assign the correct code.

Column-I		Column-II	
A	Borazole	1	$B(OH)_3$
B	Boric acid	2	$B_3N_3H_6$
C	Quartz	3	$Na_2[B_4O_5(OH)_4]8H_2O$
D	Borax	4	$SiO_2$

	A	B	C	D
(a)	2	1	4	3
(b)	1	2	4	3
(c)	1	2	4	3
(d)	None of these			

16. Duralumin is an alloy of  
(a) Cu, Mn (b) Cu, Al, Mg (c) Al, Mn (d) Al, Cu, Mn, Mg
17. The compound that is used in nuclear reactors as protective shields and control rods is  
(a) Metal borides (b) metal oxides (c) Metal carbonates (d) metal carbide
18. The stability of +1 oxidation state increases in the sequence  
(a)  $Al < Ga < In < Tl$  (b)  $Tl > In < Ga < Al$   
(c)  $In < Tl < Ga < Al$  (d)  $Ga < In < Al < Tl$

### ADDITIONAL QUESTIONS

19. In borax bead test which compound is formed?  
(a) Double Oxide (b) Tetra borate (c) Meta-borate (d) Ortho-borate
20. Which one of the following anions is present in the chain structure of silicates?  
(a)  $Si_2O_7^{6-}$  (b)  $(Si_2O_5^{2-})_n$  (c)  $(SiO_3^{2-})_n$  (d)  $SiO_4^{4-}$
21. Which of the following oxide is amphoteric?  
(a)  $SiO_2$  (b)  $CO_2$  (c)  $SnO_2$  (d)  $CaO$
22. Elements present in zeolites  
(a) Al, Si, C (b) Al, C, O (c) Al, Si, O (d) Si, O, C
23. The oxidising power of oxo acids follows the order **(PTA MQ)**  
(a)  $HOX > HXO_2 > HXO_3 > HXO_4$  (b)  $HXO_4 > HXO_3 > HXO_2 > HOX$   
(c)  $HXO_3 > HXO_4 > HXO_2 > HOX$  (d)  $HOX > HXO_4 > HXO_3 > HXO_2$



24. **Assertion** : Aqueous solution of potash Alum is acidic.  
**Reason** : Aluminium sulphate undergo hydrolysis. **(PTA MQ)**
- (a) Both assertion and reason are true and reason is the correct explanation of assertion  
(b) Both assertion and reason are true but reason is not the correct explanation of assertion  
(c) Assertion is true but reason is false  
(d) Both assertion and reason are false
25. Which of the following statement about  $H_3BO_3$  is not correct? **(PTA MQ)**
- (a) It is a strong tribasic acid  
(b) It is prepared by acidifying an aqueous solution of borax  
(c) It is a layer structure in which planer  $BO_3$  units are joined by hydrogen bonds  
(d) It does not act as proton donor but acts as a Lewis acid by accepting hydroxyl ion
26. On hydrolysis  $BF_3$  gives Boric acid and converted to fluoroboric acid. The fluoroboric acid contains the species **(PTA MQ)**
- (a)  $H^+$ ,  $F^-$  &  $BF_3$       (b)  $H^+$  &  $[BF_4]^-$       (c)  $[HBF_3]^+$  &  $F^-$       (d)  $H^+$ ,  $B^{3+}$  &  $F^-$
27. Inorganic benzene is: **(Corona-20)**
- (a)  $B_2H_6$       (b)  $B_3N_3H_6$       (c)  $H_3BO_3$       (d)  $H_2B_4O_7$
28. Sodium Salt of tetraboric acid is known as: **(SEP 20)**
- (a)  $B_2H_6$       (b)  $Na_2BO_3$       (c)  $H_3BO_3$       (d)  $Na_2B_4O_7 \cdot 10H_2O$

### 1. Metallurgy

1. What is the role of Limestone in the extraction of Iron from its oxide Fe<sub>2</sub>O<sub>3</sub>?

(June 20, Sep 20) (Gem Guide Q.No: 3)

Key Answer	Mark
Lime stone (CaO) is used as a basic flux	2

2. Which type of ores can be concentrated by froth flotation method? Give two examples for such ores. (June-2020, Mar-23) (Gem Guide Q.No: 4)

Key Answer	Mark
Sulphide ores	1
Example: 1) Galena (PbS) 2) Zinc blende (ZnS)	½ + ½

3. Explain the following terms with suitable examples. i) Gangue ii) Slag (PTA-2, Sep-2020) (Gem Guide Q.No: 10)

Key Answer	Mark
(i) Gangue: Correct explanation + one example	½ + ½
(ii) Slag: Correct explanation + one example	½ + ½

4. What is the difference between minerals and ores?

(June 20, May, 22, Mar 2024) (Gem Guide Q.No: 1)

Key Answer	Mark
Any three differences	3

5. Describe a method for refining nickel. (or) Explain Mond's process

(May – 22, June 23) (Gem Guide Q.No: 5)

Key Answer	Mark
Two correct equations with temperature $\text{Ni}_{(s)} + 4\text{CO}_{(g)} \xrightarrow{350\text{K}} [\text{Ni}(\text{CO})_4]_{(g)} \xrightarrow{460\text{K}} \text{Ni}_{(s)} + 4\text{CO}_{(g)}$	3

6. Give the limitations of Ellingham diagram. (June-23) (Gem Guide Q.No:15)

Key Answer	Mark
Any Two limitation	1 ½ + 1 ½

7. Explain Zone refining process with an example.

(Mar-2020, Mar-23) (Gem Guide Q.No: 6)

Key Answer	Mark
Fractional crystallization	1
The impurities will prefer to remain in the molten region.	
Explanation	3
Examples: Ge (or) Si (or) Ga (or) semiconductor	1

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

Silica in the extraction of copper (Mar 24) (Gem Guide Q.No: 12)

Key Answer	Mark
Silica acts as acidic flux (or) Correct equation only	2

9. Write about calcination. (or) What is calcination? (Mar-2024) (Gem Guide Q.No: 23)

Key Answer	Mark
Correct explanation (or) Correct Equation	2

10. Write about gravity separation or hydraulic wash? (May-22) (Gem Guide Q.No: 18)

Key Answer	Mark
Correct explanation + Any one example of ores	3

11. Write about liquation process of refining a metal? (June-23) (Gem Guide Q.No:29)

Key Answer	Mark
Correct explanation	2

**12. Explain froth floatation method. (Aug 2021) (Gem Guide Q.No: 42)**

Key Answer	Mark
Sulphide ores are concentrated by froth floatation process	1
Water + pine oil + Eucalyptus oil + sodium ethyl xanthate	1
Foam is produced by passing air into the mixture	1
Ore particles are watted by the oil rise to the surface along with the froth	1
Diagram	1

**13. Explain the Principal of electrolytic refining with an example.**

(July 2022) (Gem Guide Q.No: 13)

Key Answer	Mark
<b>Anode:</b> Impure Silver <b>Cathode:</b> Pure Silver	1+1
<b>Electrolyte:</b> Acidified silver nitrate solution.	1
<b>Reaction: Anode</b> : $\text{Ag}_{(g)} \longrightarrow \text{Ag}^+ + 1e^-$	1
<b>Cathode</b> : $\text{Ag}^+ + 1e^- \longrightarrow \text{Ag}_{(s)}$	1
During electrolysis pure metal deposits at cathode.	

**14. What are the various steps involved in the extraction of pure metals from their ores.**

(July 2024) (Gem Guide Q.No: 2)

Key Answer	Mark
(i) Concentration of ores (ii) Extraction of crude metal (iii) Refining of crude metal	2

**15. Explain the electrometallurgy of aluminium. (or) Explain Alumino Thermic Process.**

(July 2024) (Gem Guide Q.No: 9)

Key Answer	Mark
<b>Process:</b> Hall-Herold process	
<b>Anode:</b> Carbon rods <b>Cathode:</b> Iron tank lined with carbon	$\frac{1}{2} + \frac{1}{2}$
<b>Electrolyte:</b> 20% Alumina + molten cryolite + 10% calcium chloride solution	$\frac{1}{2}$ $\frac{1}{2}$
<b>Temperature:</b> 1270K	
During electrolysis anode dissolves slowly	$\frac{1}{2}$
The pure aluminium is formed at the cathode.	$\frac{1}{2}$
$4\text{Al}^{3+} + 6\text{O}^{2-} + 3\text{C}_{(s)} \longrightarrow 4\text{Al}_{(l)} + 3\text{CO}_{2(g)}$	2

**16. Explain Acid leaching with an example. (July 2024) (Gem Guide Q.No: 41)**

Key Answer	Mark
$2\text{ZnS} + 2\text{H}_2\text{SO}_4 + \text{O}_2 \longrightarrow 2\text{ZnSO}_4 + 2\text{S} + \text{H}_2\text{O}$	3
(or) Correct Explanation	

## 2. p-Block Elements-I

1. Write a short note on anomalous properties of the first element of p-block.

(Sep-20, Aug 2021) (Gem Guide Q. No: 1)

Key Answer	Mark
Small size of first member	1
High ionization enthalpy and high electronegativity	1
Absences of d-orbital in their valence shell	1

2. Give the uses of borax. (Aug-21) (Gem Guide Q. No: 3)

Key Answer	Mark
Any two uses	2

3. Write a short note on hydroboration. (June-23) (Gem Guide Q. No: 9)

Key Answer	Mark
$B_2H_6 + 6RCH = CHR \longrightarrow 2B(RCH - CH_2R)_3$	2
Mentioning anti markovnikov addition.	1

4. Give one example for each of the following: (June-23) (Gem Guide Q. No: 10)

a) Icosagens    b) Tetragen    c) Pnictogen    d) Chalcogan

Key Answer	Mark
Each one example	$4 \times \frac{1}{2} = 2$

5. How will you identify borate radical? Write the reaction involved. (or) write the ethyl borate test (Mar -23) (Gem Guide Q. No: 13)

Key Answer	Mark
Triethyl borate (green edged flame)	2

6. How will you convert boric acid to boron nitride? (Mar -2024) (Gem Guide Q. No: 15)

Key Answer	Mark
Correct equation	2

7. A hydride of 2<sup>nd</sup> period alkali metal (A) on reaction with compound of Boron (B) to give a reducing agent (c). Identify A, B, and C. (June-2020) (Gem Guide Q. No: 16)

Key Answer	Mark
A - LiH (or) Lithium Hydride	$\frac{1}{2}$
B - $B_2H_6$ (or) Diborane	$\frac{1}{2}$
C - $LiBH_4$ (or) Lithium Borohydride	1

8. What is catenation? Describe briefly the catenation property of carbon.

(Mar-20, Sep -20, July – 22) (Gem Guide Q. No: 4)

Key Answer	Mar-2020
Correct definition	2
Any two conditions	2

9. Write a note on Fisher tropesch synthesis. (Mar -23) (Gem Guide Q. No: 5)

Key Answer	Mark
$nCO + (2n+1)H_2 \xrightarrow{500-700k, less than 50 atm} C_nH_{(2n+2)} + nH_2O$	3
$nCO + 2nH_2 \xrightarrow{500-700k, less than 50 atm} C_nH_{2n} + nH_2O$	

10. Give the Uses of Silicones. (Mar -23) (Gem Guide Q. No: 7)

Key Answer	Mark
Any two uses	1+1

**11. Describe the structure of diborane. (Mar -23) (Gem Guide Q. No: 8)**

Key Answer	Mark
Correct structure	1
<b>Any four points from the following.</b> 1. Two B H <sub>2</sub> units are linked by two bridged hydrogens. 2. It has eight B-H bonds. 3. It has only 12 valence electrons unable to form normal covalent bonds. 4. The four terminal B-H bonds (2c-2e) bond. 5. Two B-H-B (3c-2e) or bridged bond. 6. The bridging hydrogen atoms are in a plane 7. The boron is sp <sup>3</sup> hybridized.	4×½ =2

**12. Write the Uses of Boron. (Aug 21) (Gem Guide Q. No: 24)**

Answer Key	Marks
Any three uses	3

**13. Write the uses of boric acid (May-22, July -22, Mar -2024) (Gem Guide Q. No: 30)**

Key Answer	May-2022
Any three uses	3

**14. What is potash alum? How to prepare potash alum?**

(June -2020) (Gem Guide Q. No: 38)

Key Answer	Mark
$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 4Al(OH)_3 + 6H_2SO_4 \rightarrow K_2SO_4 + 3Al_2(SO_4)_3 + 12H_2O$	1½
$K_2SO_4 + Al_2(SO_4)_3 + 24H_2O \rightarrow K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	1½

**15. Why the ionization enthalpy from aluminium to thallium is only a marginal difference?**

(Mar-2020) (Gem Guide Q. No: 52)

Key Answer	Mark
Due to the presence of inner 'd' and 'f' electron which has poor shielding effect compared to 's' and 'p' electrons.	3

**16. What are silicates? (Mar -2024) (Gem Guide Q. No: 55)**

Key Answer	Mark
Correct definition	2

### 3 p-Block Elements-II

1. What is inert pair effect? (May-22) (Gem Guide Q. No: 1)

Key Answer	Mark
Correct definition	2

2. Give the oxidation state of halogen in the following a)  $OF_2$  b)  $O_2F_2$  c)  $Cl_2O_3$  d)  $I_2O_4$

(Gem Guide Q. No: 4)

Key Answer	Mark
a) $OF_2 = -1$ b) $O_2F_2 \Rightarrow -1$ c) $Cl_2O_3 \Rightarrow +3$ d) $I_2O_4 = +4$	$4 \times \frac{1}{2} = 2$

3. What are interhalogen compounds? Give examples (Aug -2021, May-22) (Gem Guide Q. No: 5)

Key Answer	Mark
Correct definition	2
Any two examples	$2 \times \frac{1}{2} = 1$

4. Give the uses of helium. (Sep-2020, Aug-2021, June-23, Mar-2024) (Gem Guide Q. No: 7)

Key Answer	Mark
Any three points	3

5. Give the balanced equation for the reaction between chlorine with cold NaOH and hot NaOH. (Sep 20) (Gem Guide Q. No: 9)

Key Answer	Mark
Balanced Equations	3
Unbalanced Equations	2

6. Give a reason to support that sulphuric acid is a dehydrating agent. (or) prove the dehydrating property of sulphuric acid. (June-23, Mar -2024) (Gem Guide Q. No:12)

Key Answer	Mark
Any one balanced equation	2

7. Give the uses of argon (July 22) (Gem Guide Q. No: 15)

Key Answer	Mark
Uses	2

8. What type of hybridization occur in a)  $BrF_5$  b)  $BrF_3$  c)  $BrF$  d)  $IF_7$

(June -2020) (Gem Guide Q. No: 22)

Key Answer	Mark
a) $BrF_5 \Rightarrow sp^3 d^2$ b) $BrF_3 \Rightarrow sp^3 d$ c) $BrF \Rightarrow sp^3$ d) $IF_7 \Rightarrow sp^3 d^3$	$4 \times \frac{1}{2} = 2$

9. Complete the following reaction (Mar 23)

(i)  $P_4 + NaOH + H_2O \rightarrow$  (ii)  $Cu + H_2SO_4 \rightarrow$  (iii)  $XeF_6 + H_2O \rightarrow$  (Gem Guide Q. No: 23)

Key Answer	Mark
Correct Equations	3

10. Write the uses of oxygen (May-22) (Gem Guide Q. No: 47)

Key Answer	Mark
Any two uses	2

11. Sulphuric acid is a dibasic acid. Prove it (Sep-2020) (Gem Guide Q. No: 51)

Key Answer	Mark
Any two balanced equation	$2 \times \frac{1}{2} = 1$

12. Explain the preparation of chlorine (Sep 20) (Gem Guide Q. No: 53)

Key Answer	Mark
Balanced Equation	2
Unbalanced Equation	1

13. How bleaching powder is prepared? (Mar 20, May 22) (Gem Guide Q. No: 54)

Key Answer	Mark
Balanced Equation	2
Unbalanced Equation (or) Theory only	1

**14. HF acid is not stored in glass bottles. Why? (March -2020) (Gem Guide Q. No: 58)**

Key Answer	Mark
HF react with glass	1
Balanced equation	2

**15. Write the molecular formula and draw the structure of sulphurous acid and marshall's acid. (Mar 20) (Gem Guide Q. No: 70)**

Key Answer	Mark
Two formula and Structure	1+2

**16. Give the uses of phosphine or write about Holmes signal. (Sep-2020) (Gem Guide Q. No: 71)**

Key Answer	Mark
A mixture of calcium carbide and calcium phosphide	1
liberates phosphine and acetylene	1
phosphine catches fire and ignites acetylene	1

**17. Explain the bleaching action of sulphur dioxide.**

(Aug -2021, June-23) (Gem Guide Q. No: 76)

Key Answer	Mark
Reducing property	1
$SO_2 + 2H_2O \longrightarrow H_2SO_4 + 2[H]$	1
$X(\text{coloured}) + 2[H] \longrightarrow XH_2(\text{colourless})$	1
Correct explanation (or) equation	2

**18. How chlorine is manufactured by Deacon's process?**

(June -2020) (Gem Guide Q. No: 79)

Key Answer	Mark
Correct balanced equations	5

**19. Write the properties of interhalogen compounds (July 22) (Gem Guide Q. No: 80)**

Key Answer	Mark
Any five points	5

**20. Give the uses of sulphuric acid. (July 24) (Gem Guide Q. No: 11)**

Key Answer	Mark
Any three uses	3

#### 4. Transition and Inner Transition Elements

1. Describe the preparation of potassium dichromate. (Corona 20) (Gem Guide Q. No: 6)

Key Answer	Mark
Ore and Concentration method	1
Three equations	4

2. What is Lanthanide contraction? Explain its consequences.

(July 23, Mar 24) (Gem Guide Q. No: 7)

Key Answer	Mark
Correct explanation for lanthanide contraction	2
Consequences (or) Effects of lanthanide contraction	3×1=3

3. What are interstitial compounds? (Sep -2020, Aug 2021, June-23) (Gem Guide Q. No: 9)

Key Answer	Mark
Compound that is formed when small atoms like H, B, C or N are trapped in the interstitial holes in a metal lattice	2
One example	1

4. Calculate the number of unpaired electrons in  $Ti^{3+}$ ,  $Mn^{2+}$  and calculate the spin only magnetic moment. (Aug – 2021) (Gem Guide Q. No: 10)

Key Answer	Mark
$Ti^{3+} \Rightarrow 1$ unpaired electron	$\frac{1}{2}$
$Mn^{2+} \Rightarrow 5$ unpaired electron	$\frac{1}{2}$
Magnetic moment $\mu_s = \sqrt{n(n+2)}$ BM	1
Magnetic moment of $Ti^{3+} = 1.73$ BM	$\frac{1}{2}$
Magnetic moment of $Mn^{2+} = 5.91$ BM	$\frac{1}{2}$

5. Which is more stable?  $Fe^{3+}$  or  $Fe^{2+}$  - explain. (May-22, Mar – 2024) (Gem Guide Q. No: 13)

Key Answer	Mark
$Fe^{3+}$ is more stable than $Fe^{2+}$	1
$Fe^{3+} - [Ar]3d^5$	1
$d^5$ configuration (or) Half-filled d orbital	1

6. Compare lanthanides and actinides. (J-22, Mar -23) (Gem Guide Q. No: 15)

Key Answer	Mark
Any three differences	3×1=3

7. Which metal in the 3d series exhibits +1 oxidation state most frequently. why?

(Sep-2020) (Gem Guide Q. No: 25)

Key Answer	Mark
Copper	1
In +1 oxidation state it forms $cu^+$ ion with stable $3d^{10}$ configuration. It attains stable configuration	1

8. What is Ziegler-Natta catalyst? How poly propylene polymer is obtained? Give its use.

(July 22) (Gem Guide Q. No: 33)

Key Answer	Mark
Balanced equation	2
Use	1



**9. What are the properties of interstitial compounds? (May-2022) (Gem Guide Q. No: 34)**

Key Answer	Mark
Any three properties	3

**10. What is chromyl chloride test? (March-2020) (Gem Guide Q. No: 38)**

Key Answer	Mark
Balanced equation	3

**11. Classify the following elements into d-block and f-block element.**

(Mar 20) (Gem Guide Q. No: 44)

(i) Tungsten (ii) Ruthenium (iii) Promethium (iv) Einsteinium

Key Answer	Mark
Tungsten $\Rightarrow$ d-block	$\frac{1}{2}$
Ruthenium $\Rightarrow$ d-block	$\frac{1}{2}$
Promethium $\Rightarrow$ f-block	$\frac{1}{2}$
Einsteinium $\Rightarrow$ f-block	$\frac{1}{2}$

**12. Why d block elements exhibit variable oxidation states?**

(Aug – 2021) (Gem Guide Q. No: 51)

Key Answer	Mark
The energy difference between (n-1)d and ns orbitals are very small	2

### 5. Coordination Chemistry

1. For the complex,  $[\text{Pt}(\text{NO}_2)(\text{H}_2\text{O})(\text{NH}_3)_2] \text{Br}$ , Identify the following. (Mar 23) (Gem guide Q.No: 2)

- (i) Central metal atom / ion (ii) Ligand(s) and their types (iii) Coordination entity  
(iv) Oxidation number of the central metal ion (v) Coordination number

Key Answer	Mark
(i) Pt (II) (or) $\text{Pt}^{2+}$	1
(ii) $\text{NO}_2^-$ nitrito – $\kappa\text{N}$ (Anionic ligand), $\text{H}_2\text{O}$ aqua (Neutral ligand), $\text{NH}_3$ ammine (Neutral ligand)	1
(iii) $[\text{Pt}(\text{NO}_2)(\text{H}_2\text{O})(\text{NH}_3)_2]^+$	1
(iv) $x + (-1) + 0 + 2(0) = +1$ ; $x = +2$ ,	1
(v) 4	1

2. Give an example of coordination compound used in medicine and two examples of biologically important coordination compounds. (Mar 2024) (Gem guide Q.No: 4)

Key Answer	Mark
one example for medical importance	1
one example for biological importance	1

3. Based on VB theory explain  $[\text{Ni}(\text{CN})_4]^{2-}$  is diamagnetic. (Aug 21) (Gem guide Q.No: 5)

Key Answer	Mark
Electronic Configuration of $\text{Ni}^{2+}$ ; $\text{CN}^-$ , Strong ligand	$\frac{1}{2} + \frac{1}{2}$
Pairs 3d electrons ; Unpaired electrons = 0	$\frac{1}{2} + \frac{1}{2}$

4. Draw all possible geometrical isomers of the complex  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$  and identify the optically active isomer. (June 23) (Gem guide Q.No: 6)

Key Answer	Mark
Two cis and one trans isomers-structures	3
Optically active isomers: mentioning two cis isomers	2

5.  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  is coloured, while  $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$  is colourless- explain. (March 2020) (Gem guide Q.No: 7)

Key Answer	Mark
The outer electronic configuration of central metal ion $\text{Sc}^{3+}$ is $3d^0$	1
Due to presence of vacant or empty d-orbital	1
So d-d transition is possible in this complex. So, it is coloured.	1

6. In an octahedral crystal field, draw the figure to show splitting of d Orbitals.

(June-2020) (Gem guide Q.No: 10)

Key Answer	June-2020
Correct diagram	3

7. Give the difference between double salts and coordination compounds

(Jul 20, Aug 21, Mar 24) (Gem guide Q.No: 13)

Key Answer	Mark
Any Three Differences	3

8. Write the postulates of Werner's Theory. (Sep 2020, May 22) (Gem guide Q.No: 14)

Key Answer	Mark
Five Postulates	5

9. Write any two hydrate isomers of the complex with the molecular formula  $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ .

(Mar 20) (Gem guide Q.No: 17)

Key Answer	Mark
(i) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ (ii) $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$ (iii) $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl}_2 \cdot \text{H}_2\text{O}$	2

10. Discuss briefly the nature of bonding in metal carbonyls. (Mar 23) (Gem guide Q.No: 21)

Key Answer	Mar-23
The bond between metal atom and the carbonyl ligand consists of two components	1
$\text{M} \leftarrow \text{CO}$ sigma bond. (or) explanation	1
The sigma bond formation increases the electron density in metal d orbitals.	1
Correct explanation for $\pi$ -back bonding (or) suitable diagram.	2

11. What are the limitations of VB theory? (Aug 2021, Jul 22) (Gem guide Q.No: 24)

Key Answer	Mark
Three Limitations	3

12. Write the oxidation state, coordination number, nature of ligand, magnetic property and electronic configuration in octahedral crystal field for the complex  $K_4[Mn(CN)_6]$

(June 23) (Gem guide Q.No: 25)

Key Answer	Mark
Oxidation state of central metal ion: +2	1
Coordination number - 6	1
Nature of ligand - strong field ligand (CN <sup>-</sup> )	1

13. Write the IUPAC name of the following. (Mar 20) (Gem guide Q.No: 31)

(i)  $[Ag(NH_3)_2]^+$  (ii)  $[Co(NH_3)_5Cl]^{2+}$

Key Answer	Mark
(i) Diamminesilver (I) ion (ii) Pentaamminechloridocobalt (III) ion	$\frac{1}{2} + \frac{1}{2}$

14. Calculate the magnetic moment and magnetic property of  $[CoF_6]^{3-}$ .

(Mar 2020) (Gem guide Q.No: 32)

Key Answer	Mark
Magnetic property - No. of unpaired electrons = 4 (or) paramagnetic	1
Magnetic moment $\mu = \sqrt{n(n+2)}$ $BM = \sqrt{4(4+2)} = 4.899$ BM	1

15. Indicate the possible type of Isomerism for the following complexes.

(i)  $[Co(en)_3]^{3+}$  (ii)  $[Pt(NH_3)_2Cl_2]^{2+}$

(Sep 20) (Gem guide Q.No: 33)

Key Answer	Mark
(i) Optical Isomerism (ii) Geometrical Isomerism (or) Cis-trans isomerism	1+1

16. Mention the metal complexes and its metal ions are used in biological system.

(Sep 2020) (Gem guide Q.No: 34)

Key Answer	Mark
Any three	3

17. Write the following for the complex  $[Ag(NH_3)_2]^+$  (May 22) (Gem guide Q.No: 37)

(i) Ligand (b) Central metal ion (c) IUPAC name

Key Answer	Mark
(a) $NH_3$ (ammine) (b) $Ag^+$ (Silver) (c) Diamminesilver (I) ion	3

18. Write the IUPAC ligand name for the following. (July 22) (Gem guide Q.No: 43)

(a)  $C_2O_4^{2-}$  (b)  $H_2O$  (c)  $Cl^-$

Key Answer	Mark
a) Oxalato b) aqua c) chlorido	3

19. Define the term central metal atom and Coordination number in coordination compounds. (May 22, Mar 23) (Gem guide Q.No: 45)

Key Answer	Mark
Correct Definition	2

20. What is linkage isomerism? Explain with an example. (June-24) (Gem guide Q.No: 11)

Key Answer	Mark
Correct Definition	2
Any one example	1

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L-1	14 a	3 b	17 a	12 d	7 a	L-5	14 a	7 b	21 d	11 c	25 c	13 a
1 b	15 c	4 a	18 a	13 d	8 b	1 d	15 d	8 d	22 b	12 a	L-8	14 d
2 c	16 c	5 c	L-3	14 c	9 b	2 b	16 c	9 c	23 a	13 b	1 d	15 d
3 c	17 b	6 c	1 a	15 a	10 b	3 c	17 d	10 d	L-7	14 c	2 d	16 d
4 b	18 d	7 c	2 d	16 d	11 c	4 d	18 c	11 a	1 c	15 b	3 c	17 a
5 a	19 d	8 a	3 d	17 d	12 c	5 d	19 c	12 c	2 c	16 c	4 a	18 c
6 d	20 b	9 d	4 b	18 c	13 c	6 d	20 d	13 b	3 b	17 a	5 c	19 c
7 c	21 b	10 b	5 a	L-4	14 b	7 c	L-6	14 b	4 c	18 c	6 c	20 b
8 d	22 c	11 a	6 a	1 b	15 d	8 b	1 c	15 a	5 c	19 d	7 b	21 a
9 b	23 b	12 d	7 b	2 a	16 a	9 a	2 b	16 c	6 a	20 a	8 a	22 c
10 c	24 b	13 a	8 a	3 a	17 b	10 b	3 b	17 d	7 b	21 a	9 b	23 b
11 b	L-2	14 d	9 d	4 c	18 a	11 d	4 c	18 a	8 b	22 b	10 b	
12 c	1 c	15 a	10 b	5 a	19 a	12 a	5 a	19 b	9 a	23 d	11 a	
13 a	2 d	16 d	11 b	6 c		13 c	6 c	20 c	10 d	24 b	12 b	

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L-9	14 d	L-10	14 d	7 a	21 b	12 a	L-13	14 d	L-14	14 c	L-15	14 b
1 c	15 d	1 c	15 a	8 c	22 b	13 b	1 a	15 b	1 c	15 c	1 c	15 d
2 b	16 a	2 b	16 a	9 b	L-12	14 a	2 b	16 b	2 d	16 d	2 a	
3 c	17 b	3 d	17 d	10 a	1 b	15 d	3 a	17 d	3 b	17 d	3 a	
4 b	18 c	4 c	18 d	11 a	2 d	16 a	4 d	18 b	4 a	18 d	4 a	
5 c	19 d	5 a	19 a	12 d	3 c	17 b	5 c	19 a	5 a	19 c	5 d	
6 b	20 b	6 b	20 d	13 c	4 b	18 b	6 c	20 d	6 c	20 b	6 c	
7 a	21 d	7 b	L-11	14 d	5 c	19 a	7 c	21 b	7 a	21 a	7 a	
8 b	22 a	8 b	1 a	15 a	6 a	20 b	8 c	22 b	8 c	22 c	8 c	
9 b	23 b	9 d	2 c	16 c	7 a	21 c	9 b	23 a	9 d	23 b	9 a	
10 c	24 a	10 b	3 a	17 d	8 b	22 d	10 d	24 b	10 d	24 d	10 d	
11 b	25 a	11 d	4 c	18 c	9 c	23 c	11 d	25 b	11 d	25 d	11 d	
12 c		12 b	5 c	19 d	10 c	24 d	12 a		12 d		12 c	
13 a		13 d	6 b	20 a	11 a		13 a		13 a		13 d	



