UNIT VI --General Principles and process of Isolation of elements

METALLURGY

SUBTOPIC-I (PRACTICE QUESTIONS)

1. The most abundant metal on the surface of the earth is

1. Fe 2. Al

3. Ca 4. Na

2. The most abundant element in the earth's crust (by weight) is

1. Si 2. Al

3. O 4. Fe

3. Which of the following metal occurs in native state?

1. Ca 2. Au

3. Zn 4. Al

4. The earthy impurities present in the mineral are called

1. Flux 2. Slag

3. Gangue 4. Refractory material

5. During smelting, an additional substance is added which combines with impurities to from a fusible product. It is known as

1. Slag 2. Mud

3. Gangue 4. Flux

6. In metallurgy, flux is a substance used to convert

1. Insoluble impurities to a fusible mass 2. Minerals into silicates

3. Soluble particles into insoluble particles 4. Fusible impurities to infusible impurities

7. When a metal is to be extracted from its ore and the gangue associated with the ore is silica, then

1. An acidic flux is added
2. A basic flux is added
3. Both acidic and basic and basic fluxes are added
4. Neither of them is needed

8. Which of the following is not a basic flux?

1. $CaCO_3$
2. Lime
3. SiO_2
4. CaO

9. An example of halide ore is

1. Galena
2. Bauxite
3. Cinnabar
4. Cryolite

10. Horn silver is

1. Carbonate mineral
2. Chloride mineral
3. Sulphate mineral
4. Phosphate mineral

11. Willemite is a

1. Sulphide mineral
2. Silicate mineral
3. Carbonate mineral
4. Oxide mineral

12. Which of the following is a basic carbonate mineral?

i) Malachite ii) Bauxite iii) Azurite iv) Celestite

1. Both i & iii
2. Both ii & iv
3. Both i & iv
4. Both iii & iv

13. Method used for the concentration of tinstone ore is

1. Hand picking
2. Froth flotation
3. Magnetic separation
4. Leaching

14. The sulphide ores are generally concentrated by

1. Gravity separation
2. Froth flotation process
3. Magnetic separation
4. Liquation

15. Froth floatation process is based on:

1. Wetting properties of ore particle
2. Specific gravity of ore particles
3. Magnetic properties of ore particles
4. Electrical properties of ore particles

16. In the froth floatation process of concentration of ores, the ore particles float because they:

1. Are light
2. Are insoluble
3. Have the surface which is not wetted easily
4. Have a constant electrical charge

17. The oil used in the froth floatation method for the purification of ores is

1. Coconut oil
2. Kerosene oil
3. Mustard oil
4. Pine oil

18. The olive oil in forth floatation process is called

1. Frothing agent
2. Collecting agent
3. Conditioning
4. Lubricating agent

19. The collecting agent in froth floatation process is

1. Sodium ethyl xanthate
3. Pine oil
3. Lime
4. Water

20. The magnetic impurity present in cassiterite ore is

1. Silica
2. Wolframite
3. SnO_2
4. Caly

21. Heating of ore in the absence of air below its melting point is called

1. Leaching 2. Roasting 3. Smelting 4. Calcination

22. The role of calcinations in metallurgical operations is

1. To remove moisture
2. To decompose carbonate
3. To drive off organic matter
4. All the above

23. Which of the following reactions is an example for calcinations process?

1. $2Ag + 2HCl + (O) \rightarrow 2AgCl + H_2O$
2. $2Zn + O_2 \rightarrow 2ZnO$
3. $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$
4. $MgCO_3 \rightarrow MgO + CO_2$

24. Heating of metal pyrites to convert them into oxides of metal in the presence of air is called

1. Smelting 2. Calcination 3. Liquation 4. Roasting

25. Leaching process is one stage in the metallurgy of

1. Zinc 2. Iron 3. Aluminium 4. Copper

26. The common method of extraction of metals from oxide ores is

1. Reduction with carbon
2. Reduction with hydrogen
3. Reduction with aluminium
4. Electrolytic method

27. In electro-refining of metal the impure metal is made the anode a strip pure metal, the cathode, during the electrolysis an aqueous solution of a complex metal salt. This method can not be used for refining of

1. Silver 2. Copper 3. Aluminium 4. Sodium

28. An ore after levigation is found to contain basic impurities. The flux which can be used during smelting is

1. SiO_2 2. $CaCO_3$ 3. Dil HCl 4. CaO and SiO_2

29. The method for the purification of impure metals which is based upon the phenomenon of electrolysis is called

1. Electrorefining 2. Hydrometallurgy 3. Poling 4. Liquation

30. The phenomenon of removing layrers of basic oxides form metals before electroplating is called.

1. Galvanising 2. Anodising 3. Picking 4. Poling

31. Glauber salt is

1. hepta hydrate 2. Deca hydrate 3. Penta hydrate 4. Dehydrate

32. Gelena on heating in limited supply of air gives lead metal. This is known as

1. Smelting 2. Calcination 3. Self reduction 4. Sulphatizing roasing

33.

Column-I (Metals)	**Column-II (Ores)**
A) Tin	**1) Calamine**
B) Zinc	**2) Cassiterite**
C) Titanium	**3) Cerrusite**
D) Lead	**4) Rutile**

	A	B	C	D
1)	1	2	3	4
2)	2	1	4	3
3)	4	3	2	1
4)	2	1	3	4

34. Match the following

List-I	**List-II**
Metallurgical process	**Main change**
A) Smelting	**1) in the absence of air ore decomposes**
B) Roasting	**2) the ore generally is converted into a soluble compound**
C) Calcination	**3) electrolysis takes place**
D) Leaching	**4) Oxidation and the product i solid state**
	5) Reduction and the product (metal or its sulphate) as liquid

	A	B	C	D
1)	5	4	1	2
2)	2	3	4	1
3)	3	1	5	2
4)	5	2	1	3

35. Froth flotation process used for the concentration of sulphide ore

a) Is based on the difference in wettability of different minerals

b) Uses sodium ethyl xanthate, $C_2H_5OCS_2$ Na as collector

c) Uses NaCN as depressant in the mixture of ZnS and PbS when ZnS forms soluble complex and PbS forms froth

1. (a), (b) only correct
2. (b), (c) only correct
3. (a), (c) only correct
4. (a), (b), (c) are correct

36. Choose the correct code regarding Roasting process

I) It is the process of heating ore in air to obtain the oxide

II) It is an exothermic process

III) It is used for hydrated oxide and oxy salt ore

IV) It is used after the concentration of ore

1. I, II and III 2. I , II and IV 3. I, III and IV 4. I, II, III and IV

37. In van Arkel method, If I_2 is introduced at 1700K over impure metal, the product will be

1. Iodide of the metal
2. No reaction takes place
3. Impurities react with iodine
4. Metal doesn't react

38. Match the following

List-I	**List-II**
Dressing methods	**Principle involved**
A) Washing with water	**1) Fusibility difference**
B) Forth floatation	**2) density difference**
C) Hand picking	**3) Wetting difference**
D) Liquation	**4) Colour, size etc. of ore particulars difference**
	5) Magnetic property difference

	A	B	C	D
1)	3	1	4	2
2)	5	2	1	3
3)	2	3	4	1
4)	3	2	5	4

39. The chemical formula of feldspar is

1. $KAlSi_3O_8$
2. Na_3AlF_6
3. $NaAlO_2$
4. $K_2SO_4.Al_2(SO_4)_3.4Al(OH)_3$

40. Match the following

List-I	**List-II**
A) Flespar	**I)** $[Ag_3SbS_3]$
B) Absestos	**II)** $Al_2O_3.H_2O$
C) Pyrargyrite	**III)** $MgSO_4.H_2O$
D) Diaspore	**IV)** $KAlSi_3O_8$
	V) $CaMg_3(SiO_3)_4$

The correct answer is

	A	B	C	D
1)	IV	V	II	I
2)	IV	V	I	II
3)	IV	I	III	II
4)	II	V	IV	I

41. Which of the following factors is of no significance for roasting sulphide ores to the oxides and not directly?

1. Metal sulphides are thermodynamically more stable than CS_2

2. CO_2 is thermodynamically more stable than CS_2

3. Metal sulphides are less stable than the corresponding oxides

4. CO_2 is more volatile than CS_2

42. Assertion: Ores are generally converted into oxides, prior to reduction.

Reason: Metal oxides can be easily reduced.

1. If both assertion and reason are correct, and reason is the correct explanation of the assertion

2. If both assertion and reason are correct, but reason is not the correct explanation of the assertion

3. If assertion is correct but reason is incorrect

4. If assertion is incorrect but reason is correct

43. Assertion: In froth floatation process sodium ethyl xanthate is used as collector

Reason: Sulphide ores are water soluble.

1. If both assertion and reason are correct, and reason is the correct explanation of the assertion

2. If both assertion and reason are correct, but reason is not the correct explanation of the assertion

3. If assertion is correct but reason is incorrect

4. If assertion is incorrect but reason is correct

44. Assertion: Lead, tin and bismuth are purified by liquation method.

Reason: Lead, tin and bismuth have low m.p. as compared to impurities.

1. If both assertion and reason are correct, and reason is the correct explanation of the assertion

2. If both assertion and reason are correct, but reason is not the correct explanation of the assertion 3. If assertion is correct but reason is incorrect

4. If assertion is incorrect but reason is correct

45. Assertion: All the ores are mineral Reason: Ores contains metals combined state.

1. If both assertion and reason are correct, and reason is the correct explanation of the assertion

2. If both assertion and reason are correct, but reason is not the correct explanation of the assertion 3. If assertion is correct but reason is incorrect

4. If assertion is incorrect but reason is correct

METALLURGY

SUBTOPIC-I (KEY)

1) 2	2) 3	3) 2	4) 3	5) 4	6) 1	7) 2	8) 3	9) 4	10) 2
11) 2	12) 1	13) 3	14) 2	15) 1	16) 3	17) 4	18) 1	19) 1	20) 2
21) 4	22) 4	23) 4	24) 4	25) 3	26) 1	27) 2	28) 1	29) 1	30) 3
31) 2	32) 3	33) 2	34) 1	35) 4	36) 2	37) 2	38) 3	39) 1	40) 2
41) 3	42) 3	43) 3	44) 1	45) 3					

SUBTOPIC-I SOLUTIONS

1. $Al - 7.28\%$ by weight.

2. O > Si > Al > Fe

3. Au, Pt, Pd are occur is native state.

6. Flux is added to convert insoluble impurities to a fusible mass.

9. Cryolyte is $Na_3AlF_6\,(or)\,3NaF : AlF_3$

13. Tinstone is SnO_2

18. Olive oil in the froth floatation process act as Frothing agent.

23. $MgCO_3 \xrightarrow{\Delta} MgO + CO_2$

26. Reduction with carbon.

$MgO + C \rightarrow Mg + CO$

31. Glanber salt - $Na_2SO_4 10H_2O$

33. Calamine - $ZnCO_3$

Cayreterite - SnO_2

Cerruyite - $PbCO_3$

Rutile -

39. Feld SpO_4 - $KAlSi_3Og$

SUBTOPIC-III (PRACTICE QUESTIONS)

1. Bauxite is boiled with aqueous NaOH solution. Sodium metal aluminate solution is formed. This part in the metallurgy aluminium is called

1. Liquation 2. Amalgamation 3. Leaching 4. Calcination

2. When Baxuite is heated with NaOH solution, the water soluble compound formed is

1. $NaAlO_2$ 2. Na_3AlO_3 3. $Al(OH)_3$ 4. Al_2O_3

3. A mixture of White Bauxite powder and coke is heated in nitrogen gas very strongly. The products are

1. Al_2O_3, C_2N_2 2. $Al(NO_3)_3, CO$

3. AlN, CO, Si vapour 4. $Al_2(CO_3)_3, N_2O$

4. Aluminium is obtained by the electrolysis of pure Al_2O_3 dissolved in

1. Alummina 2. Bauxite 3. Cryolite 4. Feldspar

5. In the electrolysis of alumina cryolite is added to

1. Lower the melting point of alumina 2. Increase the electrical conductivity

3. Minimise the anode effect 4. Remove impurities from alumina

6. In the extraction of aluminium the electrolyte is

1. Fused cryolite with felspar
2. Fused cryolite with fluorspar
3. Pure alumina in molten cryolite with fluorospar
4. Pure alumina with bauxite and moleten cryolite

7. Metal extracted from sea water is

1. Be
2. Mg
2. Ba
4. Ca

8. The formula of Dolomite is

1. $MgCO_3.CaCl_2$
2. $MgCO_3.CaCO_3$
3. $MgCO_3.CaSO_4$
4. $MgCl_2.CaCO_4$

9. Composition of carnallite is

1. $CaCO_3.MgCO_3$
2. $MgCl_2.KCl.6H_2O$
3. $Al_2O_3.2H_2O$
4. $MgSO_4.7H_2O$

10. Hydrated magnesium chloride becomes anhydrous salt when is is heated

1. With P_4O_{10}
2. With anhydrous $CaCl_2$
3. In dry HCl gas
4. With conc. H_2SO_4

11. Anhydrous Magnesium chloride can be prepared by heating $MgCl_2.2H_2O$

1. in a current of dry HCl
2. With carbon
3. unit it fuses
4. With lime

12. The formula of the most abundant salt of sodium in nature is

1. Potassium
2. Sodium
3. Calcium
4. Lithium

13. Tincal contains mainly

1. $NaNO_3$
2. $Na_2B_4O_7.10H_2O$
3. Na_2CO_3
4. Na_2SO_4

14. In Down's process a small amount of KCl is added to NaCl

1. To decrease melting point of NaCl
2. To increase electrical Conductivity
3. To maintain electrical contact
4. To prevent oxidation of sodium metal formed

15. Goldsmith thermitt process involves in the following reaction

1. $Cr_2O_3 + 2Al \rightarrow 2Cr + Al_2O_3$
2. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_3$
3. $MoO_3 + 3H_2 \xrightarrow{IR} Mo + 3H_2O$
4. $2NiO + [H_2 + CO] \xrightarrow{300^0 C} 2Ni + [H_2O + CO_2]$

16. In the purification of "Al" by Hoop's process the correct statement is

1. Electrolytic cell is iron cell and it it contains three layer mass
2. under layer is pure Al and Carbon rods in it are cathode and the bottom layer contains impure Al and carbon lining of the cell is anode
3. Electrolyte is the middle layer with fused mixture of flouri of Na,Al Ba
4. All the above

17. Observer the following statements regarding purification of bauxite:

I) During Hall's process, silica, is removed as Si (vapour)

II) Bauxite ore contaminated with Fe_2O_3 is purified in Baeyer's process

III) During Serpeck's proess, AlN is formed the correct answer is

1. I, II and III are correct
2. Only I and II are correct
3. Only I and III are correct
4. Only II and III are correct

18. Assertion (A): Anhydrous $MgCl_2$ is prepared by heating $MgCl_2.6H_2O$ is a current of HCl gas.

Reason (R): Presence of HCl gas checks up the hydrolysis of $MgCl_2$ by its water or crystallization.

1. Both A and R are true and R is correct explanation of A
2. Both A and R are true and R is not correct explanation of A
3. A is true but R is false
4. A is false but R is true

19. In Down's process for the extraction of sodium, the melting point of NaCl is lowered from 803^0C **to** 600^0C

a) In order to avoid vaporization of metallic sodium

b) In order to avoid corrosive action of sodium and chlorine on the vessel at the high temperature

c) By mixing sufficient amounts of KCl and KF

1. Only 'a' is correct
2. 'a' & 'b' are only correct
3. a & c are correct
4. a, b, c are correct

20. During the electrolysis of fused NaCl, the reaction at anode is

1. Cl^- Ions are oxidised
2. Cl^- Ions are reduced
3. Na^- Ions are oxidised
4. Na^+ Ions are reduced

21. Ellingham diagram represents

1. Change of ΔG with temperature
2. Change of ΔH with temperature
3. Change of ΔG with pressure
4. Change of $(\Delta G - T\Delta S)$ with temperature

22. Select correct statement

a) The decomposition of an oxide into oxygen and metal vapour enthropy increases

b) Decomposition of an oxide is an endothermic change

c) To mak ΔG^0 negative, temperature should be high enough so that $T\Delta S^0\ T\Delta S^0 > \Delta H^0$

1. (a), (b) only correct
2. (b), (c) only correct
3. (a), (c) only correct
4. (a), (b), (c) only correct

23. Match the following

List-I	**List-II**
A) The Electrolysis of Al_2O_3 is in the presence of	**1) Sodium chloride + potassium chloride**
B) Refining of Al by Hoopes process with cathode	**2) Molten sodium chloride of $CaCl_2$, CaF_2 or KCl**
C) Electrolysis of molten $MgCl_2$ in the presence of	**3) Cast iron**
D) In Down's process, the electrolyte	**4) Carbon**
	5) Cryolite + fluorspar

	A	B	C	D
1)	2	3	4	1
2)	5	4	1	2
3)	3	2	1	4
4)	5	2	3	2

24. Calomel (Hg_2Cl_2) on reaction with ammonium hydroxide gives

1. $Hg-NH_2-Cl$
2. $NH_2-Hg-Hg-Cl$
3. Hg_2O
4. HgO

25. Assertion: Thermite mixture Fe_2O_3+Al (powder) is used in the welding

Reason: Al is a good reductant

1. If both assertion and reason are correct, and reason is the correct explanation of the assertion
2. If both assertion and reason are correct, but reason is not the correct explanation of the assertion
3. If assertion is correct but reason is incorrect
4. If assertion is is incorrect but reason is correct

26. Assertion: Cryolite is used in electrolytic extraction of Al from alumina

Reason: It dissolves alumina

1. If both assertion and reason are correct, and reason is the correct explanation of the assertion

2. If both assertion and reason are correct, but reason is not the correct explanation of the assertion

3. If assertion is correct but reason is incorrect

4. If assertion is is incorrect but reason is correct

27. Assertion: In the electrolytic reduction of Al_2O_3 .cyolite is used

Reason: Cryolite is an ore of aluminium

1. If both assertion and reason are correct, and reason is the correct explanation of the assertion

2. If both assertion and reason are correct, but reason is not the correct explanation of the assertion

3. If assertion is correct but reason is incorrect

4. If assertion is incorrect but reason is correct

28. Assertion: Al_2O_3 is converted into Al by reduction with carbon at high temp.

Reason: Carbon has greater affinity for oxygen than aluminium

1. If both assertion and reason are correct, and reason is the correct explanation of the assertion

2. If both assertion and reason are correct, but reason is not the correct explanation of the assertion

3. If assertion is correct but reason is incorrect

4. If assertion is is incorrect but reason is correct

29. Assertion: Reduction of ZnO with carbon is done at 1100^0C.

Reason: ΔG^0 is negative at this temperature thus, process is spontaneous.

1. If both assertion and reason are correct, and reason is the correct explanation of the assertion

2. If both assertion and reason are correct, but reason is not the correct explanation of the assertion

3. If assertion is correct but reason is incorrect

4. If assertion is incorrect but reason is correct

30. Which of the following metal can be obtained by the electrolysis of the aqueous solutions of their salts?

1. Cu 2. Na 3. Mg 4. K

31. The mass of carbon anode consumed (giving only carbon dioxide) in the production of 270 kg of aluminium metal from bauxite by the Hall process is

1. 180 kg 2. 270 kg 3. 540 kg 4. 90 kg

32. Railway wagon axles are made by heating iron rods embedded in charcoal power. This process is known as

1. Tempering 2. Annealing 3. Sheraradsing 4. Case hardening

33. By annealing, steel

1. Becomes soft
2. Becomes liquid
3. Becomes hard and brittle
4. Is covered with a thin film of Fe_3O_4

34. Stainless steel does not rust because

1. Chromium and nickel combine with iron

2. Chromium forms an oxide layer and protects iron form rusting

3. Nickel present in it, does not rust

4. Iron forms a hard chemical compound with chromium present in it.

35. In the electrolysis of alumina, cryolite and CaF_2 are added to

1. Increase the emf of cell
2. Decrease the emf of cell
3. decrease the melting point
4. Both (b) and (c)

36. The method used to prepare steel is

1. Bessemer's convertor method
2. Siemen's Martin process
3. Siemens' electric are furnace
4. All of the above

37. Out of the following metals that cannot be obtained by electrolysis of the aqueous solution of their salts are

1. Ag
2. Cr
3. Cu
4. Mg

38. On the extraction of iron, the slag produced is

1. CO
2. $FeSiO_3$
3. $MgSiO_3$
4. $CaSiO_3$

39. In electro refining of copper some gold is deposited at

1. Cathode
2. Electrode
3. Cathode mud
4. Anode mud

40. Tin stone (SnO_2) is concentrated by

1. Electromagnetic separation
2. Gravity separation
3. Roasting
4. All of the above

41. Which form of iron is least ductile?

1. Hard steel
2. Cast iron
3. Mild steel
4. Wrought steel

METALLURGY SUBTOPIC-III KEY

1) 3	2) 1	3) 3	4) 2	5) 2	6) 3	7) 2	8) 2	9) 2	10) 3	
11) 1	12) 2	13) 2	14) 1	15) 1	16) 4	17) 4	18) 1	19) 4	20) 1	
21) 1	22) 4	23) 2	24) 1	25) 2	26) 1	27) 2	28) 3	29) 1	30) 1	
31) 4	32) 4	33) 1	34) 2	35) 3	36) 4	37) 4	38) 2	39) 4	40) 4	41) 2

METALLURGY (SUBTOPIC-III (SOLUTIONS)

2. $Al_2O_3 2H_2O + NaOH \rightarrow 2NaAlO_2 + 3H_2O$

3. $Al_2O_3 + SiO_2$ is white bauxite.

$SiO_2 + 2C \rightarrow Si + 2CO$

$Al_2O_3 + 3C + N_2 \xrightarrow{2075K} 2AlN + 3CO$

6. In the extraction of alumimium electrolyte is pure alumina with bauxite and cryolyte.

8. Dolomite is $MgCO_3CaCO_3$

9. Carnallite is $KClMgCl_2 6H_2O$

13. Tincol is $Na_2B_4O_7 10H_2O$

15. In Allumino thermitt process the reaction involved is $Cr_2O_3 + 2Al \rightarrow 2Cr + Al_2O_3 + heat$

24. $HgCl_2 + 2NH_2OH \rightarrow Hg + Hg(NH_2)Cl + NH_4Cl + 2H_2O$

31. Copper metal (Cu) is obtained by the electrolysis of the aqueous solution of their salts.

32. In case hardening technique, iron rods embedded in charcoal power are heated repeatedly and thus, this technique is used in making axles of railway wagon.

33. Annealing is the process of heating steel to redness followed by slow cooling. It makes steel soft.

34. Chromium is more electropositive metal than iron. In stainless, chromium forms an oxide layer and thus, it protects steel from corrosion.

35. Cryolite and CaF_2 (fluorospar) are added to alumina in its electrolysis to decrease its melting point and to increase the electrical conductivity.

36. All the given methods are used to manufacture steel.

37. Magnesium (Mg) cannot be obtained by the electrolysis of their aqueous salt solution because when it is liberated at cathode, at once reacts with H_2O give metal hydroxide and hydrogen.

38. In the iron silica is present as impurity so far the removal of silica impurity limestone is used.

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

$$CaO + SiO_2 \rightarrow \underset{Slag}{CaSiO_3}$$

40. Tin stone (SnO_2) has impurities of wolframite $(FeWO_4.MnWO_4)$, which are removed by electromagnetic separation. Being heavy it is also concentrated by gravity separation it is also concentrated by roasting to remove volatile impurities of S and arsenic sulphide etc.

$$S + O_2 \rightarrow SO_2$$

41. Cast iron or pig contains 2 to 4.5% of carbon. It is the least ductile and least pure form of iron; it is brittle and cannot be welded.