Q1: NTA Test 01 (Single Choice)

Which one of the following ores is best concentrated by froth floatation method?

(A) Galena

(B) Malachite

(C) Magnetite

(D) Siderite

Q2: NTA Test 02 (Single Choice)

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) greater solubility of the impurity in the molten state than in the solid.

(C) higher melting point of the impurity than that of the pure metal.

(D) All above the correct

Q3: NTA Test 03 (Single Choice)

Electrometallurgical process is used to extract

(A) Fe

(B) Pb

(C) Na

(D) Ni

Q4: NTA Test 04 (Single Choice)

Four metals and their methods of refinement are given

i. Ni, Cu, Zr, Ga

ii. Electrolysis, van-Arkel process, Zone refining, Mond's process

Choose the right method for each.

(A) Ni : Electrolysis, Cu : van-Arkel process, Zr : Zone refining, Ga : Mond's process

(B) Ni : Mond's process, Cu : Electrolysis, Zr : van-Arkel process, Ga : Zone refining

(C) Ni : Mond's process, Cu : van-Arkel process, Zr : Zone refining, Ga : Electrolysis

(D) Ni : Electrolysis, Cu : Zone refining, Zr : van-Arkel process, Ga : Mond's process

Q5: NTA Test 05 (Single Choice)

Pb and Sn are extracted from their chief ore respectively by

(A) Carbon reduction and self reduction

(B) Self reduction and carbon reduction

(C) Electrolysis and self reduction.

(D) Self reduction and electrolysis.

Q6: NTA Test 06 (Single Choice)

The electrolytic method of reduction is employed for the preparation of metals that

(A) are weakly electropositive

(B) are moderately electropositive

(C) are strongly electropositive

(D) form acidic oxides

Q7: NTA Test 06 (Single Choice)

Van-Arkel process and Mond's process are respectively used for refining of:

(A) Zr and Ti

(B) Ni and Zr

(C) Ti and Ni

(D) Ni and Fe

Q8: NTA Test 07 (Single Choice)

In blast furnace iron oxide is reduced by

(A) Silica

(B) CO

(C) NaOH

(D) Lime stone

Q9: NTA Test 08 (Single Choice)

Electrolytic reduction of alumina to aluminium by Hall-Heroult process is carried out

(A) in the presence of NaCl

(B) in presence of fluorite

(C) in presence of cryolite which forms a melt with lower melting temperature

(D) in the presence of cryolite which forms a melt with higher melting temperature

Q10: NTA Test 09 (Single Choice)

Which of the following processes involves smelting

(A) $ZnCO_3 \rightarrow ZnO+CO_2$

(B) $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$

(C) $2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$

(D) $Al_2O_3.2H_2O \rightarrow Al_2O_3 + 2H_2O$

Q11: NTA Test 10 (Single Choice)

Metal which can be extracted from all the three dolomite, magnesite and carnallite is

(A) Na

(B) K

(C) Mg

(D) Ca

Q12: NTA Test 11 (Single Choice)

Match list I with List II and select the correct answer using the codes given below

	List I		**List II**
	(Types of ore)		**(example)**
P	Oxide ore	A.	Feldspar
Q	Sulphide ore	B.	Barytes
R	Sulphate ore	C.	Fluorspar
S	Halide ore	D.	Galena
		E.	Corundum

(A) P-B, Q-D, R-C, S-A

(B) P-B, Q-D, R-E, S-A

(C) P-E, Q-B, R-D, S-C

(D) P-E, Q-D, R-B, S-C

Q13: NTA Test 12 (Single Choice)

CN^- solution used in extraction of which metal?

(A) Ag

(B) Ti

(C) Zn

(D) Sn

Q14: NTA Test 14 (Single Choice)

Gold is leached using CN^- solution followed by reduction with Zn. What is the co-ordination number of Zn in the final product?

(A) 2

(B) 6

(C) 5

(D) 4

Q15: NTA Test 15 (Single Choice)

White bauxite is leached by

(A) Hall's process

(B) Serpeck's process

(C) Bayer's process

(D) All of these

Q16: NTA Test 16 (Single Choice)

Which among the following is not a carbonate ore? : -

(A) Pyrolusite

(B) Siderite

(C) Dolomite

(D) Magnesite

Q17: NTA Test 17 (Single Choice)

Oxidation state of iron and chromium in chromite ore is:

(A) 2, 3

(B) 3, 2

(C) 2, 2

(D) 3,3

Q18: NTA Test 17 (Single Choice)

Incorrect statement related to extraction of copper from copper pyrite is:

(A) Iron silicate is obtained as slag

(B) Copper matte in the form of $CuS + FeS$ is obtained

(C) Copper is obtained by self reduction

(D) Blister copper is obtained after reduction process

Q19: NTA Test 18 (Single Choice)

In the extraction of Cu, the metal is formed in the Bessemer converter due to the reaction:

(A) $Cu_2S + 2\ Cu_2O \xrightarrow{\Delta} 6\ Cu + SO_2$

(B) $Cu_2S \rightarrow 2\ Cu + S$

(C) $Fe + Cu_2O \rightarrow 2\ Cu + FeO$

(D) $2\ Cu_2O \rightarrow 4\ Cu + O_2$

Q20: NTA Test 19 (Single Choice)

Which one of the following reactions is an example for calcination process?

(A) $2\ Ag + 2\ HCl + (O) \rightarrow 2\ AgCl + H_2O$

(B) $2\ Zn + O_2 \rightarrow 2\ ZnO$

(C) $2\ ZnS + 3\ O_2 \rightarrow 2\ ZnO + 2\ SO_2$

(D) $MgCO_3 \rightarrow MgO + CO_2$

Q21: NTA Test 20 (Numerical)

How many of the following species are related to Hall's process of purification of bauxite?

White bauxite, Na_2CO_3, CO_2, cryolite, red bauxite, NaOH

Q22: NTA Test 21 (Single Choice)

Gallium arsenide is purified by

(A) van-Arkel method

(B) Zone-refining method

(C) Electrolytic method

(D) Liquation

Q23: NTA Test 23 (Single Choice)

Which reaction does not occur in roasting process.

(A) $HgS + 2HgO \xrightarrow{\Delta} 3Hg + SO_2$

(B) $PbS + 2PbO \xrightarrow{\Delta} 3Pb + SO_2$

(C) $ZnS + 2ZnO \xrightarrow{\Delta} 3Zn + SO_2$

(D) None of these

Q24: NTA Test 25 (Single Choice)

Among the reactions (a) – (d) , the reaction(s) that does/do not occur in the blast furnace during the extraction of iron is/are

(a) $CaO + SiO_2 \rightarrow CaSiO_3$

(b) $3\ Fe_2O_3 + CO \rightarrow 2\ Fe_3O_4 + CO_2$

(c) $FeO + SiO_2 \rightarrow FeSiO_3$

(d) $FeO \rightarrow Fe + \frac{1}{2}O_2$

(A) (c) and (d)

(B) (a) and (d)

(C) (a)

(D) (d)

Q25: NTA Test 27 (Single Choice)

Which of the following mineral does not contain Al.

(A) Cryolite

(B) Mica

(C) Feldspar

(D) Fluorspar

Q26: NTA Test 28 (Single Choice)

Oxidation states of the metal in the minerals haematite and magnetite, respectively, are

(A) II, III in haematite and III in magnetite

(B) II, III in haematite and II in magnetite

(C) II in haematite and II, III in magnetite

(D) III in haematite and II, III in magnetite

Q27: NTA Test 29 (Single Choice)

Sulphide ores are common for the metals

(A) Ag, Cu and Pb

(B) Ag, Cu and Sn

(C) Ag, Mg and Pb

(D) Al, Cu and Pb

Q28: NTA Test 29 (Single Choice)

When a metal is electroplated with silver (Ag)

(A) The metal is the anode

(B) Ag metal is the cathode

(C) The solution contains Ag^+ ions

(D) The reaction at the anode is $Ag^+ + e^- \rightarrow Ag$

Q29: NTA Test 30 (Numerical)

The number of correctly matched combination is/are

Ore	Element
Chalcopyrite	Cu
Limestone	Ca
Corundum	Al
Magnetite	Fe
Pyrolusite	Mn
Cassiterite	Zn
Cinnabar	Hg
Calamine	Ca
Siderite	Sn
Cerussite	Pb

Q30: NTA Test 31 (Single Choice)

The pair that does not require calcination is

(A) ZnO and MgO

(B) Fe_2O_3 and $CaCO_3$. $MgCO_3$

(C) ZnO and Fe_2O_3. xH_2O

(D) $ZnCO_3$ and CaO

Q31: NTA Test 32 (Single Choice)

Heating mixture of Cu_2O and Cu_2S will give

(A) $Cu+SO_2$

(B) $Cu+SO_3$

(C) CuO+CuS

(D) Cu_2SO_3

Q32: NTA Test 35 (Numerical)

Among the following metals the number of metals that are extracted by self-reduction method from their respective ores is

Hg, Zn, Cu, Al, Mg, Pb, Fe, Na.

Q33: NTA Test 36 (Single Choice)

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

Q34: NTA Test 37 (Single Choice)

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

Column-I	Column-II
(I) Argentite	(1) Halide ore
(II) Cuprite	(2) Carbonate ore
(III) Siderite	(3) Oxide ore
(IV) Carnallite	(4) Sulphide ore

(A) i-1, ii-3, iii-4, iv-3

(B) i-3, ii-4, iii-1, iv-3

(C) i-4, ii-3, iii-2, iv-1

(D) i-4, iii-2, iii-3, iv-1

Q35: NTA Test 38 (Single Choice)

During the process of electro refining of copper, some metals present as impurity settle down as anode mud. These are:

(A) Sn and Ag

(B) Pb and Zn

(C) Ag and Au

(D) Fe and Ni

Q36: NTA Test 39 (Single Choice)

Which of the following metals cannot be extracted by carbon reduction process

(A) Pb

(B) Al

(C) Hg

(D) Zn

Q37: NTA Test 41 (Single Choice)

An example of halide ore is

(A) Galena

(B) Bauxite

(C) Cinnabar

(D) Cryolite

Q38: NTA Test 42 (Single Choice)

In the metallurgy of iron, when limestone is added to the blast furnace, the calcium ion ends up in:-

(A) Slag

(B) Gangue

(C) Metallic Ca

(D) $CaCO_3$

Q39: NTA Test 43 (Single Choice)

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 and cassiterite are carbonate ores.

Q40: NTA Test 44 (Single Choice)

Match the compound with the metal for which it is used for the process of extraction.

(i) NaCN	(a) Titanium
(ii) Iodine	(b) Aluminium
(iii) Cryolite	(c) Silver ore

(A)
(i)-(c),(ii)-(a),(iii)-(b)

(B)
(i)-(c),(ii)-(b),(iii)-(a)

(C)
(i)-(a),(ii)-(c),(iii)-(b)

(D)
(i)-(b),(ii)-(a),(iii)-(c)

Q41: NTA Test 44 (Numerical)

How many of the following metals can be extracted by auto-reduction? Fe, Zn, Pb, Al, Hg, Cu, K, Ca

Q42: NTA Test 45 (Single Choice)

Which of the following process involves smelting?

(A) $ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2$

(B) $Fe_2O_3 + 3C \xrightarrow{Heat} 2Fe + 3CO$

(C) $2\,PbS + 3O_2 \xrightarrow{Heat} 2PbO + 2SO_2$

(D) $Al_2O_3 . 2H_2O \xrightarrow{Heat} Al_2O_3 + 2H_2O$

Q43: NTA Test 47 (Single Choice)

The minimum voltage required to electrolyse alumina in the Hall-Heroult process is

Given, $\Delta G_f^\circ\left(Al_2O_3\right) = -1520\ \text{kJ mol}^{-1}$

$\Delta G_f^\circ\left(CO_2\right) = -394\ \text{kJ mol}^{-1}$

(A) 1.575 V

(B) 1.60 V

(C) 1.312 V

(D) −2.62 V

Answer Keys

Q1: (A)

Q2: (B)

Q3: (C)

Q4: (B)

Q5: (B)

Q6: (C)

Q7: (C)

Q8: (B)

Q9: (C)

Q10: (B)

Q11: (C)

Q12: (D)

Q13: (A)

Q14: (D)

Q15: (B)

Q16: (A)

Q17: (A)

Q18: (B)

Q19: (A)

Q20: (D)

Q21: 3

Q22: (B)

Q23: (C)

Q24: (A)

Q25: (D)

Q26: (D)

Q27: (A)

Q28: (C)

Q29: 6

Q30: (A)

Q31: (A)

Q32: 3

Q33: (B)

Q34: (C)

Q35: (C)

Q36: (B)

Q37: (D)

Q38: (A)

Q39: (D)

Q40: (A)

Q41: 3

Q42: (B)

Q43: (B)

Solutions

Q1: (A) Galena

Froth floatation method is used for concentration of sulphide ores.

Galena $\rightarrow$ PbS

Malachite is $Cu_2(CO_3)_2(OH)_2$

Magnetite is Fe_3O_4

Siderite is $FeCO_3$

Q2: (B) greater solubility of the impurity in the molten state than in the solid.

A movable heater is fitted around a rod of impure metal. As heater is moved from one end to another pure metal crystallises while impurities pass on to adjacent melted zone.

Q3: (C) Na

Because Na is very reactive and can not be extracted by means of the reduction by C, CO. etc. So, it is extracted by electrolysis of molten NaCl Solution.

Q4: (B) Ni : Mond's process, Cu : Electrolysis, Zr : van-Arkel process, Ga : Zone refining

Ni - Mond's process; Cu: Electrolysis

Zr: van-Arkel process; Ga: Zone refining.

Q5: (B) Self reduction and carbon reduction

PbO and $PbSO_4$ get reduced by PbS itself which is already present in mixture so because the reduction took place by mixture itself, hence is known as self reduction.

$2PbO+PbS \xrightarrow{\Delta} 3Pb+SO_2 \uparrow$

$PbSO_4 + PbS \xrightarrow{\Delta} 2Pb + 2SO_2 \uparrow$

$SnO_2 + C \rightarrow Sn + CO_2$

Q6: (C) are strongly electropositive

Pure metal is obtained at cathode and impurities are obtained at anode.

Q7: (C) Ti **and** Ni

Van-Arkel process $\Rightarrow$ Ti, Hf, Zr, B

Mond's Process $\Rightarrow$ Ni

Q8: (B) CO

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

In blast furnace, iron oxide is reduced by carbon monoxide to give iron and carbon dioxide.

Q9: (C) in presence of cryolite which forms a melt with lower melting temperature

Cryolite is used to lower the meeting point of alumina (Al_2O_3) as well as to make it good conductor of electric current.

Q10: (B) $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$

Reduction with carbon is called smelting

$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$

Q11: (C) Mg

Dolamite	$MgCO_3.CaCO_3$
Magnesite	$MgCO_3$
Carnallite	$KCl.MgCl_2.6H_2O$

Q12: (D) P-E, Q-D, R-B, S-C

List I (Types of ore)	**List II (Example)**
Oxide ore	Corundum (Al_2O_3)
Sulphide ore	Galena (PbS)
Sulphate ore	Barytes ($BaSO_4$)
Halide ore	Fluorsper (CaF_2)

Q13: (A) Ag

CN^- solution used in extraction of Ag metal in the cyanide process.

Q14: (D) 4

$$4Au + 8CN^- + 2H_2O + O_2 \rightarrow 4\left[Au(CN)_2\right]^- + 4OH^-$$
$$2[Au(CN)_2]^- + Zn \rightarrow [Zn(CN)_4]^{2-} + 2Au$$

Q15: (B) Serpeck's process

In white bauxite, SiO_2 is main impurity and concentrated by serpeck's process.

Q16: (A) Pyrolusite

Pyrolusite is MnO_2

Q17: (A) 2, 3

Chromite ore is $FeCr_2O_4$ containing Fe^{+2} and Cr^{+3}
$FeCr_2O_4 = FeO \cdot Cr_2O_3$

Q18: (B) Copper matte in the form of $CuS + FeS$ is obtained

Copper Matte is $Cu_2S + FeS$

Q19: (A) $Cu_2S + 2\ Cu_2O \xrightarrow{\Delta} 6\ Cu + SO_2$

The following reaction taken place in the formation of blister copper in the Bessemer converter

$Cu_2S + 2\ Cu_2O \xrightarrow{\Delta} 6\ Cu + SO_2$

Q20: (D) $MgCO_3 \rightarrow MgO + CO_2$

The process of heating the concentrated ore in the absence of air is known as calcination. The carbonate ore gets decomposed to form oxide of metal on calcination.

Q21: 3

Na_2CO_3, CO_2 and red bauxite are related to Hall's process of purification of bauxite.

$2\ Al_2O_3 + 3C \rightarrow 4\ Al + 3CO_2$

Q22: (B) Zone-refining method

Gallium arsenide is purified by zone refining method. It is based on the principle that impurities are more soluble in molten state then in solid state

Q23: (C) $ZnS + 2ZnO \xrightarrow{\Delta} 3Zn + SO_2$

On roasting HgS and PbS sulphides ores are partly converted into their respective oxides. Since the oxides of Hg and Pb are unstable. While that of zinc is stable, therefore, oxides of Hg and Pb bring about the reduction of their sulphides to metals, but zinc oxides does not reduce ZnS to Zn

metal

$$HgS + \underset{\text{unstable}}{2HgO} \xrightarrow{\Delta} 3Hg + SO_2$$

$$PbS + \underset{\text{unstable}}{2PbO} \xrightarrow{\Delta} 3Pb + SO_2$$

$$ZnS + \underset{\text{(stable)}}{2ZnO} \not\longrightarrow 3Zn + SO_2$$

Q24: (A) (c) **and** (d)

$CaO + SiO_2 \rightarrow CaSiO_3$

$3Fe_2O_3 + CO \rightarrow 2Fe_3O_4 + CO_2$

Used as flux.

Reduction is done by CO.

Hence these two reactions are possible butthe reactions given below are not possible

$FeO \rightarrow Fe + \frac{1}{2}O_2$

$FeO + SiO_2 \rightarrow FeSiO_3$

Q25: (D) Fluorspar

Fluorspar (CaF_2), Cryolite (Na_3AlF_6),
Feldspar $(KAlSi_3O_8)$, mica $(K_2O.3Al_2O_3.6SiO_2.2H_2O)$

Q26: (D) III in haematite and II, III in magnetite

Hematite is a common iron oxide with a formula of Fe_2O_3 so Fe in it has +3 oxidation state.
Magnetite is a rock mineral and one of the main iron ores, with the chemical formula Fe_3O_4 or $(Fe_2O_3.FeO)$ .so it is a mixed oxide with oxidation states of Fe as +3 and +2.

Q27: (A) Ag, Cu and Pb

Silver, copper and lead mainly found in their sulphides ores like Argentite (Ag_2S), Copperpyrite $(CuFeS_2)$ and Galena (PbS)

Q28: (C) The solution contains Ag^+ **ions**

For electroplating of metal with silver

Cathode $\rightarrow$ Metal

Anode $\rightarrow$ Ag

Solution $\rightarrow$ Electrolyte containing Ag^+

Q29: 6

The correctly matched ores are

Ore	Element
Chalcopyrite	Cu
Limestone	Ca
Corundum	Al
Magnetite	Fe
Pyrolusite	Mn
Cassiterite	Zn
Cinnabar	Hg

Q30: (A) ZnO **and** MgO

Calcination is required for carbonate and hydrated oxide ores. ZnO and MgO both are oxides, so they donot require calcination.

Q31: (A) $Cu+SO_2$

$Cu_2S+2Cu_2O \rightarrow 6Cu+SO_2$ (Auto-reduction).

This reaction occurs in reverberatory furnace to get metallic copper.

Q32: 3

Self-Reduction Process: The cations of the less electropositive metals like Pb, Hg and Cu may be reduced without the use of any additional reducing agent.

Self-reduction of Cu:

$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2\,(g)$

It is called self-reducing because copper oxide itself reduced the copper sulfide to give copper and sulfur dioxide.

Similar reactions occurs for Pb and Hg.

Q33: (B) Argentite and cuprite are oxides

(A) Calamine $= ZnCO_3$, Sidereite $= FeCO_3$

(B) Argentite $= Ag_2S$ and Cuprite $= Cu_2O$

(C) Zinc blende $= ZnS$, Pyrites $= FeS_2$

(D) Malachite $= CuCO_3Cu(OH)_2$, Azurite $= 2CuCO_3Cu(OH)_2$

Q34: (C) i-4, ii-3, iii-2, iv-1

Argentite $\rightarrow Ag_2S$; Cuprite $\rightarrow Cu_2O$

Siderite $\rightarrow FeCO_3$; Carnallite $\rightarrow KCl \cdot MgCl_2 \cdot 6H_2O$

Q35: (C) Ag and Au

In anode mud, less electropositive elements are present. Ag and Au are less electropositive than Cu .

Q36: (B) Al

Al is highly electropositive. It can be obtained by electrolytic reduction.

Q37: (D) Cryolite

Cryolite $\left(Na_3AlF_6\right) \rightarrow$ Halide ore

$$\left.\begin{array}{l}\text{Galena } (PbS) \\ \text{Cinnabar } (HgS)\end{array}\right\} \text{Sulphide ore}$$

Bauxite $Al_2O_3.2H_2O \rightarrow$ Oxide ore

Q38: (A) Slag

Lime stone acts as flux in this process.

$CaCO_3 \rightarrow CaO + C0_2$

$CaO + SiO_2 \rightarrow CasiO_3\left(\text{slag}\right)$

Q39: (D) Siderite and cassiterite are carbonate ores.

(i) Molten mixture of alumina and cryolite

(ii) $2PbS + 3O_2 \rightarrow 2Pb + 2SO_2$ (self-reduction)

$PbS + 2PbO \rightarrow 3Pb + SO_2$ (Self reduction)

$PbO + C \rightarrow Pb + CO$ (carbon reduction)

(iii) $SnO_2 + C \rightarrow Sn + CO$ (carbon reduction

(iv) siderite $= FeCO_3$, cassiterite $= SnO_2$ and argentite $= Ag_2S$.

Q40: (A)
(i)-(c),(ii)-(a),(iii)-(b)

(i) Role of NaCN in the extraction of silver is to do the leaching of silver ore in the presence of air from which the silver is obtained later by

$$4Ag(s) + 8CN^-(aq) + 2H_2O(aq) + O_2(g) \rightarrow \left[Ag(CN)_2\right]^-(aq) + 4OH^-(aq)$$

replacement

$$2\left[Ag(CN)_2\right]^-(aq) + Zn(s) \rightarrow 2Ag(s) + \left[Zn(CN)_4\right]^{2-}(aq)$$

(ii) $Ti + I_2 \xrightarrow{\Delta} TiI_4 \xrightarrow{\Delta} Ti + I_2$ (Van-Arkel method)

(iii) In the metallurgy of aluminium, cryolite lowers the melting point of the mixture and improves the electrical conductivity of the cell.

Q41: 3

Pb, Cu and Hg can be extracted by self or autoreduction.

Q42: (B) $Fe_2O_3 + 3C \xrightarrow{\text{Heat}} 2Fe + 3CO$
We know that smelting is reduction with carbon. Here Fe_2O_3 with the help of carbon.

Q43: (B) 1.60 V

$$2Al_2O_3\,(s) + 3C \xrightarrow{12e^-} 4Al\,(s) + 3CO_2\,(g)$$

$$\Delta G^\circ = 3\Delta G_f^\circ\,(CO_2) - 2\Delta G^\circ\,(Al_2O_3)$$

$$= -3 \times 394 - 2\,(-1520)$$

$$= -1182 + 3040 = +1858\ \text{kJ}$$

$$\Delta G^\circ = -nFE^\circ$$

$$1858 \times 1000 = -12 \times 96500 \times E^\circ$$

$$\therefore\ E^\circ = -1.60\ \text{V}$$

Thus, voltage requires $=1.60$ V