



## CHEMISTRY

### BOOKS - CBSE COMPLEMENTARY MATERIAL CHEMISTRY (HINGLISH)

### ELECTROCHEMISTRY

#### Multiple Choice Questions 1 Mark

1. When a lead storage battery is discharged:

- A.  $SO_2$  is evolved
- B. lead is formed
- C.  $H_2SO_4$  is consumed
- D.  $PbSO_4$  is consumed

**Answer: C**



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2. How many coulombs are required for the oxidation of 1 mol of  $H_2O_2$  ?

A.  $9/65 \times 10^4 C$

B. 93000 C

C.  $1.93 \times 10^5 C$

D.  $19.3 \times 10^2 C$

Answer: C



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3.  $KCl$  is used in salt bridge because:

A. It forms a good jelly with agar-agar

B. It is a strong electrolyte

C. It is a good conductor of electricity

D. Migration factor of  $K^+$  and  $Cl^-$  ions are almost equal

**Answer: D**



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4. The nature of curve of  $E^\circ$  cell against  $\log K_C$  is:

A. a straight line

B. parabola

C. a hyperbola

D. an elliptical curve

**Answer: A**



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5. For a spontaneous reaction,  $\Delta G$ , equilibrium constant (K) and  $E_{cell}^{\circ}$  will be respectively:

A.  $-ve$ ,  $< 1$ ,  $-ve$

B.  $-ve$ ,  $> 1$ ,  $-ve$

C.  $-ve$ ,  $> 1$ ,  $+ve$

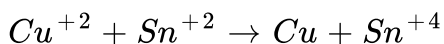
D.  $+ve$ ,  $> 1$ ,  $-ve$

**Answer: C**

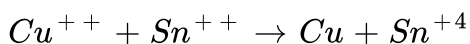


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6. Determine the value of  $E^{\circ}$  cell for the following reaction



Equilibrium constant is  $10^6$



A. 0.1773

B. .01773

C. 0.2153

D. 1.773

**Answer: A**



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7. Which one is the best reducing agent ?

A.  $F^-$

B.  $Cl^-$

C.  $Br^-$

D.  $I^-$

**Answer: D**



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8. If a salt bridge is removed between the half cells, the voltage

- A. drops to zero
- B. does not change
- C. increase gradually
- D. increases rapidly

**Answer: A**



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9. Faraday's laws of electrolysis are related to

- A. Atomic number of the cation
- B. atomic number of the anion
- C. equivalent weight of the electrolyte
- D. speed of the cation

**Answer: C**

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**10.** The process in which chemical change occurs on passing electricity is termed:

- A. Ionisation
- B. neutralisation
- C. electrolysis
- D. hydrolysis

**Answer: C**

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**11.** The charge required for the reduction of 1 mol of  $MnO_4^-$  to  $MnO_2$  is

A. 1 F

B. 3 F

C. 5 F

D. 4 F

**Answer: B**



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12. The value of  $\Lambda_m^\circ$  for  $NH_4Cl$ ,  $NaOH$  and  $NaCl$  are 129.8, 248.1 and 126.4  $\text{Ohm}^{-1} \text{cm}^2 \text{mol}^{-1}$  respectively. Calculate  $\Lambda_m^\circ$  for  $NH_4OH$  solution.

A. 215.5

B. 251.5

C. 244.7

D. 351.5



**Answer: B**



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**13.** A Current of 9.65 ampere flowing for 10 minutes deposits 3.0g of the metal which is monovalent. The atomci mass of the metal is

A. 10 g

B. 30 g

C. 50 g

D. 96.5 g

**Answer: C**



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**14.** In a Golvenic cell the electrical work done is equal to:

- A. free energy change
- B. mechanical work done
- C. thermodynamic work done
- D. all of the above

**Answer: A**

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**15. When a lead storage battery is charged, it acts as**

- A. an electrolyte cell
- B. a galvenic cell
- C. a daniel cell
- D. a and b both

**Answer: A**

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16. In a galvanic cell the direction of current is:

A. anode to cathode

B. cathode to anode

C. *Zn* rod to *Cu* rod

D. Depend on concentration of  $\text{ZnSO}_4$  and  $\text{CuSO}_4$

**Answer: B**



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17. Which of the following metals does not give the following reaction? (M

+ water  $\rightarrow$  oxide or hydroxide +  $\text{H}_2$ )

A. *Fe*

B. *Na*

C. *Hg*

D.  $Ag$

Answer: C::D

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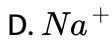
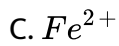
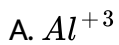
18. Electrolysis of aq.  $CuSO_4$  produces:

- A. an increase in pH
- B. a decrease in pH
- C. either decrease or increase
- D.  $H_2SO_4$  in the solution

Answer: B::D

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19. Zn cannot displace following ions from their aqueous solution:



**Answer: A::D**



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**20. Which one is not a secondary battery?**

A. laclanche cell

B. Ni-Cd cell

C. Mercury cell

D. Daniel cell

**Answer: A::C::D**



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21. Which of the following decrease with increase in concentration?

- A. conductance
- B. specific conductance
- C. Molar conductance
- D. Conductivity

**Answer: A::C**

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### Fill In The Blanks Type Question

1. To deposit 2 mol of Ca from  $CaCl_2$  ..... electricity is required.

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2. .... gives a constant voltage throughout its life.

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3. Match the column and choose correct option:

- |                       |                                   |
|-----------------------|-----------------------------------|
| (A) Conductance       | P. $\text{m}^{-1}$                |
| (B) Conductivity      | Q. $\text{S cm}^{-1}$             |
| (C) Molar conductance | R. Siemen                         |
| (D) Cell constant     | S. $\text{S cm}^2\text{mol}^{-1}$ |

A.  $A - R, B - Q, C - S, D - P$

B.  $A - R, B - S, C - Q, D - P$

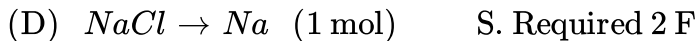
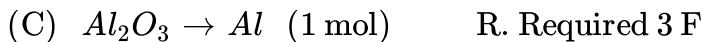
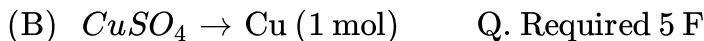
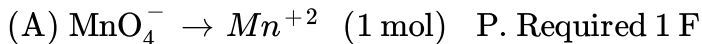
C.  $A - R, B - Q, C - P, D - S$

D.  $A - R, B - P, C - Q, D - S$

**Answer: A**

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4. Match the column and choose correct option:



A.  $A - Q, B - P, C - S, D - R$

B.  $A - P, B - Q, C - S, D - R$

C.  $A - Q, B - S, C - P, D - R$

D.  $A - Q, B - S, C - R, D - P$

Answer: D



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Assertion Reason Type

1. The questions consist of two statements each, printed as Assertion and Reason. While answering these questions you are required to choose any



one of the following four responses :

Assertion : Galvanised iron does not rust .

Reason : Zinc has a more negative electrode potential than iron .

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2. Assertion (A) Conductivity of all electrolytes decreases on dilution.

Reason(R) On dilution number of ions per unit volume decreases.

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### Very Short Answer Type Questions 1 Mark

1. Why is it not possible to measure the single electrode potential ?

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2. Name the factor on which emf of a cell depends.



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3. What is the effect of temperature on the electrical conductance of metal ?



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4. What is the effect of temperature on the electrical conductance of electrolyte ?



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5. What is the relation between conductance and conductivity ?



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6. Reduction potentials of 4 metals A, B, C and D are  $-1.66V$ ,  $+0.34V$ ,  $+0.80V$  and  $-0.76V$ . What is the order of their reducing power and reactivity ?

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7. Why a dry cell becomes dead after a long time even if it is not used ?

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8. Why Na cannot be obtained by the electrolysis of aqueous  $NaCl$  solution ?

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9. What is the use of platinum foil in the hydrogen electrode ?

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10. Why  $\Lambda_m^\circ$  for  $CH_3COOH$  cannot be determined experimentally ?

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11. Why is it necessary to use a salt bridge in a galvanic cell ?

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12. Why does mercury cell gives a constant voltage throughout its life ?

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13. What is the role of  $ZnCl_2$  in dry cell ?

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14. Why does the conductivity of a solution decrease with dilution ?

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15. Suggest two materials other than hydrogen that can be used as fuels in fuel cells.

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16. How does the pH of  $Al - NaCl$  solution be affected when it is electrolysed ?

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17. Which reference electrode is used to measure the electrode potential of other electrodes?

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18. Out of  $Sn$  and  $Zn$  which one protects  $Fe$  better even after cracks ?

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19. Define corrosion. What is the chemical formula of rust ?

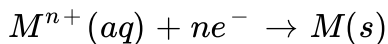
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20. What is the electrolyte used in a dry cell ?

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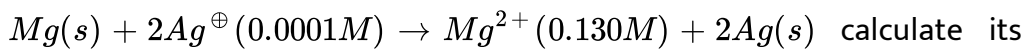
### Short Answer I Type Questions 2 Marks

1. How can you increase the reduction potential of an electrode for the reaction :



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2. Represent the cell in which following reaction takes place :



$E_{cell}$  if  $E^{c^{-}} \cdot_{cell} = 3.17V$ .

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3. Suggest a way to determine  $\wedge_{m^{\circ}}$  value of water.

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4. How much electricity in terms of Faraday is required to produce 40.0g of Al from molter  $Al_2O_3$ ?

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5. Predict the product of electrolysis of an aqueous solution of  $CuCl_2$  with an inert electrode.

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6.  $\Lambda^\circ_m$  for  $CaCl_2$  and  $MgSO_4$  from the given data.

$$\lambda^\circ_{Ca^{2+}} = 119.0 \text{ Scm}^2 \text{ mol}^{-1} \text{ tbr. } \lambda^\circ_{Cl^-} = 76.3 \text{ Scm}^2 \text{ mol}^{-1}$$

$$\lambda^\circ_{Mg^{2+}} = 106.0 \text{ Scm}^2 \text{ mol}^{-1}$$

$$\lambda^\circ_{SO_4^{2-}} = 160.0 \text{ cm}^2 \text{ mol}^{-1}$$

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7. Calculate the potential of hydrogen electrode in contact with a solution whose  $pH = 10$ .

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8. If a current of  $0.5A$  flows through a metallic wire for 2 hours, then how many electrons would flow through the wire ?

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9. How many coulombs are required for the oxidation of 1 mol of  $FeO$  to  $Fe_2O_3$  ?

(Hint.  $Fe^{2+} \rightarrow Fe^{3+} + e^-$ )

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10. The conductivity of  $0.20M$  solution of  $KCl$  at  $298K$  is  $0.0248Scm^{-1}$ . Calculate its molar conductivity.

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11. Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

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12. The resistance of a conductivity cell containing  $0.001M KCl$  solution at  $298K$  is  $1500\Omega$ . What is the cell constant if conductivity of  $0.001M KCl$  solution at  $298K$  is  $0.146 \times 10^{-3} Scm^{-3} Scm^{-1}$ .

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13. Indicate the reactions which take place at cathode and anode in fuel cell.

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14. State Kohlrausch's Law for the independent migration of ions.

Mention the applications of the Law.

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15. The standard reduction potential for the  $Zn^{2+}(aq) / Zn(s)$  half cell is  $-0.76V$ . Write the reactions occurring at the electrodes when coupled with standard hydrogen electrode (SHE).

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16. Calculate the electrode potential of a copper wire dipped in  $0.1M CuSO_4$  solution at  $25^\circ C$ . The standard electrode potential of copper is  $0.34$  Volt.

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17. Two metals A and B have reduction potential values  $-0.76V$  and  $+0.34V$  respectively. Which of these will liberate  $H_2$  from dil. $H_2SO_4$  ?

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18. How does conc. of sulphuric acid change in lead storage battery when current is drawn from it ?

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19. What type of a battery is lead storage cell ? Write the anode and cathode reaction and overall reaction occurring in a lead storage battery during discharging and recharging of cell.

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20. Why is alternating current used for measuring resistance of an electrolytic solution ?

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21.  $E^\theta$  values of  $MnO_4^-$ ,  $Ce^{4+}$  and  $Cl_2$  are 1.507, 1.61 and 1.358 V respectively. Arrange these in order of increasing strength as oxidizing agent.

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22. Draw a graph between  $\Lambda_m^\circ$  and  $\sqrt{C}$  for strong and weak electrolyte.

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23. The conductivity of 0.02M solution of  $NaCl$  is  $2.6 \times 10^{-2} \text{ S cm}^{-1}$ .

What is its molar conductivity ?

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24. Give products of electrolysis of an aqueous solution of  $AgNO_3$  with silver electrode.

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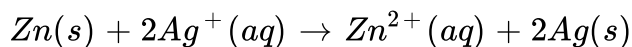
### Short Answer II Type Questions

1. A solution of  $CuSO_4$  is electrolysed for 10 minutes with a current of 1.5 amperes. What is the mass of copper deposited at the cathode ?

(Molar mass of  $Cu = 63.5g/mol$ )

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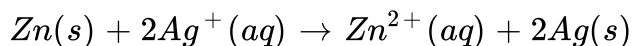
2. Depict the galvanic cell in which the reaction



takes place. Further indicate what are the carriers of current inside and outside the cell. State the reaction at each electrode.

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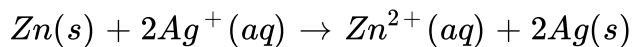
3. Depict the galvanic cell in which the reaction



takes place. Further indicate what are the carriers of current inside and outside the cell. State the reaction at each electrode.

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4. Depict the galvanic cell in which the reaction



takes place. Further indicate what are the carriers of current inside and outside the cell. State the reaction at each electrode.

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5. The resistance of a conductivity cell containing  $0.001M KCl$  solution at  $298K$  is  $1500\Omega$ . What is the cell constant if conductivity of  $0.001M KCl$  solution at  $298K$  is  $0.146 \times 10^{-3} S cm^{-1}$ .

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6. Predict the products of electrolysis in each of the following :

(a) An aqueous solution of  $AgNO_3$  with platinum electrodes.

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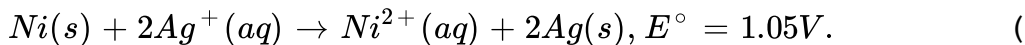
7. Predict the products of electrolysis in each of the following :

(b) An aqueous solution of  $CuCl_2$  with Pt electrodes.

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8. Determine the values of equilibrium constant ( $K_c$ ) and  $\Delta G^\circ$  for the reaction





Given  $1F = 96500C \text{ mol}^{-1}$ )

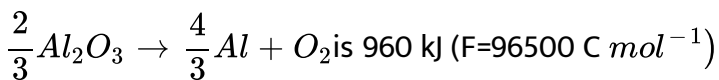
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9. The  $K_{sp}$  for AgCl at 298 K is  $1.0 \times 10^{-10}$ . Calculate E for  $Ag^+ / Ag$  electrode immersed in 1.0 M KCl solution.

Given :  $E^\circ Ag^+ / Ag = 0.799 \text{ V}$ .

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10. Estimate the minimum potential difference needed to reduce  $Al_2O_3$  at  $500^\circ C$  The gibbs energy change for the decomposition reaction



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11. Two electrolytic cells containing silver nitrate solution and copper sulphate solution are connected in series. A steady current of 2.5 amp was passed through them till 1.078 g of Ag were deposited. How long did the current flow ? What weight of copper will be deposited ?  
( $Ag = 107.8u$ ,  $Cu = 63.5u$ )

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12. A solution of  $Ni(NO_3)_2$  is electrolyzed between platinum electrodes using a current of 5A for 20min. What mass of Ni is deposited at the cathode ?

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13. The cell in which the following reaction occurs

$2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$  has  $E_{cell}^0 = 0.236V$  at 298 K.

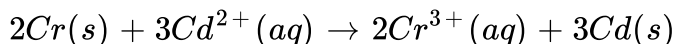
Calculate the standard Gibbs energy and the equilibrium constant of the cell reaction.

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14. The molar conductivity of 0.025 M methanoic acid (HCOOH) is  $46.15 \text{ S cm}^2 \text{ mol}^{-1}$ . Calculate its degree of dissociation and dissociation constant. Given  $\lambda_{(H^+)}^\circ = 349.6 \text{ S cm}^2 \text{ mol}^{-1}$  and  $\lambda_{(HCOO^-)}^\circ = 54.6 \text{ S cm}^2 \text{ mol}^{-1}$ .

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15. Calculate the standard cell potential of the galvanic cell in which the following reaction takes place:



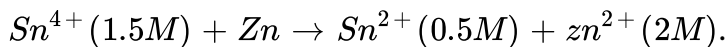
Also calculate the  $\Delta_r G^\ominus$  value of the reaction

(given  $E_{Cr^{3+}/Cr}^\ominus = -0.74V$ ,  $E_{Cd^{2+}/Cd}^\ominus = -0.40V$  and

$$F = 96500 \text{ C mol}^{-1}$$

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16. Calculate the potential of the following cell



Given :  $E_{\text{Sn}^{4+} / \text{Sn}^{2+}}^{\circ} = 0.13V$ ,  $E_{\text{Zn}^{2+} / \text{Zn}}^{\circ} = -0.76V$

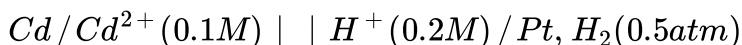
Will the cell potential  $\uparrow$  or  $\downarrow$  if the concentration of  $\text{Sn}^{4+}$  is increased ?

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17.  $E^{\circ} (\text{Cu}^{2+} / \text{Cu})$  and  $E^{\circ} (\text{Ag}^{+} / \text{Ag})$  is  $0.337V$  and  $+0.799V$  respectively. Make a cell whose EMF is  $+ve$ . If the concentration of  $\text{Cu}^{2+}$  is  $0.01M$  and  $E_{\text{cell}}$  at  $25^{\circ}C$  is zero, calculate the concentration of  $\text{Ag}^{+}$ .

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18. Calculate the potential of the cell at 298 K :



Given  $E^\circ$  for  $Cd^{2+}/Cd = -0.403V$ ,  $R = 8.314J^{-1} \text{ mol}^{-1}$ ,  $F = 965$

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19. The electrical resistance of a column of 0.05M NaOH solution of diameter 1 cm and length 50 cm is  $5.55 \times 10^3$  ohm. Calculate its resistivity, conductivity and molar conductivity.

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20. Conductivity of saturated solution of  $BaSO_4$  at 315 K is  $3.648 \times 10^{-6} \text{ ohm}^{-1} \text{ cm}^{-1}$  and that of water is  $1.25 \times 10^{-6} \text{ ohm}^{-1} \text{ cm}^{-1}$ . Ionic conductance of  $Ba^{2+}$  and  $SO_4^{2-}$  are 110 and  $136.6 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$  respectively. Calculate the solubility of  $BaSO_4$  in g/L.

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1. Conductivity of 0.00241M acetic acid is  $7.896 \times 10^{-5} \text{ S cm}^{-1}$ . Calculate its molar conductivity and if  $\Lambda_m^\circ$  for acetic acid is  $390.5 \text{ S cm}^2 \text{ mol}^{-1}$ , what is its dissociation constant ?

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2. Three electrolytic cell  $A$ ,  $B$ , and  $C$  containing solutions of  $\text{ZnSO}_4$ ,  $\text{AgNO}_3$ , and  $\text{CuSO}_4$ , respectively, are connected in series. A steady current of  $1.5\text{A}$  was passed through them until  $1.45\text{g}$  of silver deposited at the cathode of cell  $B$ . How long did the current flow ? What mass of copper and zinc were deposited ?

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3. (a) Define Kohlraush's law.

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4. (b) Suggest a way to determine the  $\Lambda_m^\circ$  for  $CH_3COOH$ .

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5. Molar conductivities ( $\Lambda_m^\circ$ ) at infinite dilution of  $NaCl$ ,  $HCl$  and  $CH_3COONa$  are 126.4, 425.9 and  $91.0 \text{ Scm}^2 \text{ mol}^{-1}$  respectively.  $\Lambda_m^\circ$  for  $CH_3COOH$  will be

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6. How the weak and strong electrolytes are distinguished?

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7. (b) The  $E^\theta$  values corresponding to the following two reduction electrode processes are :

$$(i) Cu^+ / Cu = 0.52V (ii) Cu^{2+} / Cu^+ = 0.16V$$

Formulate the galvanic cell for their combination. Calculate the cell potential and  $\Delta G^\circ$  for the cell reaction.



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