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India's Number 1 Education App

CHEMISTRY

BOOKS - IIT-JEE PREVIOUS YEAR (CHEMISTRY)

ELECTROCHEMISTRY

Jee Main And Advanced

1. Given $E^{\circ}_{Cl_2/Cl^-} = 1.36V, E^{\circ}_{Cr^{3+}/Cr} = -0.74V$

$E^{\circ}_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33V, E^{\circ}_{MnO_4^-/Mn^{2+}} = 1.51V$

Among the following, the strongest reducing agent is

A. Cr

B. Mn^{2+}

C. Cr^{3+}

D. Cl^-

Answer: a

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2. For the following electrochemical cell at $298K$

$$Pt(s) + H_2(g, 1^-)\left|H^+(aq, 1M)\right|\left|M^{4+}(aq), M^{2+}(aq)\right|Pt(s)$$

$E_{cell} = 0.092V$ when $\dfrac{\left[M^{2+}(aq)\right]}{\left[M^{4+}(aq)\right]} = 10^x$

Guven, $E^{\circ}_{M^{4+}/M^{2+}} = 0.151V$, $2.303\dfrac{RT}{F} = 0.059$

The value of x is-

A. -2

B. -1

C. 1

D. 2

Answer: d

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3. Two Faraday of electricity is passed through a solution of $CuSO_4$. The mass of copper deposited at the cathode is (at. Mass of Cu=63.5u)

A. 0g

B. 63.5g

C. 2g

D. 127g

Answer: b

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4. Given $E^{\circ}_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33V, E^{\circ}_{MnO_4^-/Mn^{2+}} = 1.51V$

Among the following, the strongest reducing agent is

$E^{\circ}_{Cr^{3+}/Cr} = -0.74V^x, E^{\circ}_{MnO_4^-/Mn^{2+}} = 1.51V$

$E^{\circ}_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33V, E^{\circ}_{Cl/Cl^-} = 1.36V$

Based on the data given above strongest oxidising agent will be

A. Cl

B. Cr^{3+}

C. Mn^{2+}

D. MnO_4^-

Answer: d

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5. Electrolysis of dilute aqueous $NaCl$ solution was carried out by passing $10mA$ current. The time required to liberate $0.01mol$ of H_2 gas at the cathode is $\left(1F = 96500Cmol^{-1}\right)$

A. $9.65 \times 10^4 s$

B. $19.3 \times 10^4 s$

C. $28.95 \times 10^4 s$

D. $38.6 \times 10^4 s$

Answer: b

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6. In the electrolysis cell, flow of electrons is from

A. cathode to anode in solution

B. cathode to anode through external supply

C. cathode to anode through internal supply

D. anode to cathode through internal supply

Answer: c

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7. Standard electrode potential data are useful for understanding the suitability of an oxidant in a redox titration. Some half cell reaction and their standard potentials are given below:

$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l) E^\circ = 1.51V$

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l), E^\circ = 1.38V$

$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq), E^\circ = 0.77V$

$CI_2(g) + 2e^- \rightarrow 2CI^-(aq), E^\circ = 1.40V$

Identify the only correct statement regarding quantitative estimation of aqueous $Fe(NO_3)_2$

A. MnO_4^- can be used in aqueous HCL

B. $Cr_2O_7^{2-}$ can be used in aqueous HCl

C. MnO_4^- can be used in aqueous H_2SO_4

D. $Cr_2O_7^{2-}$ can be used in aqueous H_2SO_4

Answer: a

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8. A standard solution of KNO_3 is used to make salt bridge, because

A. velocity of K^+ is greater than that of NO_3^-

B. velocity of NO_3^- is greater than that of K^+

C. velocities of both K^+ and NO_3^- are nearly the same

D. KNO_3 is highly soluble in water.

Answer: c

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9. The gas X at 1 atm is bubbled through a solution containing a mixture of $2MY^-$ and $1MZ^-$ at $25^\circ C$. If the order of reduction potential is $Z > Y > X$, then

A. Y will oxidise X and not Z

B. Y will oxidise Z and not X

C. Y will oxidise both X and Z

D. Y will reduce both X and Z

Answer: a

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10. The standard reduction potential values of three metallic cations, $X, Y,$ and Z are $0.52, -3.03,$ and $-0.18V$, respectively. The order of reducing power of the corresponding metal is

A. $Y > Z > X$

B. $X > Y > Z$

C. $Z > Y > X$

D. $Z > X > Y$

Answer: a

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11. The standard reductino potentials E^{c-} for the half reactinos are as follows :

$Zn \rightarrow Zn^{2+} + 2e^{-} \qquad E^{c-} = +0.76V$

$Fe \rightarrow Fe^{2+} + 2e^{-} \qquad E^{c-} = 0.41V$

The EMF for the cell reaction

$Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$

is

A. $-0.35V$

B. $+0.35V$

C. $+1.17V$

D. $-1.17V$

Answer: b

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12. When a lead storage battery is discharged.

A. SO_2 is evolved

B. lead is formed

C. lead sulphate is consumed

D. sulphuric acid is consumed.

Answer: d

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13. The reaction

$$\frac{1}{2}H_2(g) + AgCl(s) \Leftrightarrow H^+(aq) + Cl^-(aq) + Ag(s)$$

occurs in the galvanic cell

A. $Ag|AgCl(s)|KCl(\text{soln})|AgNO_3|Ag$

B. $Pt|H_2(g)|HCl|(\text{soln})|AgNO_3(\text{soln}) \mid Ag$

C. $Pt|H_2(g)HCL(\text{soln})|AgCl(s) \mid Ag$

D. $Pt|H_2(g)|KCl(\text{soln})|AgCl(s)|Ag$

Answer: c

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14. The electrice charge for eeletrode deposition of $1g$ equivalent of a substance is

A. one ampere per second

B. 96.500 colulombs per second

C. one ampere for one hour

D. charge on one mole of electrons

Answer: d

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15. A solution containing $1mol$ per litre of each $Cu(NO_3)_2$, $AgNO_3$, and $Hg_2(NO_3)_2$ is being electrolyzed by using inert electrodes. The values of standard electrode potentials in volts (reduction potential) are

$Ag|Ag^{\oplus} = +0.80, 2Hg|Hg_2^{2+} = +0.79$

$Cu|Cu^{2+} = +0.34, Mg|Mg^{2+} = -2.37.$

With increasing voltage, the sequence of deposition of metals at the cathode will be

A. Ag,Hg,Cu,Mg

B. Mg,Cu,Hg,Ag

C. Ag,Hg,Cu

D. Cu,Hg,Ag

Answer: c

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16. Faraday's laws of electrolysis are related to the

A. atomic number of the cation

B. atomic number of the anion

C. eqivalent weight of the electrolyte

D. speed of the cation.

Answer: c

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17. The standard reduction potentials at 298K, for the following half cells are given:

$Zn^{2+}(aq) + 2e^- \Leftrightarrow Zn(s) : E^\circ = -0.762V$

$Cr^{3+}(aq) + 3e^- \Leftrightarrow Cr(s) : E^\circ = -0.740V$

$2H^+(aq) + 2e^- \Leftrightarrow H_2(g), E^\circ = 0.000V$

$Fe^{3+}(aq) + e^- \Leftrightarrow Fe^{2+}(aq), E^\circ = 0.770V$

Which is the stronget reducing agent?

A. Zn(s)

B. Cr(s)

C. $H_2(g)$

D. $Fe^{2+}(aq)$

Answer: a

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18. In a galvanic cell, the salt bridge.

A. does not participate chemically in the cell reaction

B. stops the diffusion of ions from one electrode to another

C. is necessary for the occurrence of the cell reaction.

D. ensures mixing of the two electrolytic solutions.

Answer: a,b

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19. For the reduction of NO_3^- ion in an aqueous solution E° is $+0.96V$. Values of E° for some metal ions are given below

$V^{2+}(aq) + 2e^- \Leftrightarrow V, E^\circ = -1.19Vtt$

$Fe^{3+}(aq) + 3e^- \rightarrow Fe: E^\circ = -0.04V$

$Au^{3+}(aq) + 3e^- \rightarrow Au, E^\circ = +1.40V$

$Hg^{2+}(aq) + 3e^- \rightarrow Hg, E^\circ = +0.86V$

The pari(s) of metals that is/are oxidised by NO_3^- in aqueous solution is (are)

A. V and Hg

B. Hg and Fe

C. Fe and Au

D. Fe and V

Answer: a,b,d

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20. Chemical reactions involve interation of atoms and molecules. A large number of atoms / molecules (approximately 6.023×10^{23}) are present in a few grams of any chemical compound varying with their atomic / molecular masses. To handle such large numbers conveniently, the mole concept was introduced. This concept has implications in diverse areas such as analytical chemistry, biochemistry, electrochemistry, and radiochemistry. The following example illustrates a typical case, involving

chemical / electrochemical reaction, which requires a clear understanding of the mole concept.

A $4.0M$ aqueous solution of $NaCl$ is prepared and $500mL$ of this solution is electrolyzed. This leads to the evolution of chlorine gas at one of the electrodes (atomic mass of Na is 23 and Hg is $200)(1F = 96500C)$.

The total number of moles of chlorine gas evolved is

A. 0.5

B. 1

C. 2

D. 3

Answer: b

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If the cathode is an Hg electrode, the maximum weight ($\in g$) of amalgam formed from this solution is

A. 200

B. 225

C. 400

D. 446

Answer: d

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The total number of moles of chlorine gas evolved is

A. 2412.5

B. 48250

C. 96500

D. 193000

Answer: d

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23. The following electrochemical cell has been set up :

$Pt(l)\left|Fe^{3+}, Fe(a=1)\right|Ce^{4+}, Ce^{3+}(a=1) \mid Pt(2)$

$E^{c-}_{\cdot\left(Fe^{3+}\quad Fe^{2+}\right)} = 0.77V$

and

$E^{c-}_{\cdot\left(Ce^{4+}\quad Ce^{3+}\right)} = 1.61V$

If an ammeter is connected between two platinum electrodes, predict the direction of the flow of current. Will the current increase or decreases with time ?

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24. Copper sulphate solution $(250ML)$ was electrolyzed using a platinum anode and a copper cathode. A constant current of $2mA$ was passed for $16min$. It was found that after electrolysis the absorbance of the solution was reducted to $50\,\%$ of its original value . Calculate the concentration of copper sulphate in the solution to begin with.

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25. A cell, $Ag|Ag^{\oplus}||Cu^{2+}\,|\,Cu$, initially contains $1MAg^{\oplus}$ and $1MCu^{2+}$ ions. Calculate the change in the cell the potential after the passage of $9.65A$ of current for $1h$.

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26. How many grams of silver could be plated out on a serving tray be electrolysis of solution containing silver in $+1$ oxidation state for a period of 8.0 hour at a current of 8.46 ampere? What is the area of the

tray if the thickness of the silver plating is $0.00254cm$? Density of silver is $10.5g/cm^3$.

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27. The Edison storage cell is represented as :

$Fe(s)|FeO(s)|KOH(aq)|Ni_2O_3(s)|Ni(s)$

The half $-$ cell reactions are :

$$Ni_2O_3(s) + H_2O(l) + 2e^- \rightleftharpoons 2NiO(s) + 2\overset{\ominus}{O}H \; ; \quad E^{\ominus} = +0.40 \text{ V}$$

$$FeO(s) + H_2O(l) + 2e^- \rightleftharpoons Fe(s) + 2\overset{\ominus}{O}H \; ; \; E^{\ominus} = -0.87 \text{ V}$$

$a.$ What is the cell reaction ?

$b.$ What is the cell EMF ? How does it depend on the concentration of KOH ?

$c.$ What is maximum amount of electrical energy that can be obtained from $1mol$ of Ni_2O_3 ?

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28. The standard reduction potential for the half cell :

$NO_3^{c-}(aq) + 2H^{c-} + e^- \rightarrow NO_2(g) + H_2O$ is $0.78V$.

a. Calculate the reduction potential in $8MH^{\oplus}$.

b. What will be the reduction potential of the half cell in a neutral solution ? Assume all the other species to be at unit concentration.

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29. Chromium metal can be plated out from an acidic solution containing CrO_3 according to the following equation.

$CrO_3(aq) + 6H^+(aq) + 6e^- \rightarrow Cr(s) + 3H_2O$

Calculate (i) How many grams of chromium will be plated out by 24,000 C and (ii) How long will it take to plate out 1.5g of chromium by using 12.5 current?

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30. An aqueous solution of $NaCl$ on electrolysis gives $H_2(g), Cl_2(g)$, and $NaOH$ accroding to the reaction :

$$2Cl^{c-}(aq) + 2H_2O \rightarrow 2\overset{c-}{O}H(aq) + H_2(g) + Cl_2(g)$$

A direct current of $25A$ with a current efficiency of 62% is passed through $20L$ of $NaCl$ solution (20% by weight). Write down the reactions taking place at the anode and cathode. How long will it take to produce $1kg$ of Cl_2? What will be the molarity of the solution with respect to hydroxide ion ? (Assume no loss due to evaporation .)

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31. For the galvanic cell :

$Ag \mid AgCl(s)), KCl(0.2M) \mid \mid KBr(0.001M), AgBr(s) \mid Ag,$ calculate the EMF generated and assign correct polarity to each electrode for a spontaneous process after taking into account the cell reaction at $25^\circ C$.

$\left[K_{sp}(AgCl) = 2.8 \times 10^{-10}, K_{sp}(AgBr) = 3.3 \times 10^{-13}\right]$

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32. A current of 1.70 A is passed through 300.0 mL of 0.160 M solution of a $ZnSO_4$ for 230 s with a current efficiency of 90% . Find out the molarity of Zn^{2+} after the deposition Zn. Assume the volume of the solution to remain cosntant during the electrolysis.

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33. Calculate the quantity of electricity that would be required to reduce $12.3g$ of nitrobenzene to aniline, if the current efficiency for the process is $50\ \%$. If the potential drop across the cell is 3.0V, how much energy will be consumed?

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34. An acidic solution of Cu^{2+} salt containing $0.4g$ of Cu^{2+} is electrolyzed until all the copper is deposited. The electrolysis is continued for seven more minutes with the volume of solution kept at $100mL$ and

the current at $1.2A$. Calculate the volume of gases evolved at STP during the entire electrolysis.

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35. In a fuel cell, hydrogen and oxygen react to produce electricity. In process, hydrogen gas is oxidized at the anode and oxygen at the cathode. If $67.2L$ of H_2 at STP reacts in $15min$, what is the average current produced ? If the entire current is used for electro $-$ deposition of copper from copper (II) solution, how many grams of copper will be deposited ?

Anode reaction : $H_2 + 2\overset{c-}{O}H \rightarrow 2H_2O + 2e^-$

Cathode reaction : $O_2 + 2H_2O + 2e^- \rightarrow 4\overset{c-}{O}H$

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36. A cell contains two hydrogen electrodes. The negative electrode is in contact with a solution of 10^{-6} M hydrogen ions. The emf of the cell is

0.118 V at $25^{\circ}C$ calculate the concentration of hydrogen ions at the positive electrode.

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37. A $100-W, 110-V$ incardescent lamp is connected in series with an electrolyte cell containing cadmium sulphate solution. How much cadmium will be deposited by the current flowing for $10h$?

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38. During the discharge of a lead storage battery, the density of sulphuric acid fell from $1.294gmL^{-1}$ to $1.139gmL^{-}$. Sulphuric acid of density $1.294gmL^{-1}$ is $39\,\%$ by weight and that of density $1.139gmL^{-1}$ is $20\,\%$ by weight. The battery hold 3.5 litre of acied and discharge. Calculate the no. of ampere hour for which the battery must have been used. The charging and discharging reactions are:

$Pb+SO_4^{2-}\rightarrow PbSO_4+2e$ (charging)

$PbO_2+4H^{+}+SO_4^{2-}+2e\rightarrow PbSO_4+2H_2O$ (discharging)

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39. How long current of 3A has to be passed through a solution of silver nitrate to coat a metal surface of $80cm^2$ with a 0.005mm thick layer? Density of silver is 10.5 g/cm^3.

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40. In an electrolysis experiment, current was passed for $5h$ through two cells connected in series. The first cell contains a solution of gold and second contains copper sulphate solution. In the first cell, $9.85g$ of gold was deposited. If the oxidation number of gold is $+3$, find the amount of copper deposited at the cathode of the second cell. Also calculate the magnitude of the current in ampere, (Atomic weight of Au is 197 and atomic weight of Cu is 63.5).

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41. A current of $3.7A$ is passed for $6h$ between nickel electrodes in $0.5L$ of a $2M$ solution of $Ni(NO_3)_2$. What will be the molarity of the solution at the end of electrolysis?

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42. For the following cell , $Zn_s|ZnSO_4((aq))CuSO_4((aq))|Cu(s)$ When the concentration of Zn^{2+} is 10 times the concentration of Cu^{2+}, the expression for $\Delta G(\text{in } Jmol^{-1}$ is [F is Faraday constant , R is gas constant , T is temperature , $E^{\circ}_{cell} = 1.1V$]

A. 2.303RT+L 1F

B. 1.1F

C. 2.303 RT-2.2F

D. $-2.2F$

Answer: c

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43. Galvanisation is applying a coating of

A. Cr

B. Cu

C. Zn

D. Pb

Answer: c

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44. Given below are half-cell reaction:

$Mn^{2+} + 2e^- \rightarrow Mn, , E^\circ = -1.81V$

$2\left(Mn^{3+} + e^- \rightarrow Mn^{2+}\right), , E^\circ = +1.51V$

The E° for $3Mn^{2+} \rightarrow Mn + 2Mn^{3+}$ will be:

A. $-2.69V$, the reaction will not occur

B. $-2.69V$, the reaction will occur

C. $-0.33V$, the reaction will not occur

D. $-0.33V$, the reaction will occur

Answer: a

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45. The equivalent conductance of NaCl at concentration C and at infinite dilution are λ_C and λ_∞, respectively. The correct relationship between λ_C and λ_∞ is given as (where, the constant B is positive)

A. $\lambda_C = \lambda_\infty + (B)C$

B. $\lambda_C = \lambda_\infty - (B)C$

C. $\lambda_C = \lambda_\infty - (B)\sqrt{C}$

D. $\lambda_C = \lambda_\infty + (B)\sqrt{C}$

Answer: c

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46. Resistance of $0.2M$ solution of an electrolyte is $50ohm$. The specific conductance of the solution is $1.4Sm^{-1}$. The resistance of $0.5M$ solution of the same electrolyte is 280Ω. The molar conductivity of $0.5M$ solution of the electrolyte in Sm^2mol^{-1} id

A. 5×10^{-4}

B. 5×10^{-3}

C. 5×10^{3}

D. 5×10^{2}

Answer: a

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47. The standard reduction potential data at $25^\circ C$ is given below

$E^\circ\left(Fe^{3+}, Fe^{2+}\right) = +0.77V,$

$E^\circ\left(Fe^{2+}, Fe\right) = -0.44V,$

$E^{\circ}\left(Cu^{2+}, Cu\right) = +0.34V,$

$E^{\circ}\left(Cu^{+}, Cu\right) = +0.52V,$

$E^{\circ}\left(O_2(g) + 4H^{+} + 4e^{-} \rightarrow 2H_2O\right] = +1.23V$

$E^{\circ}\left[\left(O_2(g) + 2H_2O + 4e^{-} \rightarrow 4OH^{-}\right)\right] = +0.40V,$

$E^{\circ}\left(Cr^{3+}, Cr\right) = -0.74V,$

$E^{\circ}\left(Cr^{2+}, Cr\right) = -0.91V,$

Match E° of the redox pair in List-I with the values given in List-II and select the correct answer using the code given below teh lists:

$List - I$	$List - II$
$(P) E^{\circ}\left(Fe^{3+}, Fe\right)$	$(1) -0.18V$
$(Q) E^{\circ}(4H_2O \Leftrightarrow 4H^{+} + 4OH^{+})$	$(2) -0.4V$
$(R) E^{\circ}\left(Cu^{2+} + Cu \rightarrow 2Cu^{+}\right)$	$(3) -0.04V$
$(S) E^{\circ}\left(Cr^{3+}, Cr^{2+}\right)$	$(4) -0.83V$

Codes:

A.

P	Q	R	S
4	1	2	3

B.

P	Q	R	S
1	2	3	4

C.

P	Q	R	S
2	3	4	1

D.

P	Q	R	S
3	4	1	2

Answer: d

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48. An aqueous solution of X is added slowly to an aqueous solution of Y as shown in List-I. The variation in conductivity of these reactions is given in List-II. Match List-I with List-II and select the correct answer using the code given below the lists:

$List - I$	$List - II$
$(P)(C_2H_5)_3N + CH_3COOH$ X Y	(1)Conductivity decreases adn then inc
$(Q)KI(0.1M) + AgNO_3(0.01M)$ X Y	(2)Conductivity decreases and then do
$(R)CH_3COOH + KOH$ X Y	(3)Conductivity increases and then do
$(S)NaOH + Hi$ X Y	(4)Conductivity does not change much

Codes:

A. $\begin{matrix} P & Q & R & S \\ 3 & 4 & 2 & 1 \end{matrix}$

B. $\begin{matrix} P & Q & R & S \\ 4 & 3 & 2 & 1 \end{matrix}$

C. $\begin{matrix} P & Q & R & S \\ 2 & 3 & 4 & 1 \end{matrix}$

D. $\begin{matrix} P & Q & R & S \\ 1 & 4 & 3 & 2 \end{matrix}$

Answer: a

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49. Consider the following cell reaction.

$2Fe(s) + O_2(g) + 4H^+(aq) \rightarrow 2Fe^{2+}(aq) + 2H_2O(l),$

$E^\circ = 1.67V$

At $\left[Fe^{2+}\right] = 10^{-3}M$, $P(O_2) = 0.1$ atm and pH=3, the cell potential at $25^\circ C$ is

A. 1.47V

B. 1.77V

C. 1.87V

D. 1.57V

Answer: d

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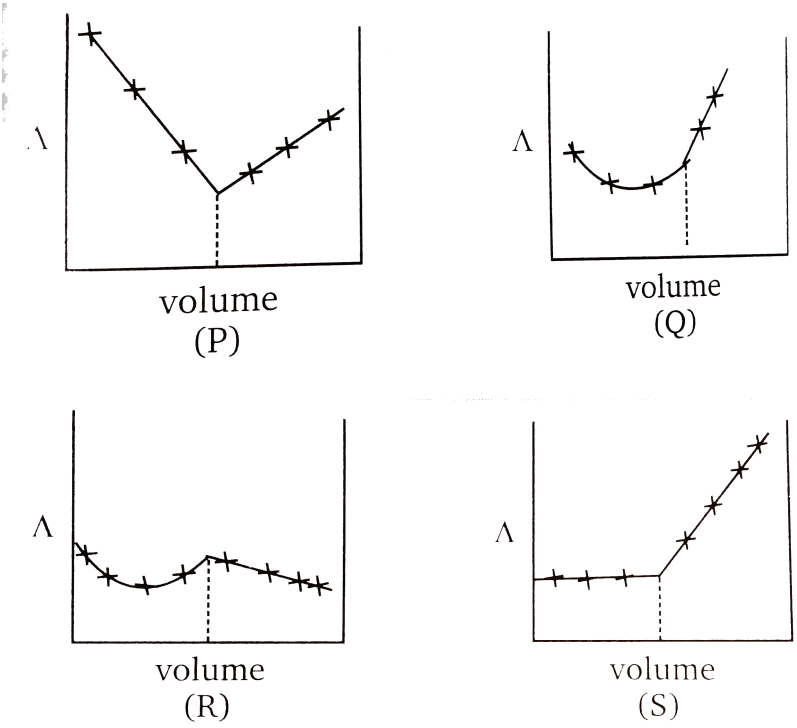
50. $AgNO_3(aq.)$ was added to an aqeous KCl solution gradually and the conductivity of the solution was measured. The plot of conductance (Λ) versus the volume of $AgNO_3$ is :



A. P

B. Q

C. R

D. S

Answer: d

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51. The half cell reaction for rusting of iron are:

$2H^+ + 2e^- + \frac{1}{2}O_2 \rightarrow H_2O(l), E^\circ = +1.23V$

$Fe^{2+} + 2e^- \rightarrow Fe(s), E^\circ = -0.44V$

ΔG° (in KJ) for the reaction is

A. -76

B. -322

C. -122

D. -176

Answer: b

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52. $Zn\left|Zn^{2+}(a=0.1M)\right|\left|Fe^{2+}(a=0.01M)\right|Fe.$

The emf of the above cell is 0.2905V. Equilibrium constant for the cell reaction is

A. $10^{0.32/0.059}$

B. $10^{0.32/0.0295}$

C. $10^{0.26/0.0295}$

D. $10^{0.32/0.295}$

Answer: b

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53. The correct order of equivalent conductance at infinite dilution of $LiCl$, $NaCl$ and KCl is:

A. $LiCl > NaCl > KCl$

B. $KCl > NaCl > LiCl$

C. $NaCl > KCl > LiCl$

D. $LiCl > KCl > NaCl$

Answer: b

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54. For the electrochemicl cell, $M|M^+||X^-|XE^\circ_{(M^+/M)} = 0.44V$ and $E^\circ_{(X/X^-)} = 0.33V$

From this data one can deduce that :

A. M+X $\rightarrow M^+ + X^-$ is the spontaneous reaction

B. $M^+ + X^- \rightarrow M + X$ is the spontaneous reaction

C. $E_{\text{cell}} = -0.77V$

D. $E_{\text{cell}} = 0.77V$

Answer: b

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55. The standard reduction potential of Cu^{2+}/Cu and Cu^{2+}/Cu^{+} are 0.337 and 0.153 respectively. The standard electrode potential of Cu^{+}/Cu half $-$ cell is

A. 0.184V

B. 0.827V

C. 0.521V

D. 0.490V

Answer: c

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56. The electrochemical cell shown below is a concentration cell. $M \mid M^{2+}($ saturated solution of sparingly soluble salt, $MX_2) \mid \left|M^{2+}\left(0.001 moldm^{-3}\right)\right| M$

The emf of the cell depends on the difference in the concentration of

M^{2+} ions at the two electrodes. The emf of the cell at 298 is $0.059V$.

The solubility product $\left(K_{sp}, mol^3dm^{-9}\right)$ of MX_2 at 298 based on the information available the given concentration cell is (Take $2.303 \times R \times 298/F = 0.059V$)

A. 1×10^{-15}

B. 4×10^{-15}

C. 1×10^{-12}

D. 4×10^{-12}

Answer: b

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57. The electrochemical cell shown below is a concentration cell. $M \mid M^{2+}($ saturated solution of sparingly soluble salt, $MX_2) \mid \left|M^{2+}\left(0.001moldm^{-3}\right)\right|M$

The emf of the cell depends on the difference in the concentration of M^{2+} ions at the two electrodes. The emf of the cell at 298 is $0.059V$.

The solubility product $\left(K_{sp}, mol^3 dm^{-9}\right)$ of MX_2 at 298 based on the information available the given concentration cell is (Take $2.303 \times R \times 298/F = 0.059V$)

A. -5.7

B. 5.7

C. 11.4

D. 11.4

Answer: d

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58. The concentration of potassium ions inside a biological cell is at least 20 times higher than outside. The resulting potential difference across the cell is important in several processes such as transmission of nerve impulses and maintaining the ion balance. A simplel model for a concentration cell involving a metal M is

$M(s) \mid M^{\oplus}(aq, 0.05 \text{ molar}) \mid \mid M^{\oplus}(aq, 1 \text{ molar}) \mid M(s)$

For the abov electrolytic cell, the magnitude of the cell potential is $|E_{cell}| = 70mV$.

For the above cell

A. $E_{\text{cell}} < 0 : \Delta G > 0$

B. $E_{\text{cell}} > 0, \Delta G < 0$

C. $E_{\text{cell}} < 0, \Delta G^{\circ} > 0$

D. $E_{\text{cell}} > 0, \Delta G^{\circ} < 0$

Answer: b

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59. The concentration of potassium ions inside a biological cell is at least 20 times higher than outside. The resulting potential difference across the cell is important in several processes such as transmission of nerve impulses and maintaining the ion balance. A simplel model for a concentration cell involving a metal M is

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For the abov electrolytic cell, the magnitude of the cell potential is $|E_{cell}| = 70mV$.

If the 0.05 moolar solution of $M^{\oplus}$ is replaced by a 0.0025 molar $M^{\oplus}$ solution, then the magnitude of the cell potential would be

A. 35mV

B. 70mV

C. 140mV

D. 700mV

Answer: c

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60. Redox reactions play a pivotal role in chemistry and biology. The values standard redox potential $\left(E^{c-}\right)$ of two half cell reactions decided which way the reaction is expected to preceed. A simple example is a Daniell cell in which zinc goes into solution and copper sets deposited. Given below are a set of half cell reactions (acidic medium) along with

their E^{c-} (V with respect to normal hydrogen electrode) values. Using this data, obtain correct explanations for Question.

$I_2 + 2e^- \rightarrow 2I^{c-}, \qquad E^{c-} = 0.54$

$Cl_2 + 2e^- \rightarrow 2Cl^{c-}, \qquad E^{c-} = 1.36$

$Mn^{3+} + e^- \rightarrow Mn^{2+}, \qquad E^{c-} = 1.50$

$Fe^{3+} + e^- \rightarrow Fe^{2+}, \qquad E^{c-} = 0.77$

$O_2 + 4H^{\oplus} + 4e^- \rightarrow 2H_2O, \qquad E^{c-} = 1.23$

Among the following, identify the correct statement.

A. Chloride ion is by iodine

B. Iodide ion is oxidised by chlorine

C. Iodide ion is oxidised by chlorine

D. Mn^{2+} is oxidised by chlorine

Answer: c

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61. Redox reactions play a pivotal role in chemistry and biology. The values standard redox potential $\left(E^{c-}\right)$ of two half cell reactions decided which way the reaction is expected to preceed. A simple example is a Daniell cell in which zinc goes into solution and copper sets deposited. Given below are a set of half cell reactions (acidic medium) along with their $E^{c-}(V$ with respect to normal hydrogen electrode) values. Using this data, obtain correct explanations for Question.

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$Fe^{3+} + e^- \rightarrow Fe^{2+}, \qquad E^{c-} = 0.77$

$O_2 + 4H^{\oplus} + 4e^- \rightarrow 2H_2O, \qquad E^{c-} = 1.23$

While Fe^{3+} is stable, Mn^{3+} is not stable in acid solution because

A. O_2 oxidises Mn^{2+} to Mn^{3+}

B. O_2 oxidises both Mn^{2+} to Mn^{3+} and Fe^{2+} to Fe^{3+}

C. Fe^{3+} oxidises H_2O to O_2

D. Mn^{2+} is oxidised by chlorine

Answer: d

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62. Redox reactions play a pivotal role in chemistry and biology. The values standard redox potential $\left(E^{c-}\right)$ of two half cell reactions decided which way the reaction is expected to preceed. A simple example is a Daniell cell in which zinc goes into solution and copper sets deposited. Given below are a set of half cell reactions (acidic medium) along with their $E^{c-}(V$ with respect to normal hydrogen electrode) values. Using this data, obtain correct explanations for Question.

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$O_2 + 4H^{\oplus} + 4e^- \rightarrow 2H_2O, \qquad E^{c-} = 1.23$

Sodium fusion extract obtained from aniline on treatment with iron (II) sulphate and H_2SO_4 in the presence of air gives a Prussion blue precipitate. The blue colour is due to the formation of

A. $Fe_4\left[Fe(CN)_6\right]_3$

B. $Fe_3\left[Fe(CN)_6\right]_2$

C. $Fe_4\left[Fe(CN)_6\right]_2$

D. $Fe_3\left[Fe(CN)_6\right]_3$

Answer: a

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63. Tollen reagent is used for the detection of aldehydes. When a solution of $AgNO_3$ is added to glucose with NH_4OH, then gluconic acid is formed.

$Ag^{\oplus} + e^{-} \rightarrow Ag, \qquad E^{c-}{}_{\cdot red} = 0.8V$

$C_6H_{12}O_6 \rightarrow \underset{Gluconicacid}{C_6H_{12}O_7} + 2H^{\oplus} + 2e^{-}, \qquad E^{c-}{}_{\cdot oxid} = -0.05V$

$\left[Ag(NH_3)_2\right]^{\oplus} + e^{-} \rightarrow Ag(s) + 2NH_3, \qquad E^{c-}{}_{\cdot red} = 0.337V$

$\left[Use 2.303 \times \frac{RT}{F} = 0.0592 \text{ and } \frac{F}{RT} = 38.92 at 298K\right]$

$2Ag^{\oplus} + C_6H^{12}O_6 + H_2O \rightarrow 2Ag^{s} + C_6H_{12}O_7 + 2H^{\oplus}$ Find $\ln K$ of this reaction.

A. 66.13

B. 58.38

C. 28.3

D. 46.29

Answer: b

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$$\left[Ag(NH_3)_2\right]^{\oplus} + e^{-} \rightarrow Ag(s) + 2NH_3, \qquad E^{c-}{}_{\cdot red} = 0.337V$$

$$\left[Use 2.303 \times \frac{RT}{F} = 0.0592 \text{ and } \frac{F}{RT} = 38.92 at 298K\right]$$

When ammonia is added to the solution, pH is raised to 11. Which half cell reaction is affected by pH and by how much ?

A. E_{oxi} will increase by a factor of 0.65 from E°_{oxi}

B. E_{oxi} will decrease by a factor of 0.65 from E°_{cell}

C. E_{red} will increase by a factor of 0.65 from E_{red}

D. E_{red} will decrease by a factor of 0.65 from E_{red}

Answer: c

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$$\left[Use 2.303 \times \frac{RT}{F} = 0.0592 \text{ and } \frac{F}{RT} = 38.92 at 298K\right]$$

Ammonia is always added in this reaction. Which of the followijng must be wrong ?

A. NH_3 is a stronger with Ag^+ to form a complex

B. $Ag(NH_3)_2^+$ is a stronger oxidising reagent than Ag^+

C. In the absence of NH_3 silver salt of gluconic acid is formed.

D. NH_3 has affected the standard reduction potential of glucose glueconic acid electrode

Answer: d

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66. We have taken a saturated solution of $AgBr$, whose K_{sp} is 12×10^{-14}. If $10^{-7}M$ of $AgNO_3$ are added to $1L$ of this solutino, find the conductivity (specific conductance) of the solution in terms of $10^{-7}Sm^{-1}$ units.

Given :

$\lambda^\circ_{\cdot(Ag^\oplus)} = 6 \times 10^{-3}Sm^2mol^{-1}$

$\lambda^\circ_{\cdot(Br^{c-})} = 8 \times 10^{-3}Sm^2mol^{-1}$

$\lambda^\circ_{\cdot\left(NO_3^{C-}\right)} = 7XX10^{-3}Sm^2mol^{-1}$

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67. Find the equilibrium constant for the reaction

$Cu^{2+} + In^{2+} \Leftrightarrow Cu^{+} + In^{3+}$

Given that $E^{\circ}_{cu^{2+}/Cu^{+}} = 0.15V$,?

$E^{\circ}_{In^{2+}/In^{+}} = -0.4V,$

$E^{\circ}_{In^{3+}/In^{+}} = -0.42V$

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68. The standard potential of the following cell is $0.23V$ at $15^{\circ}C$ and $0.21V$ at $35^{\circ}C$:

$Pt \mid H_{2(g)} \mid HCl(aq) \mid AgCl(s) \mid Ag(s)$

$a.$ Write the cell reaction.

$b.$ Calculate ΔH^{c-} and ΔS^{c-} for the cell reaction by assuming that these quantities remain unchanged in the range $15^{\circ}C$ to $35^{\circ}C$

$c.$ Calculate the solubility of $AgCl$ in water at $25^{\circ}C$.

Given : The standard reduction potential of $Ag^{\oplus}(aq) \mid Ag(s)$ is $0.80V$ at $25^{\circ}C$.

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69. Find the solubility product of a saturated solution of Ag_2CrO_4 in water at $298K$, if the EMF of the cell :

$Ag|Ag^{\oplus}(satAg_2CrO_4sol)||Ag(0.1M)|Agis0.164V$ at $298K$.

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70. Calculate the equilibrium constant for the reaction, $2Fe^{3+} + 3I^{-} \Leftrightarrow 2Fe^{2+} + I_3^{-}$, the standard reduction potentials in acidic conditions are 0.77V and 0.54V respectively for Fe^{3+}/Fe^{2+} and I_3^{-}/I^{-} couples.

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71. Calculate the equilibrium constant for the reaction : $Fe^{2+} + Ce^{4+} \Leftrightarrow Fe^{3+} + Ce^{3+}$ Given, $E^{\circ}_{Ca^{4+}/Ce^{3+}} = 1.44V$ and $E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.68V$

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72. The standard reduction potential for $Cu^{2+} \mid Cu$ is $+0.34V$. Calculate the reduction potential at $pH = 14$ for the above couple . K_{sp} of $Cu(OH)_2$ is 1.0×10^{-19}

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73. An excess of liquid mercury is added to an acidicfied solution of $1.0 \times 10^{-3} MFe^{3+}$. It is found that $5\,\%$ of Fe^{3+} remains at equilibrium at $25^{\circ}C$. Calculate $E^{c-}_{.(Hg_2^{2+}|Hg)}$ assuming that the only reaction that occurs is

$2Hg + 2Fe^{3+} \rightarrow Hg_2^{2+} + 2Fe^{2+}$

Given : $E^{c-}_{.(Fe^{3+}|Fe^{2+})} = 0.77V$

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74. The standard reduction potential of the $Ag^{\oplus}|Ag$ electrode at $298K$ is $0.799V$. Given that for AgI, $K_{sp} = 8.7 \times 10^{-17}$, evaluate the potential of the $Ag^{\oplus}|Ag$ electrode in a saturated solution of AgI. Also calculate the standard reduction potential of the I^{c-}|AgI|Ag` electrode.

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75. Zinc granules are added in excess to $500mL$ OF $1.0m$ nickel nitrate solution at $25^{\circ}C$ until the equilibrium is reached. If the standard reduction potential of $Zn^{2+} \mid Zn$ and $Ni^{2+} \mid Ni$ are $-0.75V$ and $-0.24V$, respectively, find out the concentration of Ni^{2+} in solution at equilibrium.

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76. The standard reduction potential of $Cu^{2+} \mid Cu$ and $Ag^{\oplus} \mid Ag$ electrodes are 0.337 and $0.799V$, respectively. Construct a galvanic cell using these electrodes so that its standard EMF is positive. For what concentration of $Ag^{\oplus}$ will the EMF of the cell , at $25^{\circ}C$, be zero if the concentration fo Cu^{2+} is $0.01M$?

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77. The standard reduction potential at $25^{\circ}C$ of the reaction $2H_2O + 2e^{-} \Leftrightarrow H_2 + 2\overset{\Theta}{O}H$ is $-0.8277V$. Calculate the equilibrium constant for the reaction.

$2H_2O \Leftrightarrow H_3O^{\oplus} + \overset{\Theta}{O}H$ at $25^{\circ}C$.

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78. The emf of a cell corresponding to the reaction

$Zn + 2H^{+}(aq) \rightarrow Zn^{2+}(0.1M) + H_2(g)1$ atm is 0.28 volt at $25^{\circ}C$.

Calculate the pH of the solution at the hydrogen electrode.

$E^{\circ}_{Zn^{2+}/Zn} = -0.76$ volt and $E^{\circ}_{H^{+}/H_2} = 0$

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79. Give reasons in one or two sentences

"Anhydrous HCl is a bad conductor of electricity but aqueous HCl is a good conductor".

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80. Consider the cell,

$Zn\left|Zn^{2+}(aq)(1.0M)\right|\left|Cu^{2+}(aq)(1.0M)\right|Cu$ The standard reduction potentially are 0.350V for

$Cu^{2+}(aq) + 2e^{-} \rightarrow Cu$

and $-0.763V$ for $Zn^{2+}(aq) + 2e^{-} \rightarrow Zn$

(i) Write down the cell reaction

(ii) Calculate the emf of the cell.

(iii) Is the cell reaction spontaneous or not?

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81. All the energy realesed from the reation $X \to Y, \Delta_r G^\circ = -193 kJ mol^{-1}$, is used for oxidizing M^+ as $M^+ \to M^{3+} + 2e^-, E^\circ = -0.25V$. Under standard consistions, the number of moles of M^+ oxidized when on e mol of X is converted to Y is $\left[F = 96,500 C \text{mol}^{-1}\right]$

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82. The standard reduction potentials of Cu^{2+}/Cu and Cu^{2+}/Cu^+ are 0.337 V and 0.153V respectively. The standard electrode potential of Cu^+/Cu half-cell is

A. 1.184V

B. 0.827V

C. 0.521V

D. 0.490V

Answer: c

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83. Calculate A^{∞} (in $Scm^2\mathrm{mol}^{-1}$) for NH_4OH, given that value of A^{∞} for $Ba(OH)_2$, $BaCl_2$ and NH_4Cl as 523.28.280.0 and 1298 $Scm^2\mathrm{mol}^{-1}$ respectively.

A. 373.8

B. 673.48

C. 543.68

D. 251.44

Answer: d

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84. If the solution of $CuSO_4$ in which Cu rod is immersed at $25^\circ C$ is dilluted 10 times, the electode potential

A. increases by 0.03V

B. decreases by 0.03V

C. increases by 0.059V

D. decreases by 0.0059V

Answer: b

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85. Which one of the following statements is (are) false in a concentration cell made of Fe in 0.010 M Fe^{2+} (aq) and Fe in 0.10 MFe^{2+}?

A. The $E^\circ_{\text{cell}} = 0$

B. $\Delta G = 0$

C. The cell reaction is. $Fe^{2+}(aq.0010M) \rightarrow Fe^{2+}(aq0.10M)$

D. At equilibrium, the $\left|Fe^{2+}\right|_{\text{anode}} = \left|Fe^{2+}\right|_{\text{cathode}}$

Answer: b,c

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86. Which one of the following statements is (are) true regarding galvanic and electrolytic cells?

A. in both cells, redox reactions take place

B. In electrolytic cells, a current is forced through a cell to produce a chemical change for which the cell potential is negative

C. in both cells, reduction takes place at the cathode

D. The ion flow the salt-bridge in galvanic cell is opposite to the flow in electrolytic cell

Answer: a,b,c

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87. Assertion When acidic solution of $KMnO_4$ is added from burette to a beaker containing oxalic acid solution, following reaction occur:

$$MnO_4^- + H_2C_2O_4 + H^+ \rightarrow Mn^{2+} + CO_2$$

However the experimentalist does not experiences any electric shock.

Reason The above redox reaction is non-spontaneous and no electricity is produced during the reaction.

A. Both assertion and reason are correct and reason is the correct but reason is the correct explanation of the assertion.

B. Both assertion and reason are correct but reason is not the correct explantion of assertion.

C. Assertion is correct but reason is wrong.

D. Assertion is wrong but reason is correct.

Answer: c

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88. Assertion Decreasing concentration by dilution increases the equivalence conductance of aqueous solution NaCl.

Reason With dilution. Degree of ionisation of NaCl increases.

A. Both assertion and reason are correct and reason is the correct but reason is the correct explanation of the assertion.

B. Both assertion and reason are correct but reason is not the correct explantion of assertion.

C. Assertion is correct but reason is wrong.

D. Assertion is wrong but reason is correct.

Answer: c

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Others

1. (a) Will pH value of water be same at temperature $25^{\circ}C$ and $4^{\circ}C$ justify in not more than 2 or 3 sentences.

(b) Two students use same solution of $ZnSO_4$ and a solution of $CuSO_4$. The emf of one cell. Given : 2.303 RT/F=0.06V.

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2. The conductance of a 0.0015M aqueous solution of a weak monobasic acid was determined by using a conductivity acid was determined by using a cunductivity cell consisting of platinised pt electrodes. The distance between the electrodes is 120cm with an area of croos section of 1 cm^2. The conductance of this solution was found to be 5×10^{-7} S. the pH of the solution is 4. The value of limiting moalr conductivity (A_m°) of this weak monobasic acid in aqueous solution is $Z \times 10^2 Scm^{-1}\text{mol}^{-1}$. the value of Z is

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3. 20mL of solution of 0.1M acetic acid is divided into two equal parts and kept in two beakers separately. To one beaker 0mL of 0.05M NaOH. Two hydrogen the other 10 mL of 0.025 M NaOH. Two hydrogen electrodes are placed in the two solutions which are linked through a salt-bridge. what would be the measured emf?

A. 59mV

B. 28mV

C. 14mV

D. 33mV

Answer: b

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4. Consider the following standard reduction potential data to answer the next three questions Half-reactions. $E^{\circ}(V)$

$NO_3^- + 4H^+ + 3e^- \rightarrow NO(g) + 2H_2O(l) 0.955V$

$NO_3^- + 3H^+ + 2e^- \rightarrow HNO_2 + H_2O(l) 0.940V$

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O 1.23V$

$Pt^{2+} + 2e^- \rightarrow Pt 1.18V$

$V^{3+} + e^- \rightarrow V^{2+} - 0.255V$

$V^{3+} + 2e^- \rightarrow V - 1.20V$

What is the E° of cell?

$NO(g) + H_2O + O_2(g) \rightarrow NO_3^- + H^+$

A. 2.185V

B. $-0.13V$

C. 0.275V

D. 0.625V

Answer: c

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5. Consider the following standard reduction potential data to answer the next three questions Half-reactions. $E^\circ(V)$

$NO_3^- + 4H^+ + 3e^- \rightarrow NO(g) + 2H_2O(l) 0.955V$

$NO_3^- + 3H^+ + 2e^- \rightarrow HNO_2 + H_2O(l) 0.940V$

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O 1.23V$

$Pt^{2+} + 2e^- \rightarrow Pt 1.18V$

$V^{3+} + e^- \rightarrow V^{2+} - 0.255V$

$V^{3+} + 2e^- \rightarrow V - 1.20V$

What is E° for

$V \rightarrow V^{3+} + 3e^-$?

A. 1.38V

B. 0.885V

C. $-0.835V$

D. $-1.38V$

Answer: b

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6. Consider the following standard reduction potential data to answer the next three questions Half-reactions. $E^{\circ}(V)$

$NO_3^- + 4H^+ + 3e^- \rightarrow NO(g) + 2H_2O(l) 0.955V$

$NO_3^- + 3H^+ + 2e^- \rightarrow HNO_2 + H_2O(l) 0.940V$

$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O 1.23V$

$Pt^{2+} + 2e^- \rightarrow Pt 1.18V$

$V^{3+} + e^- \rightarrow V^{2+} - 0.255V$

$V^{3+} + 2e^- \rightarrow V - 1.20V$

Consider the following galvanic cell:

$V|V(NO_3)_2(0.01M)||NO_3^-(0.01).\ H^+|NO(g)$

1.0 atm, Pt. If emf of the above cell is 1.94V, pH of the cathode chamber is closest to

A. 0

B. 1

C. 2

D. 3

Answer: d

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