Shiksha Classes Bhandara

Subject : Chemistry **Topic : Electrochemistry** **M.M. : 100**

Marking Scheme:

(i) Each question is allotted 4 (four) marks for each correct response.

(ii) ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

Q.1 Calculate the volume of gas liberated at anode at NTP from the electrolysis of $CuSO_4$ solution by a current of 2 ampere passed for 10 minutes.
(A) 0.0696 litre (B) 0.0211 litre
(C) 0.0727 litre (D) 0.5312 litre

Q.2 The conductivity of a solution may be taken to be directly proportional to the total concentration of the charge carries (ions) present in it in many cases. Find the percent decreases in conductivity (k) of a solution of a weak monoacidic base BOH when its 0.1 M solution is diluted to double its original volume. ($K_b = 10^{-5}$ for BOH) (take $\sqrt{50} = 7.07$)
(A) – 20.12% (B) – 29.29%
(C) – 17.12% (D) – 35.13%

Q.3 Any redox reaction would occur spontaneously, if –
(A) the cell emf is positive
(B) the free energy change (ΔG°) is positive
(C) the ΔG is positive
(D) the cell emf (E°) is negative

Q.4 Acidified water is electrolysed using an inert electrode. Volume of gases liberated at STP is 0.168L. The quantity of charge passed through the acidified water would be:
(A) 96,500C (B) 9,650C
(C) 965C (D) 168C

Q.5 The type of electrode Pb | $PbSO_4$(s) | H_2SO_4 used in acid storage cell is –
(A) Metal electrode
(B) Non-metal electrode
(C) Metal-insoluble salt-anion electrode
(D) Oxidation-reduction electrode

Q.6 Following behaves as S.H.E. at a pressure Pt, H_2 | H_2O :
(A) 1 atm (B) 10^{-7} atm
(C) 10^7 atm (D) 10^{-14} atm

Q.7 Electrode potential of the metals in their respective solution are provided. Arrange the metals in their increasing order of reducing power. $K^+/K = -2.93V$, $Ag^+/Ag = +0.80V$, $Hg^+/Hg = +0.79V$, $Mg^{2+}/Mg = -2.37V$, $Cr^{3+}/Cr = -0.74V$
(A) Ag < Hg < Cr < Mg < K
(B) Ag > Hg > Cr > Mg > K
(C) Mg < Hg < Cr < Ag < K
(D) Ag < K < Cr < Mg < Hg

Q.8 The reaction $Zn^{2+} + 2e^- \rightarrow Zn$ has a standard potential of – 0.76 V. This means –
(A) Zn can't replace hydrogen from acids
(B) Zn is reducing agent
(C) Zn is an oxidising agent
(D) Zn^{2+} is a reducing agent

Q.9 What is the value of pK_b (CH_3COO^-) if $\lambda_m^0 = 390$ & $\lambda_m = 7.8$ for 0.04 of a CH_3COOH at 25ºC
(A) 9.3 (B) 9.2
(C) 4.7 (D) 4.8

Q.10 Which statement is true about the spontaneous cell reaction in galvanic cell
(A) $E^o_{cell} > 0$; $\Delta G^o < 0$; Quotient $Q < K_c$
(B) $E^o_{cell} > 0$; $\Delta G^o > 0$; $Q < K_c$
(C) $E^o_{cell} > 0$; $\Delta G^o > 0$; $Q > C$
(D) $E^o_{cell} > -$; $\Delta G^o > 0$; $Q < K_c$

Q.11 An electric current is applied to an aqueous solution of $FeCl_2$ and $ZnCl_2$. Which reaction occurs at the cathode?
(A) $Fe^{2+}_{(aq)} + 2e^-_{(aq)} \rightarrow Fe_{(s)}$ $E°_{red} = -0.44V$
(B) $Fe_{(s)} \rightarrow Fe^{2+}_{(aq)} + 2e^-$ $E°_{ox} = 0.44V$
(C) $Zn^{+2}_{(aq)} + 2e^-_{(aq)} \rightarrow Zn_{(s)}$ $E°_{red} = -0.76V$
(D) $Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$ $E°_{ox} = 0.76V$

Q.12 Which statement is not true regarding the relationship of the free-energy change and the cell potential of a galvanic cell?
(A) When the cell potential is used to determine the free-energy change, the energy in joules is obtained.
(B) If the free-energy change indicates a spontaneous reaction, then the cell potential has a negative value.
(C) The free-energy change and the cell potential of a galvanic cell are quantitative

measures of the driving force of a chemical reaction.

(D) Both the free-energy change and the cell potential are dependent on the composition of the reaction mixture.

Q.13 Which is not a characteristic of the standard hydrogen electrode?

(A) The E° is 0 V.

(B) The concentration of H^+ is 1 M.

(C) The temperature is 298 K.

(D) This oxidation half-reaction $2H^+(aq) + 2e^- \rightarrow H_2(g)$; $2H^+(aq)$ takes place at the SHE electrode.

Q.14 If the standard potential for the galvanic cell Ba(s) | Ba^{2+}(aq) || Zn^{2+}(aq) Zn(s) is 1.14 V, then what is the standard oxidation potential for the Ba/Ba^{2+} half-cell?

(E° for Zn^{2+}/Zn half-cell = – 0.76 V.)

(A) –1.90 V (B) –1.5 V

(C) 0.38 V (D) 1.90 V

Q.15 Calculate the maximum work that can be obtained from the Daniell cell given below –

Zn (s) | Zn^{2+} (aq) || Cu^{2+} (aq) | Cu (s).

Given that $E^o_{Zn^{2+}/Zn}$ = – 0.76 V and

$E^o_{Cu^{2+}/Cu}$ = + 0.34 V

(A) – 212300 J (B) – 202100 J

(C) – 513100 J (D) – 232120 J

Q.16 A half cell is prepared by dipping Ag electrode in a solution containing KCl and some AgCl. Half cell is is used as cathode during the cell reaction. Quantity of AgCl will –

(A) Decrease (B) Increase

(C) Remain same (D) Cannot say

Q.17 A hydrogen electrode X was placed in a buffer solution of sodium acetate and acetic acid in the ratio a : b and another hydrogen electrode Y was placed in a buffer solution of sodium acetate and acetic acid in the ratio b : a. If reduction potential values for two cells are found to be E_1 and E_2 respectively w.r.t standard hydrogen electrode, the pK_a value of the acid can be given as

(A) $\frac{E_1 - E_2}{0.118}$ (B) $-\frac{E_1 + E_2}{0.118}$

(C) $\frac{E_1}{E_2} \times 0.118$ (D) $\frac{E_2 - E_1}{0.118}$

Q.18 In acidic medium MnO_4^- is an oxidising agent. $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$. If H^+ ion concentration is doubled, electrode potential of the half cell will :

(A) Increase by 28.46 mV

(B) Decrease by 28.46 mV

(C) Increase by 14.23 mV

(D) Decrease by 142.30 mV

Q.19 Calculate the EMF of the cell at 298 K, Pt | H_2 (1atm) | NaOH (xM), NaCl (xM)| AgCl (s) | Ag.

If $E^\circ_{Cl^-/AgCl/Ag}$ = + 0.222 V

(A) 1.048 V

(B) – 0.04 V

(C) – 0.604 V

(D) emf depends on x and cannot be determined unless value of x is given.

Q.20 How much time is required for the complete decomposition of 2 moles of water using a current of 2 ampere–

(A) 26.805 h (B) 53.61 h

(C) 107.22 h (D) None of these

For Q.21-Q.25 :

The answer to each question is a NUMERICAL VALUE.

Q.21 At certain temperature (T) if conductivity of pure water is 5.5×10^{-7} S cm^{-1} then calculate pOH of pure water at temperature T.

Given

$\lambda^\infty_{H^+} = 350\ S\ cm^2 eq^{-1}, \lambda^\infty_{OH^-} = 200\ S\ cm^2 eq^{-1}$

Q.22 Find for strong electrolyte AB_2 in water at 25°C from the following data :

Conc. C (mole/L)	0.25	1
$\wedge_m (\Omega^{-1} cm^2 / mol)$	160	150

Q.23 The standard oxidation potential of Ni/Ni^{+2} electrode is 0.236 V. If this is combined with a hydrogen electrode in acid solution, at what pH of the solution will the measured emf be zero at 25°C. Assume [Ni^{+2}] = 1M.

Q.24 A certain metal salt solutions is electrolysed in series with a silver coulometer. The weights of silver and the metal deposited are 0.5094 g and 0.2653 g. Calculate the valency of the metal if its atomic weight is nearly that of silver.

Q.25 It is desired to convert the energy derived from the combustion of propane into electrical energy, via a fuel cell. Given that the standard free energies of formation of $C_3H_8(g)$, $H_2O(\ell)$ and $CO_2(g)$ are –23.5, –237.2 and –394.4 kJ mol^{-1} respectively, the standard EMF of the propane fuel cell. is (X + 0.10) V. Find the value of X.