DAY SEVENTEEN

Unit Test 3

(Physical Chemistry II)

1 The cell, $Zn|Zn^{2+}(1M)||Cu^{2+}(1M)|\ Cu\,(E^\circ_{cell} = 1.10\ V)$, was allowed to be completely discharged at 298 K. The relative concentration of Zn^{2+} to $Cu^{2+}\left(\dfrac{[Zn^{2+}]}{[Cu^{2+}]}\right)$ is

(a) antilog (24.08) (b) antilog 37.3
(c) $10^{37.3}$ (d) 9.65×10^4

2 The molar conductivities Λ°_{NaOAc} and Λ°_{HCl} at infinite dilution in water at 25°C are 91.0 and 426.2 S cm^2/mol respectively. To calculate Λ°_{HOAc}, the additional value required is

(a) $\Lambda^\circ_{H_2O}$ (b) Λ°_{KCl} (c) Λ°_{HOAc} (d) Λ°_{NaCl}

3 Given the data at 25°C,

$$Ag + I^- \longrightarrow AgI + e^-;\ E^\circ = 0.152\ V$$
$$Ag \longrightarrow Ag^+ + e^-;\ E^\circ = -0.800\ V$$

What is the value of log K_{sp} for AgI ?

$$\left(2.303\,\frac{RT}{F} = 0.059\ V\right)$$

(a) – 8.12 (b) – 8.612 (c) – 37.83 (d) – 16.14

4 The highest electrical conductivity from the following aqueous solution is of

(a) 0.1 M difluoroacetic acid
(b) 0.1 M fluoroacetic acid
(c) 0.1 M chloroacetic acid
(d) 0.1 M acetic acid

5 When a certain conductivity cell was filled with 0.01 M solution of KCl, it had a resistance of 160 Ω at 25°C and when filled with 0.005 M NaOH, it had a resistance of 190 Ω. If specific resistance of KCl solution is, 700 Ω-cm, specific conductance (Ω^{-1} cm^{-1}) of NaOH solution is

(a) 0.00120 (b) 0.00170 (c) 0.00180 (d) 0.00190

6 In a hydrogen-oxygen fuel cell, combustion of hydrogen occurs to

(a) generate heat
(b) create potential difference between the two electrodes
(c) produce water of high purity
(d) remove adsorbed oxygen from electrode surfaces

7 The $E^\circ_{M^{3+}/M^{2+}}$, values for Cr, Mn, Fe and Co are – 0.41, + 1.57, + 0.77 and + 1.97 V respectively. For which one of these metals the change in oxidation state from + 2 to + 3 is easiest ?

(a) Cr (b) Mn
(c) Fe (d) Co

8 Consider the following E° values

$$E^\circ_{Fe^{3+}/Fe^{2+}} = +0.77\ V$$
$$E^\circ_{Sn^{2+}/Sn} = -0.14\ V$$

Under standard conditions the potential for the reaction

$$Sn\,(s) + 2Fe^{3+}(aq) \longrightarrow 2Fe^{2+}(aq) + Sn^{2+}(aq)$$ is

(a) 1.68 V (b) 1.40 V
(c) 0.91 V (d) 0.63 V

9 In a cell that utilises the reaction,

$$Zn\,(s) + 2H^+(aq) \longrightarrow Zn^{2+}(aq) + H_2(g)$$

addition of H_2SO_4 to cathode compartment will

(a) lower the E and shift equilibrium to the left
(b) lower the E and shift the equilibrium to the right
(c) increase the E and shift the equilibrium to right
(d) increase the E and shift the equilibrium to the left

10 Consider the following reactions at 1100°C,

I. $2C + O_2 \longrightarrow 2CO, \Delta G^\circ = -460\ kJ\ mol^{-1}$
II. $2Zn + O_2 \longrightarrow 2ZnO, \Delta G^\circ = -360\ kJ\ mol^{-1}$

Based on these, select the correct alternate.

(a) Zinc can be oxidised by CO
(b) Zinc oxide can be reduced by carbon
(c) Both (a) and (b)
(d) None of the above

11 Consider the reaction, $2A + B \longrightarrow$ products, when concentration of B alone was doubled, the half-life did not change. When the concentration of A alone was doubled, the rate increased by two times. The unit of rate constant for this reaction is

(a) $\text{L mol}^{-1}\ \text{s}^{-1}$
(b) no unit
(c) $\text{mol L}^{-1}\text{s}^{-1}$
(d) s^{-1}

12 A reaction was found to be second order with respect to the concentration of carbon monoxide. If the concentration of carbon monoxide is doubled, with everything else kept the same, the rate of reaction will

(a) remain unchanged
(b) triple
(c) increase by a factor of 4
(d) double

13 $t_{1/4}$ can be taken as the time taken for the concentration of a reactant to drop to $3/4$ of its initial value. If the rate constant for a first order reaction is k, the $t_{1/4}$ can be written as

(a) $0.75/k$
(b) $0.69/k$
(c) $0.29/k$
(d) $0.10/k$

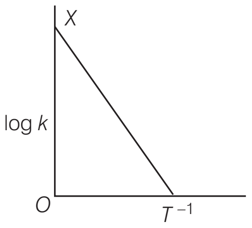
14 Consider an endothermic reaction, $X \longrightarrow Y$ with the activation energies E_b and E_f for the backward and forward reactions respectively. In general,

(a) there is no definite relation between E_b and E_f
(b) $E_b = E_f$
(c) $E_b > E_f$
(d) $E_b < E_f$

15 In a first order reaction, the concentration of the reactant decreases from 0.8 M to 0.4 M in 15 min. The time taken for the concentration to change from 0.1 M to 0.025 M is

(a) 30 min
(b) 15 min
(c) 7.5 min
(d) 60 min

16 Graph between $\log k$ and $\frac{1}{T}$ (k is rate constant in s^{-1} and T is the temperature in K is a straight line. If $OX = 5$ and slope of the line $= -\frac{1}{2.303}$ then E_a is



(a) 2.303×2 cal
(b) $\frac{2}{2.303}$ cal
(c) 2 cal
(d) None of these

17 The rate law for a reaction between the substances A and B is given by rate $= k\,[A]^n[B]^m$. On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be

(a) $\frac{1}{2^{m+n}}$
(b) $(m+n)$
(c) $(n-m)$
(d) $2^{(n-m)}$

18 Match the reactions in Column I with the number of electrons lost or gained in Column II.

Column I	Column II
A. $Mn(OH)_2 + H_2O_2 \rightarrow MnO_2$	1. 8
B. $AlCl_3 + 3K \rightarrow Al + 3KCl$	2. 2
C. $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$	3. 3
D. $H_2S + NO_3^{\ominus} \rightarrow S + NO$	4. 6

Codes

	A	B	C	D
(a)	2	4	1	3
(b)	4	1	3	2
(c)	2	3	1	4
(d)	2	1	3	4

19 The average molecular weight of colloidal particles is determined by

(a) Tyndall effect
(b) osmotic pressure measurement
(c) Victor Meyer's method
(d) None of the above

20 Oxidation number of Cr in the following compounds are x, y, z and w. (O_2 given is peroxy linkage)

$$K[\underset{x}{Cr}O(O_2)(OH)],\ K_3[\underset{y}{Cr}(O_2)_4]\ (NH_3)_3[\underset{z}{Cr}(O_2)_2],\ \underset{w}{Cr}O_2\,Cl_2$$

These values are

(a) 6, 13, 5, 6
(b) 4, 4, 4, 6
(c) 4, 5, 4, 6
(d) 4, 5, 6, 6

21 Match the following and choose the correct option.

Column I	Column II
A. Placing silica gel in water vapour	1. Occlusion
B. Placing anhydrous $CaCl_2$ in water vapour	2. Adsorption
C. Placing finely divided nickel in a closed vessel containing H_2 gas	3. Absorption
D. Shaking dilute KCl solution with blood charcoal	4. Negative adsorption

Codes

	A	B	C	D
(a)	3	1	4	2
(b)	2	3	1	4
(c)	1	4	2	3
(d)	4	2	3	1

22 When a sulphur sol is evaporated, sulphur is obtained. On mixing with water sulphur sol is not formed. The sol is

(a) lyophilic
(b) reversible
(c) hydrophobic
(d) hydrophilic

23 1 mole of N_2H_4 loses 10 moles of electrons to form a new compound *Y*. Assuming that, all the nitrogen appear in the new compound, what is the oxidation state of nitrogen in *Y*? (No change in the oxidation state of H)

(a) -1 (b) -3
(c) $+3$ (d) $+5$

24 The process of removing dissolved impurities from a colloidal system, by means of diffusion through suitable membrane under the influence of an electric field is called

(a) electroosmosis (b) electrodialysis
(c) electrophoresis (d) peptisation

Direction (Q. Nos. 25-26) *In the following questions, Assertion (A) followed by Reason (R) is given. Choose the correct option out of the following choices.*

(a) Both (A) and (R) are correct and (R) is correct explanation of (A)
(b) Both (A) and (R) are correct but (R) is not correct explanation of (A)
(c) (A) is correct but (R) is incorrect
(d) Both (A) is and (R) are incorrect

25 **Assertion** (A) Rate constants determined from Arrhenius equation are fairly accurate for simple as well as complex molecules.

Reason (R) Reactant molecules undergo chemical change irrespective of their orientation during collision.

→ NCERT Exemplar

26 **Assertion** (A) Mercury cell does not give steady potential.

Reason (R) In the cell reaction, ions are involved in solution.

27 If dilute HCl is added to a precipitate of stannic oxide,

(a) $SnCl_2$ and $SnCl_4$ are formed
(b) $Sn(OH)_2$ is formed
(c) a stable sol of stannic oxide is formed
(d) Sn_2O_3 is formed

28 Select the incorrect statement.

(a) Physical adsorption is reversible while chemical is irreversible
(b) High pressure favours physical adsorption while low pressure favours chemical adsorption
(c) Physical adsorption is not specific while chemical is highly specific
(d) High activation energy is involved in chemical adsorption.

29 Hemidialysis is used to

(a) separate colloidal sol from water
(b) separate charged and uncharged particles
(c) clean the blood of patients whose kidneys have malfunctioned
(d) None of the above

30 In multimolecular colloidal sols, atoms or molecules are held together by

(a) H-bonding (b) van der Waals' forces
(c) ionic bonding (d) polar covalent bonding

31 SnO_2 is taken in basic medium and current is passed. Colloidal sol migrates toward

(a) anode (b) cathode
(c) Both (a) and (b) (d) None of these

32 $[AgI]I^-$ colloidal sol can be coagulated by the addition of a suitable cation. 1 mole of $[AgI]I^-$ requires mole of $AgNO_3$, $Pb(NO_3)_2$ and $Fe(NO_3)_3$ as

(a) 1, 1, 1 (b) 1, 2, 3 (c) $1, \frac{1}{2}, \frac{1}{3}$ (d) 6, 3, 2

33 Equivalent conductance of $BaCl_2$, H_2SO_4 and HCl are x_1, x_2 and x_3 S cm^2 equiv^{-1} at infinite dilution. If specific conductance of saturated $BaSO_4$ solution is of y S cm^{-1}, then K_{sp} of $BaSO_4$ is

(a) $\dfrac{10^3 y}{2(x_1 + x_2 - 2x_3)}$ (b) $\dfrac{10^6 y^2}{(x_1 + x_2 - x_3)^2}$
(c) $\dfrac{10^6 y^2}{4(x_1 + x_2 - x_3)^2}$ (d) $\dfrac{x_1 + x_2 - 2x_3}{10^6 y^2}$

34 Select the correct statements.

(a) Emulsifiers stabilise the emulsion
(b) Soaps, detergents, long chain sulphonic acids and lyophilic colloids are emulsifiers
(c) Cleansing action of soap is due to the formation of emulsions
(d) All of the above are correct statements

35 Milk is an emulsion of fat dispersed in water. It is stabilised by

(a) casein—a lyophilic colloidal sol
(b) casein—a lyophobic colloidal sol
(c) lactose—a lyophilic colloidal sol
(d) lactose—a lyophobic colloidal sol

36 $KMnO_4$ reacts with oxalic acid as

$$MnO_4^- + C_2O_4^{2-} + H^+ \longrightarrow Mn^{2+} + CO_2 + H_2O$$

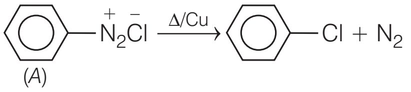
Hence, 50 mL of 0.04 $KMnO_4$ in acidic medium is chemically equivalent to

(a) 100 mL of 0.1 M $H_2C_2O_4$ (b) 50 mL of 0.2 M $H_2C_2O_4$
(c) 50 mL of 0.1 M $H_2C_2O_4$ (d) 25 mL of 0.1 M $H_2C_2O_4$

37 Given that $E^\circ_{Cu^{2+}/Cu} = 0.34$ V; $E^\circ_{Ag^+/Ag} = 0.80$ V;

$E^\circ_{Mg^{2+}/Mg} = 2.37$ V and $E^\circ_{Al^{3+}/Al} = -1.66$ V, in which of the following cells the standard free energy decrease is maximum ?

(a) $Mg|Mg^{2+}(1M)||Cu^{2+}(1\ M)|Cu$
(b) $Mg\ |Mg^{2+}(1\ M)||Ag^+\ (1\ M)|Ag$
(c) $Ag\ |Ag^+(1\ M)||Al^{3+}\ (1\ M)|Al$
(d) $Cu\ |Cu^{2+}(1\ M)||Ag^+\ (1\ M)|Ag$

38 

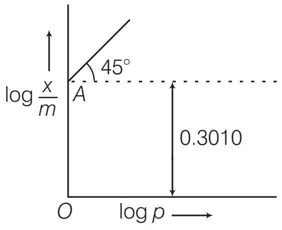
Half-life is independent of concentration of *A*. After 10 min, volume of N_2 gas is 10 L and after complete reaction 50 L. Hence, rate constant is

(a) $\frac{2.303}{10}\log 5\ \text{min}^{-1}$ (b) $\frac{2.303}{10}\log 1.25\ \text{min}^{-1}$
(c) $\frac{2.303}{10}\log 2\ \text{min}^{-1}$ (d) $\frac{2.303}{10}\log 4\ \text{min}^{-1}$

39 Gold number of haemoglobin is 0.03. Hence, 100 mL of gold sol will require haemoglobin so that gold is not coagulated by 10 mL of 10% NaCl sol is

(a) 0.03 mg (b) 30 mg
(c) 0.30 mg (d) 3 mg

40 Graph between $\log\left(\frac{x}{m}\right)$ and $\log p$ is a straight line at angle 45° with intercept *OA* as shown. Hence, $\left(\frac{x}{m}\right)$ at a pressure of 0.2 atm is



(a) 0.2 (b) 0.4 (c) 0.6 (d) 0.8

41 For the reaction,

$$3BrO^- \longrightarrow BrO_3^- + 2Br^-$$

in alkaline aqueous solution, the value of the second order (in BrO^-) rate constant at 80°C in the rate law for $-\Delta[BrO^-]/\Delta t$ was found to be 0.056 L $mol^{-1}s^{-1}$.

Thus, select correct alternate

(a) rate constant is 0.019 L mol^{-1} s^{-1} when rate law is $\frac{\Delta[BrO_3^-]}{\Delta t}$

(b) rate constant is 0.037 L mol^{-1} s^{-1} when rate law is $\frac{\Delta[Br^-]}{\Delta t}$

(c) rate constant is 0.037 L $mol^{-1}s^{-1}$ when rate law is $\frac{\Delta[BrO_3^-]}{\Delta t}$

(d) Both (a) and (b) are correct

42 3g of activated charcoal was added to 50 mL of 0.06 N acetic acid solution in a flask.

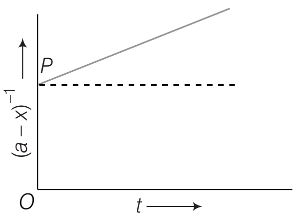
After an hour, it was filtered and strength of the filtrate was found to be 0.042 N. The amount of acetic acid adsorbed per gram of charcoal is

(a) 18 mg (b) 36 mg
(c) 42 mg (d) 54 mg

43. For the given reaction,

$$A \longrightarrow \text{Product}$$

$$\frac{dx}{dt} = k[A]^2$$



If $k = 1.0\times 10^{-2}$ L mol^{-1} min^{-1} and $OP = 0.10$ L mol^{-1} then rate at the start of the reaction is

(a) 1.0×10^{-2}mol L^{-1} min^{-1}
(b) 1.0 mol L^{-1} min^{-1}
(c) 1.0×10^{2} mol L^{-1} min^{-1}
(d) 1.0×10^{-4} mol L^{-1} min^{-1}

44. Which one of the following statements is correct ?

(a) Brownian movement is more pronounced for smaller particles than for bigger ones
(b) Sols of metal sulphides are lyophilic
(c) Hardy-Schulze law states, the bigger the size of the ion, the greater is its coagulating power
(d) One would expect charcoal to adsorb chlorine more strongly than hydrogen sulphide

45. The coagulation values of the electrolytes $AlCl_3$ and NaCl for As_2S_3 sol are 0.093 and 52 respectively. How many times has $AlCl_3$ greater coagulating power than NaCl?

(a) 100 (b) 559 (c) 993 (d) 852

46. A colloidal sol is formed by mixing $AgNO_3$ and KI in 2 : 1 molar ratio. This colloidal sol is to be coagulated by

I. NaI II. $MgSO_4$ III. $AlPO_4$

Molar ratio of these required to coagulate 1 mole colloidal sol is

(a) 1 : 1 : 1
(b) 1 : 2 : 3
(c) 3 : 2 : 1
(d) 6 : 3 : 2

Direction (Q. Nos. 47-50) *In the following questions, Assertion* (A) *followed by Reason* (R) *is given. Choose the correct option out of the following choices :*

(a) Both (A) and (R) are correct and (R) is not correct explanation of (A)
(b) Both (A) and (R) are correct but (R) is not correct explanation of (A)
(c) (A) is correct but (R) is incorrect
(d) Both (A) is and (R) are incorrect

47. **Assertion** (A) Reaction of white phosphorus with NaOH (aq) gives PH_3.

Reason (R) The reaction is disproportionation of P in alkaline medium.

48. **Assertion** (A) An ordinary filter paper impregnated with colloidion solution stops the flow of colloidal particle.

Reason (R) Pore size of the filter paper becomes more than the size of colloidal particle.

49. **Assertion** (A) For measuring resistance of an ionic solution, an AC source is used.

Reason (R) Concentration of ionic solution will change if DC source is used.

50. **Assertion** (A) The conversion of a fresh precipitate into a colloidal state by the action of solute or solvent is called peptisation.

Reason (R) Peptisation is a property of colloidal state.

ANSWERS

1 (b)	**2** (d)	**3** (d)	**4** (a)	**5** (a)	**6** (b)	**7** (a)	**8** (c)	**9** (c)	**10** (b)
11 (a)	**12** (c)	**13** (c)	**14** (d)	**15** (a)	**16** (c)	**17** (d)	**18** (c)	**19** (b)	**20** (c)
21 (b)	**22** (c)	**23** (c)	**24** (b)	**25** (c)	**26** (d)	**27** (c)	**28** (b)	**29** (c)	**30** (b)
31 (a)	**32** (c)	**33** (c)	**34** (d)	**35** (a)	**36** (c)	**37** (b)	**38** (b)	**39** (c)	**40** (b)
41 (d)	**42** (a)	**43** (b)	**44** (a)	**45** (b)	**46** (d)	**47** (a)	**48** (c)	**49** (a)	**50** (c)

Hints and Explanations

1 Cell is completely discharged, it means equilibrium gets established, $E_{cell} = 0$

$$Zn \mid Zn^{2+}(1\text{ M}) \parallel Cu^{2+}(1\text{ M}) \mid Cu$$

Cell reaction :

$$Zn + Cu^{2+} \rightleftharpoons Zn^{2+} + Cu$$

$$K_{eq} = \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

We know,

$$E_{cell} = E°_{cell} - \frac{0.0591}{n} \log K_{eq}$$

$$E°_{cell} = \frac{0.0591}{2} \log K_{eq}$$

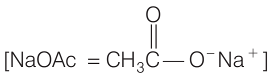
or

$$1.10 = \frac{0.0591}{2} \log K_{eq}$$

$$K_{eq} = \frac{[Zn^{2+}]}{[Cu^{2+}]} = \text{antilog} \frac{2.20}{0.0591}$$

$$= \text{antilog } 37.3$$

2 According to Kohlrausch's law



$$[NaOAc = CH_3\overset{\overset{\displaystyle O}{\|}}{C}—O^-Na^+]$$

$$\Lambda°_{CH_3COOH} = \lambda°_{CH_3COO^-} + \lambda°_{H^+} \quad ...(i)$$

$$\Lambda°_{HCl} = \lambda°_{H^+} + \lambda°_{Cl^-} \quad ...(ii)$$

$$\Lambda°_{CH_3COONa} = \lambda°_{CH_3COO^-} + \lambda°_{Na^+} \quad ...(iii)$$

Thus, after adding Eqs. (ii) and (iii) if $\lambda°_{Na^+}$ and $\lambda°_{Cl^-}$ are subtracted, we can obtained the value of $\Lambda°_{HOAc}$. Thus, additional value required is $\Lambda°_{NaCl}$.

3

$$AgI(s) + e^- \rightleftharpoons Ag(s) + I^-; E° = -0.152$$

$$Ag(s) \longrightarrow Ag^+ + e^-; E° = -0.8$$

$$AgI(s) \longrightarrow Ag^+ + I^-; \; E° = -0.952$$

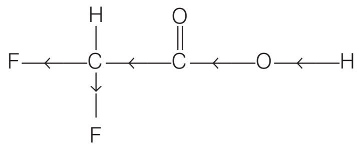
$$E°_{cell} = \frac{0.059}{n} \log K_{sp}$$

$$-0.952 = \frac{0.059}{1} \log K_{sp}$$

$$\log K_{sp} = -\frac{0.952}{0.059}$$

$$= -16.135 \approx -16.14$$

4 Fluoro group causes negative inductive effect increasing ionisation, thus 0.1 M difluoroacetic acid has highest electrical conductivity.



5 Resistance = specific resistance × cell constant

$$R_{(KCl)} = (\rho)_{KCl} \times \text{cell constant}$$

$$R_{(NaOH)} = (\rho)_{NaOH} \times \text{cell constant}$$

$$\frac{(R)_{KCl}}{(R)_{NaOH}} = \frac{(\rho)_{KCl}}{(\rho)_{NaOH}}$$

$$\frac{160}{190} = \frac{700}{(\rho)_{NaOH}}$$

$$(\rho)_{NaOH} = 831.25 \; \Omega \text{ cm}$$

Specific conductance, $\kappa_{(NaOH)}$

$$= \frac{1}{831.25}$$

$$= 1.20 \times 10^{-3} \; \Omega^{-1} \text{cm}^{-1} \text{ or } 0.00120$$

6 Any cell (like fuel cell), works when potential difference is developed.

7

$$E°_{Cr^{3+}/Cr^{2+}} = -0.41 \text{ V}$$

$$E°_{Mn^{3+}/Mn^{2+}} = +1.57 \text{ V}$$

$$E°_{Fe^{3+}/Fe^{2+}} = +0.77 \text{ V}$$

$$E°_{Co^{3+}/Co^{2+}} = +1.97 \text{ V}$$

More negative value of $E°_{red}$ indicates better reducing agent, thus easily oxidised.

Therefore, oxidation of Cr^{2+} to Cr^{3+} is easiest.

8 $Sn(s) + 2Fe^{3+}(aq) \longrightarrow 2Fe^{2+}(aq) + Sn^{2+}(aq)$

$$E°_{cell} = E°_{ox} + E°_{red}$$

$$= E°_{Sn/Sn^{2+}} + E°_{Fe^{3+}/Fe^{2+}}$$

Given, $E^\circ_{Sn^{2+}/Sn} = -0.14$ V

$\therefore \quad E^\circ_{Sn/Sn^{2+}} = +0.14$ V

$E^\circ_{Fe^{3+}/Fe^{2+}} = 0.77$ V

$\therefore \quad E^\circ_{cell} = 0.14 + 0.77 = 0.91$ V

9 $Zn(s) + 2H^+(aq) \longrightarrow Zn^{2+}(aq) + H_2(g)$

Reaction quotient, $Q = \dfrac{[Zn^{2+}]}{[H^+]^2}$

Corresponding cell is

$$\underset{\text{Anode}}{Zn \mid Zn^{2+}(C_1)} \| \underset{\text{Cathode}}{H^+(aq) \mid Pt(H_2)}$$

and $E_{cell} = E^\circ_{cell} - \dfrac{0.0591}{2}\log K$

$$= E^\circ_{cell} - \frac{0.0591}{2}\log\frac{[Zn^{2+}]}{[H^+]^2}$$

$$= E^\circ_{cell} + \frac{0.0591}{2}\log\frac{[H^+]^2}{[Zn^{2+}]}$$

If H_2SO_4 is added to cathodic compartment (towards reactant side), Q decreases (due to increase in H^+). Hence, equilibrium is displaced towards right and E_{cell} increases.

10 $ZnO + C \longrightarrow Zn + CO, \Delta G^\circ = -ve$.

Hence, this is spontaneous.

11 $2A + B \longrightarrow$ products

$[B]$ is doubled, half-life did not change. Half-life is independent of change in concentration of reactant for first order reactions, i.e. first order w.r.t to B.

When $[A]$ is doubled, rate increases by two times

$\Rightarrow$ First order w.r.t A

Hence, net order of reaction $= 1 + 1 = 2$

Unit for the rate constant $= \text{conc.}^{(1-n)}t^{-1}$

$$= (\text{mol L}^{-1})^{-1} \cdot \text{s}^{-1} = \text{L} \cdot \text{mol}^{-1}\text{s}^{-1}$$

12 Given, $\quad r \propto [CO]^2$

$r' \propto [2CO]^2$

$r' \propto 4\,[CO]^2$

Hence, $\dfrac{r'}{r} = \dfrac{4[CO]^2}{[CO]^2}$; $r' = 4\,r$

13

	$A \longrightarrow$	Product
Initially	a	0
After time t	$(a-x)$	x
After $t_{1/4}$	$\left(a - \dfrac{a}{4}\right)$	$\dfrac{a}{4}$

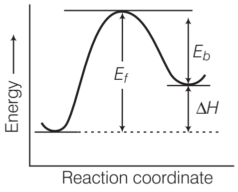
For first order kinetics,

$$k = \frac{2.303}{t}\log\left(\frac{a}{a-x}\right)$$

$\therefore \quad k = \dfrac{2.303}{t_{1/4}}\log\left(\dfrac{a}{3a/4}\right)$ and

$$t_{1/4} = \frac{2.303\log\frac{4}{3}}{k} = \frac{0.29}{k}$$

14 $X \to Y$ is an endothermic reaction, $\Delta H = +ve$



$E_b =$ energy of activation of backward reaction

$E_f =$ energy of activation of forward reaction

$\Delta H =$ heat of reaction

Thus, $E_f = E_b + \Delta H$

$\therefore \quad E_f > E_b$

15 Order $= 1$

Concentration changes from 0.8 M to 0.4 M (50%) in 15 min, thus half-life $= 15 \text{ min} = t_{50}$

A change from 0.1 M to 0.025 M is 75% and for first order reaction

$$t_{75} = 2 \times t_{50} = 2 \times 15 = 30 \text{ min}$$

or $\quad t_{50} = 15$ min

$$k = \frac{2.303\log 2}{t_{50}} = \frac{2.303\log 2}{15}$$

$a = 0.1$ M

$(a-x) = 0.025$ M

For first order,

$$k = \frac{2.303}{t}\log\left(\frac{a}{a-x}\right)$$

$$\frac{2.303\log 2}{15} = \frac{2.303}{t}\log\frac{0.1}{0.025}$$

$$= \frac{2.303}{t}\log 4$$

$$\therefore \frac{2.303\log 2}{15} = \frac{2 \times 2.303\log 2}{t};$$

$t = 30$ min

16 $\log_{10} K = \log_{10} A - \dfrac{E_a}{2.303\,RT}$

Slope $= -\dfrac{E_a}{2.303\,R} = -\dfrac{1}{2.303}$

$\therefore \quad E_a = R = 2$ cal

17 Rate becomes x^y times, if concentration is made x times of a reactant giving y^{th} order reaction.

$$\text{Rate} = k[A]^n[B]^m$$

Concentration of A is doubled, hence $x = 2$, $y = n$ and rate becomes $= 2^n$ times.

Concentration of B is halved, hence $x = 1/2$, $y = m$ and rate becomes $= \left(\dfrac{1}{2}\right)^m$ times.

Net rate becomes $= (2)^n\left(\dfrac{1}{2}\right)^m$ times $= (2)^{n-m}$ times.

18 A. $Mn^{2+} \longrightarrow Mn^{4+} + 2e^-$ (Oxidation)

$H_2O_2 + 2e^- \longrightarrow 2H_2O$ (Reduction)

B. $3K \longrightarrow 3K^+ + 3e^-$ (Oxidation)

$Al^{3+} + 3e^- \longrightarrow Al$ (Reduction)

C. $3Fe \longrightarrow Fe_3O_4 + 8e^-$ (Oxidation)

$3x = 0 \quad 3x - 8 = 0$

$3x = 8$

$4H_2O + 8e^- \longrightarrow 4H_2$ (Reduction)

$8x - 8 = 0 \quad 8x = 0$

$8x = 8$

D. $3H_2S \longrightarrow 3S + 6e^-$

(Oxidation)

$2 + X = 0 \quad x = 0$

$x = -2$

$2NO_3^- + 6e^- \longrightarrow 2NO$ (Reduction)

$x - 6 = -1 \quad x - 2 = 0$

$x = 5 \quad x = 2$

Hence, (c) option is correct.

19 The osmotic pressure measurement gives the molecular mass of aggregated molecule.

20 $\underset{\underset{+1}{\uparrow}}{K}\;[\underset{\underset{+x}{\uparrow}}{Cr}\;\underset{\underset{-2}{\uparrow}}{O}\;\underset{\underset{-2}{\uparrow}}{(O_2)}\;\underset{\underset{-1}{\uparrow}}{(OH)}] \;= 0$

$x = 4$

$\underset{\underset{3}{\uparrow}}{K_3}[\underset{\underset{+y}{\uparrow}}{Cr}\;\underset{\underset{-8}{\uparrow}}{(O_2)_4}] = 0$, $y = 5$

$\underset{\underset{0}{\uparrow}}{(NH_3)_3}[\underset{\underset{+z}{\uparrow}}{Cr}\;\underset{\underset{-4}{\uparrow}}{(O_2)_2}] = 0$ thus, $z = 4$

$\underset{\underset{w}{\uparrow}}{Cr}\underset{\underset{-4}{\uparrow}}{O_2}\;\underset{\underset{-2}{\uparrow}}{Cl_2} = 0$, $w = 6$

21 In adsorption, molecules of substances are accumulated in bulk also. Thus, the correct option is (b).

22 The sol is hydrophobic and hydrophobic sols are irreversible in nature.

23 $N_2H_4 \longrightarrow N_2(\ldots) + 10e^-$

Oxidation number of two N-atoms $= -4$ and oxidation number of two N-atoms in oxidised species $= -4 + 10 = +6$

Thus, oxidation state of N in new compound $= +3$.

24 The process of separation of soluble impurities from a colloidal solution by means of a parchment paper (a suitable membrane) is called dialysis. When the process is done under the influence of electric field, it is called **electrodialysis**.

25 **Correct Reason** Arrhenius equation is applicable to collisions between simple as well as complex molecules.

26 Mercury cell gives a steady potential. This is because in the cell reaction, the ions are not involved in the solution whose concentration changes during its life time.

27 Precipitate of stannic oxide is converted to a stable sol of stannic oxide by the addition of dilute HCl (peptisation).

28 Physical as well as chemical adsorptions are favoured by high pressure. However, the difference is that decrease in pressure causes desorption in case of physical adsorption but not in the case of chemical adsorption.

29 Hemidialysis is used to clean the blood of patients having malfunctioned kidneys.

30 Atoms or molecules in multimolecular colloidal sols are held together by van der Waals' forces.

31 In alkaline medium SnO_2 is converted into negatively charged colloidal sol.

$$SnO_2 + 2OH^- \longrightarrow SnO_3^{2-} + H_2O$$

$$SnO_2 + SnO_3^{2-} \longrightarrow \underbrace{[SnO_2]\,SnO_3^{2-}}_{\text{Anion migrate to anode}}$$

32 $$\underset{1\text{ mol}}{[AgI]I^-} + \underset{1\text{ mol}}{AgNO_3} \longrightarrow 2AgI + NO_3^-$$

$$\underset{\substack{2\text{ mol}\\1\text{ mol}}}{2[AgI]I^-} + \underset{\substack{1\text{ mol}\\1/2\text{ mol}}}{Pb(NO_3)_2}$$

$$\longrightarrow 2AgI\downarrow + PbI_2\downarrow + 2NO_3^-$$

$$\underset{\substack{3\text{ mol}\\1\text{ mol}}}{3[AgI]I^-} + \underset{\substack{1\text{ mol}\\1/3\text{ mol}}}{Fe^{3+}} \longrightarrow 3AgI + FeI_3$$

33 (*c*) $\Lambda^\circ_{BaSO_4} = \Lambda^\circ_{BaCl_2} + \Lambda^\circ_{H_2SO_4} - \Lambda^\circ_{HCl}$

$$= (x_1 + x_2 - x_3)$$

Equivalent conductance of $BaSO_4$

$$\Lambda^\circ_{BaSO_4} = \frac{1000\times \text{specific conductance}}{\text{solubility (in saturated solution)}}$$

$$(x_1 + x_2 - x_3) = \frac{1000y}{\text{Solubility}}$$

$$\text{Solubility y }(BaSO_4) = \frac{1000\,y}{(x_1 + x_2 - x_3)}\text{ N}$$

$$= \frac{1000\,y}{2(x_1 + x_2 - x_3)}\text{ M}$$

$$BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{2-}$$

$$K_{sp}(BaSO_4) = [Ba^{2+}][SO_4^{2-}]\text{ M}^2$$

$$= \frac{10^6 y^2}{4(x_1 + x_2 - x_3)^2}$$

34 All statements are correct.

35 It is stabilised by casein which is a lyophilic colloidal sol.

36 $$\text{Eq. mass of }MnO_4^- = \frac{\text{molar mass}}{7-2} = \frac{\text{molar mass}}{5}$$

$$\text{Eq. mass of }C_2O_4^{2-} = \frac{\text{molar mass}}{2[4-3]} = \frac{\text{molar mass}}{2}$$

$$\text{Meq. of }KMnO_4 = 50\times 5\times 0.04 = 10$$

$$\text{Meq. of }H_2C_2O_4 = 50\times 2\times 0.1 = 10$$

37 $\because -\Delta G^\circ = nFE^\circ_{cell}$

Thus, the standard free energy decreases is maximum in cell

$$Mg\,|\,Mg^{2+}\ (1\,M)\,||\,Ag^+\ (1\,M)\,|\,Ag$$

38 t_{50} is independent of concentration of *A*. Hence, the reaction is of first order.

$$A \longrightarrow N_2\,(g)$$

At $t = 0$,	a	0
At time t,	$(a - x)$	$x = 10\,L$ [after 10 min]

In the given reaction, $a = 50$ L

$\therefore \quad (a - x) = 40$ L

$$\therefore \quad k = \frac{2.303}{10}\log\frac{50}{40}$$

$$= \frac{2.303}{10}\log 1.25\text{ min}^{-1}$$

39 Gold number of haemoglobin = 0.03

10mL of gold sol requires haemoglobin to prevent coagulation = 0.03 mg

100 mL of gold sol will require haemoglobin to prevent coagulation = 0.3 mg

40 By Freundlich adsorption isotherm,

$$\left[\frac{x}{m}\right] = k(p)^{1/n}$$

$$\log\left[\frac{x}{m}\right] = \frac{1}{n}\log p + \log k$$

Compare with $y = mx + c$

$\therefore \quad$ Slope = $\tan\theta = \tan 45° = 1$

$$\therefore \quad \frac{1}{n} = 1$$

$\therefore \quad n = 1$ and $\log k = 0.3010 = \log 2$

$$\log\left[\frac{x}{m}\right] = \log(0.2) + \log 2 = \log 0.4$$

$$\therefore \quad \left[\frac{x}{m}\right] = 0.4$$

41 $$-\frac{1}{3}\frac{\Delta[BrO^-]}{\Delta t} = \frac{\Delta[BrO_3^-]}{\Delta t} = \frac{1}{2}\frac{\Delta[Br^-]}{\Delta t}$$

$$\therefore \quad \text{Rate constant of }\frac{\Delta[BrO_3^-]}{\Delta t} = \frac{0.056}{3}$$

$$= 0.019\text{ L mol}^{-1}\text{ s}^{-1}$$

and rate constant of

$$\frac{\Delta[Br^-]}{\Delta t} = \frac{2}{3}\times 0.056$$

$$= 0.037\text{ L mol}^{-1}\text{ s}^{-1}$$

42 CH_3COOH adsorbed

$= (0.06 - 0.042)\times 50\times 60$ mg

$= 54$ mg

$\therefore$ CH_3COOH adsorbed per gram of charcoal

$$= \frac{54}{3} = 18\text{ mg}$$

43 $$\left(\frac{dx}{dt}\right) = k[A]^2$$

It represents second order reaction

$$k = \frac{1}{t}\left[\frac{1}{a-x} - \frac{1}{a}\right]$$

$$\frac{1}{(a-x)} = kt + \frac{1}{a}$$

Thus, graph between $(a - x)^{-1}$ and time t is a straight line $(y = mx + c)$

$$\therefore \quad OP = \frac{1}{a} = 0.10\text{ L mol}^{-1}$$

$$\Rightarrow \quad a = 10\text{ mol L}^{-1}$$

$\therefore$

$$\left(\frac{dx}{dt}\right) = 1\times 10^{-2}\text{ L mol}^{-1}\text{ min}^{-1}\times(10\text{ mol L}^{-1})^2$$

$$= 1.0\text{ mol L}^{-1}\text{ min}^{-1}$$

44 Brownian movement is more pronounced for smaller particles than for bigger ones.

45 (*b*) Coagulating power of the electrolyte is inversely proportional to its coagulating value.

Thus,

$$\frac{\text{coagulating power of }AlCl_3}{\text{coagulating power of NaCl}} = \frac{52}{0.093} = 559$$

Thus, coagulating power of $AlCl_3$ is 559 times more than that of NaCl.

46 $$AgNO_3 + KI \longrightarrow AgI \xrightarrow[\text{(excess)}]{AgNO_3} \underset{\text{Colloidal sol}}{[AgI]Ag^+}$$

Sol is coagulated by anion

$$\underset{1}{[AgI]Ag^+} + \underset{1}{NaI} \longrightarrow$$

$$\underset{1}{[AgI]Ag^+} + \frac{1}{2}MgSO_4 \longrightarrow$$

$$[AgI]Ag^+ + \frac{1}{3}AlPO_4 \longrightarrow$$

$$\text{Thus, ratio} \quad 1 : \frac{1}{2} : \frac{1}{3}$$

$$6 : 3 : 2$$

47 $$4\overset{0}{P} + 3NaOH + 3H_2O \longrightarrow 3NaH_2\overset{+1}{P}O_2 + \overset{-3}{P}H_3$$

(disproportionation reaction)

48 An ordinary filter paper impregnated with colloidions solution stops the flow of colloidal particle. This is because the pore size of filter paper is less than the size of colloidal particles.

49 Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

Concentration of ionic solution changes on using DC current as a source of energy while on passing AC current, concentration does not change. Hence, AC source is used for measuring resistance.

50 Peptisation is a method to prepare gold sol.