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TOPPER'S CHOICE

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Important Questions

Chapters

- Solution

- Electrochemistry

- Chemical Kinetics

- d and f block

- Coordination Compounds

- Haloalkanes and Haloarenes

Solution

1 Which of the following solutions will have the highest conductivity at 298 K ?

(a) 0.01MHCl solution

(b) 0.1MHCl solution

(c) 0.01MCH_3COOH solution

(d) 0.1MCH_3COOH solution

2 A 5% solution of $Na_2SO_4 \cdot 1H_2O$ (MW = 322) is isotonic with 2% solution of non- electrolytic, non volatile substance X. Find out the molecular weight of X.

3 Answer the following questions:

a. State Henry's law and explain why are the tanks used by scuba divers filled with air diluted with helium (11.7% helium, 56.2% nitrogen and 32.1% oxygen)?

b. Assume that argon exerts a partial pressure of 6 bar. Calculate the solubility of argon gas in water. (Given Henry's law constant for argon dissolved in water, $K_H = 40$kbar)

4 Henna is investigating the melting point of different salt solutions.

She makes a salt solution using 10 mL of water with a known mass of NaCl salt.

She puts the salt solution into a freezer and leaves it to freeze.

She takes the frozen salt solution out of the freezer and measures the temperature when the frozen salt solution melts.

She repeats each experiment.

S.No	Mass of the salt used in g	Melting point in °C	
		Readings Set 1	Reading Set 2
1	0.3	-1.9	-1.9
2	0.4	-2.5	-2.6
3	0.5	-3.0	-5.5
4	0.6	-3.8	-3.8
5	0.8	-5.1	-5.0
6	1.0	-6.4	-6.3

Assuming the melting point of pure water as 0°C,

answer the following questions:

a. One temperature in the second set of results does not fit the pattern. Which temperature is that? Justify your answer.

b. Why did Henna collect two sets of results?

c. In place of NaCl, if Henna had used glucose, what would have been the melting point of the solution with 0.6 g glucose in it?

5. What is the predicted melting point if 1.2 g of salt is added to 10 mL of water? Justify your answer.

6. A 5.2 molal aqueous solution of methyl alcohol, CH_3OH, is supplied. What is the mole fraction of methyl alcohol in the solution?

a) 0.190　　　　　　b) 0.086　　　　　　c) 0.050　　　　　　d) 0.110

7. An azeotropic solution of two liquids has a boiling point lower than either of the two when it:

a) shows a positive deviation from Raoult's law

b) shows a negative deviation from Raoult's law

c) shows no deviation from Raoult's law

d) is saturated

8. What will happen if blood cells are kept in hypertonic solution?

a) They swell　　　　　b) They shrink　　　　c) They remain same　　　　d) They die

9. Assertion: An ideal solution obeys Henry's law.

10. Assertion: An ideal solution obeys Henry's law.

Reason: In an ideal solution, solute - solute as well as solvent - solvent interactions are similar to solute - solvent interaction.

11. What is the similarity and difference between Henry's law and Raoult's law?

12. An aqueous solution of glucose is made by dissolving 10 g of glucose ($C_6H_{12}O_6$) in 90 g of water at 303 K. If the vapour pressure of pure water at 303 K be 32.8 mmHg, what would be the vapour pressure of the solution?

13. Give reasons for the following :

a) Measurement of osmotic pressure method is preferred for the determination of molar masses of macro molecules.

b) Aquatic animals are more comfortable in cold water than warm water.

c) Elevation of boiling, point of 1MKCl solution is nearly double than that of 1M sugar solution.

Electrochemistry

1. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): During electrolysis of aqueous copper sulphate solution using copper electrodes hydrogen gas is released at the cathode.

Reason (R): The electrode potential of Cu^{2+}/Cu is greater than that of $H+/H_2$

Select the most appropriate answer from the options given below:

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

2. (a) Can we construct an electrochemical cell with two half-cells composed of $ZnSO_4$ solution and zinc electrodes? Explain your answer.

(b) Calculate the $\lambda^0{}_m$ for Cl - ion from the data given below:

$$\Lambda^0\ mMgCl2 = 258.6 Scm^2\ mol^{-1} \text{ and } \lambda^0\ mMg^{2+} = 106 Scm^2\ mol^{-1}$$

(c) The cell constant of a conductivity cell is 0.146 cm^{-1}. What is the conductivity of 0.01M solution of an electrolyte at 298 K, if the resistance of the cell is 1000 ohm ?

3. The molar conductivity of CH_3COOH at infinite dilution is $390 Scm^2/mol$. Using the graph and given information, the molar conductivity of CH_3COOK will be:

a. $100 Scm^2/mol$ b. $115 Scm^2/mol$ c. $150 Scm^2/mol$ d. $125 Scm^2/mol$
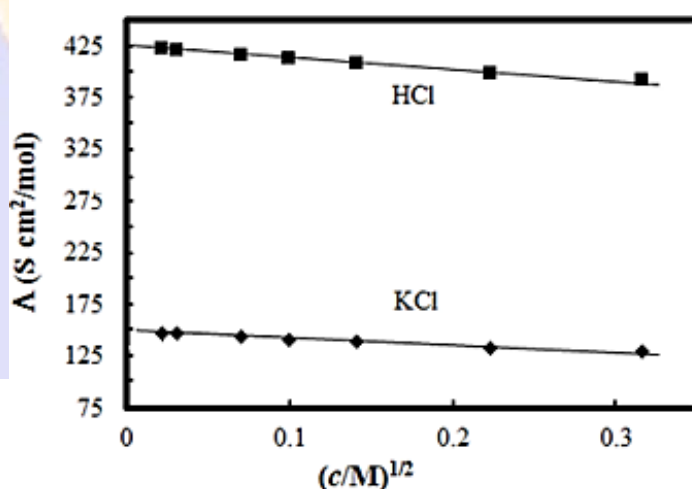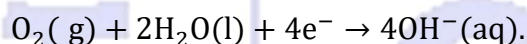

4. What is the molar conductance at infinite dilution for sodium chloride if the molar conductance at

infinite dilution of Na^+ and Cl^- ions are $51.12 \times 10^{-4} Scm^2/mol$ and $73.54 \times 10^{-4} Scm^2/mol$ respectively?

a. $124.66 Scm^2/mol$

b. $22.42 Scm^2/mol$

c. $198.20 Scm^2/mol$

d. $175.78 Scm^2/mol$

5. Corrosion is an electrochemical phenomenon. The oxygen in moist air reacts as follows:

$$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq).$$

Write down the possible reactions for corrosion of zinc occurring at anode, cathode, and overall reaction to form a white layer of zinc hydroxide.

6. a. Why does the cell voltage of a mercury cell remain constant during its 9 lifetime?

b. Write the reaction occurring at anode and cathode and the products of electrolysis of aq KCl.

c. What is the pH of HCl solution when the hydrogen gas electrode shows a potential of -0.59 V at standard temperature and pressure?

7. a. Molar conductivity of substance "A" is 5.9×10^3 S/m and " B " is 1×10^{-16} S/m. Which of the two is most likely to be copper metal and why?

b. What is the quantity of electricity in Coulombs required to produce 4.8 g of Mg from molten $MgCl_2$? How much Ca will be produced if the same amount of electricity was passed through molten $CaCl_2$? (Atomic mass of Mg = 24u, atomic mass of Ca = 40u).

c. What is the standard free energy change for the following reaction at room temperature? Is the reaction spontaneous?

$$Sn(s) + 2Cu^{2+}(aq) \text{ à } Sn^{2+}(aq) + 2Cu^+(s)$$
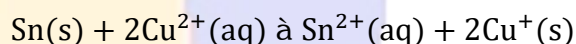
8. Solutions of two electrolytes 'A' and ' B ' are diluted. The Λm of ' B ' increases 1.5 times while that of A increases 25 times. Which of the two is a strong electrolyte? Justify your answer. Graphically show the behavior of 'A' and ' B '.

9. Represent the cell in which the following reaction takes place. The value of E° for the cell is 1.260 V. What is the value of E_{cell} ?

$$2Al(s) + 3Cd^{2+}(0.1M) \rightarrow 3Cd(s) + 2Al^{3+}(0.01M)$$
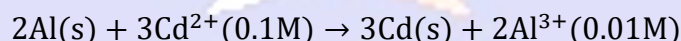
10. An electrochemical cell behaves like an electrolytic cell when:

a) $E_{cefl} = E_{external}$

b) $E_{cell} = 0$

c) $E_{external} > E_{cell}$

d) $E_{external} < E_{cell}$

11. In an electrochemical process, a salt bridge is used:

a) as a reducing agent

b) as an oxidising agent

c) to complete the circuit so that current can flow

d) none of these

12. Write the name of the cell which is generally used in transistors. Write the reaction taking place at the anode and cathode of this cell.

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

14. Molar conductivity of a solution is the conductance of solution containing one mole of electrolyte, kept between two electrodes having unit length between them and large cross sectional area, so as to contain the electrolyte. In other words molar conductivity is the conductance of the electrolytic solution kept between the electrodes of a conductivity cell at unit distance, but having area of cross-section large enough to accommodate sufficient volume of solution that contains 1 mole of the electrolyte. Thus, knowing molar concentration and conductivity, we can calculate molar conductivity at infinite dilution.

15. a) The following chemical reaction is occurring in an electrochemical cell: $Mg(s) + 2Ag^+(0.0001M) \rightarrow Mg^{2+}(0.10M) + 2Ag(s)$, the E^0 electrode values are $Mg^{2+}/Mg = -2.36$ V & $Ag^+/Ag = 0.81$ V. Calculate $E'_{cell.}$.

b) Write two advantages of $H_2 - O_2$ fuel cell over ordinary cell.

16. a) Calculate the standard cell potentials of galvanic cells in which the following reaction take place:

Chemical Kinetics

1 Which of the following statement is true?

(a) molecularity of reaction can be zero or a fraction.

(b) molecularity has no meaning for complex reactions.

(c) molecularity of a reaction is an experimental quantity

(d) reactions with the molecularity three are very rare but are fast.

2 If the initial concentration of substance A is 1.5M and after 120 seconds the concentration of substance A is 0.75M, the rate constant for the reaction if it follows zero - order kinetics is:

(a) $0.00625 mol L^{-1} s^{-1}$ (b) $0.00625 s^{-1}$ (c) $0.00578 mol L^{-1} s^{-1}$ (d) $0.00578 s^{-1}$

3 a. Radioactive decay follows first - order kinetics. The initial amount of two radioactive elements X and Y is 1gm each. What will be the ratio of X and Y after two days if their halflives are 12 hours and 16 hours respectively?

b. The hypothetical reaction $P + Q \rightarrow R$ is half order w.r.t 'P' and zero order w.r.t ' Q '. What is the unit of rate constant for this reaction?

4 Which radioactive isotope would have the longer half- life ^{15}O or ^{19}O ? (Given rate constants for ^{15}O and ^{19}O are $5.63 \times 10^{-3} s^{-1}$ and $k = 2.38 \times 10^{-2} \varepsilon^{-1}$ respectively.)

a. ^{15}O

b. ^{19}O

c. Both will have the same half-life

d. None of the above, information given is insufficient

5 For the reaction, $A + 2B \rightarrow AB_2$, the order w.r.t. reactant A is 2 and w.r.t. reactant B. What will be change in rate of reaction if the concentration of A is doubled and B is halved?

a. increases four times   b. decreases four times   c. increases two times   d. no change

6 Arrhenius equation can be represented graphically as follows:

The (i) intercept and (ii) slope of the graph are:
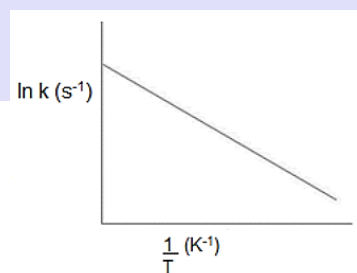
a. (i) ln A (ii) Ea/R   b. (i) A (ii) Ea   c. (i) In A (ii) $-Ea/R$ d. (i) A (ii) $-Ea$

7 A first-order reaction takes 69.3 min for 50% completion. What is the time needed for 80% of the reaction to get completed? (Given: $\log 5 = 0.6990, \log 8 = 0.9030, \log 2 = 0.3010$)

8 Explain how and why will the rate of reaction for a given reaction be affected when

a. a catalyst is added b. the temperature at which the reaction was taking place is decreased

9 For the reaction: $2 N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$, the rate of formation of $NO_2(g)$ is $2.8 \times 10^{-3}Ms^{-1}$.

The rate of disappearance of $N_2O_5(g)$ will be $-\frac{1}{2}$

a) $1.4 \times 10^{-3}Ms^{-1}$ b) $-1.8 \times 10^{-3}Ms^{-1}$ c) $-1.6 \times 10^{-3}Ms^{-1}$ d) $1.3 \times 10^{-3}Ms^{-1}$

10 Which of the following statement is incorrect about the collision theory of chemical reaction?

a) It considers reacting molecules or atoms to be hard spheres and ignores their structural features.

b) No. of effective collisions determines the rate of reaction.

c) Collision of atoms or molecules have sufficient threshold energy for product formations.

d) Molecules should collide with sufficient threshold energy and proper orientation for the collision to be effective.

11 Assertion: Order of reaction is never negative with respect to a reactant or product.

Reason: The rate of reaction is always positive.

12 What is Pseudo chemical reactions? Give an example.

b) If the activation energy of a reaction is zero, how will the temperature affect the rate of reaction?

13 In 1864, the development of chemical kinetics by formulating the law of mass action. The rate of a reaction is always an important parameter in all fields of research, medicine and also for chemical industries. The rate of reaction indicates the rate of production of our daily products. The biological processes taking place in our body are nothing but simply chemical reactions which impact our day to day activities directly therefore understanding how chemical reactions work and what affects the rate of reactions is really important.

Answer the following questions:

a) How surface area of a reactant is important parameter for a chemical reaction?

b) State law of mass action.

c) k for the decomposition of Hydrogen peroxide is 7.30×10^{-4} s^{-1}. What is the order of the reaction?

d) Plot a graph for $[R]$ vs (t) for Zero order reaction.

By Deepak Negi

d and f block

1 Match the properties with the elements of $3d$ series:

(i) lowest enthalpy of atomization (p) Sc

(ii) shows maximum number of oxidation states (q) Mn

(iii) transition metal that does not form coloured compounds (r) Zn

(s) Ti

(a) (i) (r), (ii) (q), (iii) (p)

(b) (i) (r), (ii) (s), (iii) (p)

(c) (i) (p), (ii) (q), (iii) (r)

(d) (i) (s), (ii) (r), (iii) (p)

2 The trend of which property is represented by the following graph?
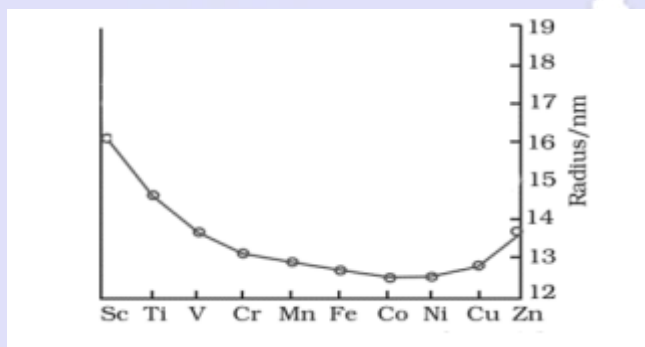
(a) ionization enthalpy

(b) atomic radii

(c) enthalpy of atomization

(d) melting point

3 Which of the following is not considered a transition element?

(a) Scandium

(b) Silver

(c) Vanadium

(d) Zinc

4 $KMnO_4$ is coloured due to:

a. d-d transitions

b. charge transfer from ligand to metal

c. unpaired electrons in d orbital of Mn

d. charge transfer from metal to ligand

5 Account for the following:

a. Ti(IV) is more stable than the Ti (II) or Ti(III).

b. In case of transition elements, ions of the same charge in a given series show progressive decrease in radius with increasing atomic number.

c. Zinc is a comparatively a soft metal, iron and chromium are typically hard.

6 a. Why are fluorides of transition metals more stable in their higher oxidation state as compared to the lower oxidation state?

b. Which one of the following would feel attraction when placed in magnetic field: Co^{2+}, Ag^+, Ti^{4+}, Zn^{2+}

c. It has been observed that first ionization energy of 5 d series of transition elements are higher than that of 3 d and 4 d series, explain why?

7 On the basis of the figure given below, answer the following questions:

8 Which of the following ion has the electronic configuration $3d^6$?
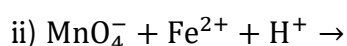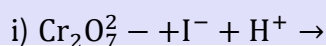
a) Ni^{3+}

b) Mn^{3+}

c) Fe^{2+}

e) Co^{3+}

9 The formula of pyrolusite is:

a) Mn_3O_4

b) MnO_2

f) MnO

d) Mn_2O_7

10 a) Account for the following :

i) Transition metals act as good catalyst.

ii) The d^2 configuration is unstable in ions.

iii) Transition metal show variable oxidation states.

b) Complete the following reactions :

i) $Cr_2O_7^{2-} + I^- + H^+ \rightarrow$

ii) $MnO_4^- + Fe^{2+} + H^+ \rightarrow$

Coordination Compounds

1 (a) Write the formula for the following coordination compound

Bis(ethane-1,2-diamine) dihydroxidochromium(III) chloride

(b) Does ionization isomer for the following compound exist? Justify your answer. $Hg[Co(SCN)_4]$

(c) Is the central metal atom in coordination complexes a Lewis acid or a Lewis base? Explain.

2 The CFSE of $[CoCl_6]^{3-}$ is 18000 cm^{-1} the CFSE for $[CoCl_4]^{-}$ will be:

a. 18000 cm^{-1}

b. 8000 cm^{-1}

c. 2000 cm^{-1}

d. 16000 cm^{-1}

3 The number of ions formed on dissolving one molecule of $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2C$ in water is:

a. 3   b. 4   c. 5   d. 6

4 Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion : Magnetic moment values of actinides are lesser than the theoretically predicted values.

Reason : Actinide elements are strongly paramagnetic.

Select the most appropriate answer from the options given below:

a. Both A and R are true and R is the correct explanation of A

b. Both A and R are true but R is not the correct explanation of A.

c. A is true but R is false.

d. A is false but R is true.

5 Using Valence bond theory, explain the following in relation to the paramagnetic complex $[Mn(CN)_6]^{3-}$

a. type of hybridization

b. magnetic moment value

c. type of complex - inner, outer orbital complex

6 Answer the following questions:

a. $[Ni(H_2O)_6]^{2+}$(aq) is green in colour whereas $[Ni(H_2O)_4(en)]^{2+}$(aq) is blue in colour, give reason in support of your answer.

b. Write the formula and hybridization of the following compound:

tris(ethane-1,2-diamine) cobalt(III) sulphate

7 In a coordination entity, the electronic configuration

of the central metal ion is $t_2 g^3 e_g{}^1$

a. Is the coordination compound a high spin or low spin complex?

b. Draw the crystal field splitting diagram for the above complex.

8 NO_2 is a :

a) Monodentate ligand   b) Tetradentate ligand

c) Hexadentate ligand   d) Ambidentate ligand

9 Which of the following shows optical isomerism?

a) $[Co(NH_3)_3Cl]^+$ b) $[Co(NH_3)_2(en)]^{2+}$

c) $[Co(H_2O)_4(en)]^{3+}$ d) $[Co(NH_3)_2(en)_2]^{3+}$

10 When 1 mole of $COCl_3.5NH_3$ was treated with excess of silver nitrate solution, 2 moles of AgCl was precipitated. The formula of the compound is :

a) $[Co(NH_3)_5Cl_2]Cl$ b) $[Co(NH_3)_5Cl]Cl_2$

c) $[Co(NH_3)_4Cl_2](NH_3)Cl$ d) $[Co(NH_3)_3Cl_3](NH_3)_2$

11 Assertion: The crystal field splitting (Δ_0) depends upon the field produced by the ligand and charge on the metal ion.

Reason: The energy of the two e_g orbitals will increase by $3/5\Delta_0$ and that of three t_{2B} will decrease by $2/5\Delta_0$.

12 Write the IUPAC name of the following (ii) $K_4[Ni(CN)_4]$ ... , ii) $[Co(en)_3]^{3+}$

b) Define chelation.

13 a) Using IUPAC norms write the formulas for the following : i) Pentaaminenitrito- N-Cobalt(III)

ii) Tetrahydroxido zincate(II)

b) What is crystal field splitting energy?

14 a) On the basis of crystal field theory, write the electronic configuration and magnetic moment of $K_4[Mn(CN)_6]$.

b) Write any one difference between double salt and coordination compound.

15 a) Using Valence bond theory, explain in detail hybridization, magnetic behavior and shape of $[Co(NH_3)_6]^{3+}$ ion.

b) Name the type of isomerism shown by the following pair of complex:

$$[Co(NH_3)_5SO_4]Br\,\&\,[Co(NH_3)_5Br]SO_4$$
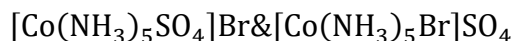
c) Define metal carbonyls. Give an example.

Haloalkanes and Haloarenes

1 (a) Arrange the isomeric dichlorobenzene in the increasing order of their boiling point and melting points.

(b) Explain why the electrophilic substitution reactions in haloarenes occur slowly and require more drastic conditions as compared to those in benzene.

2 Which one of the following compounds is more reactive towards S_N1 reaction?

a. $CH_2 = CHCH_2Br$

b. $C_6H_5CH_2Br$

c. $C_6H_5CH(C_6H_5)Br$

d. $C_6H_5CH(CH_3)Br$

3 What would be the major product of the following reaction?

$C_6H_5 - CH_2 - OC_6H5 + HBr \rightarrow A + B$
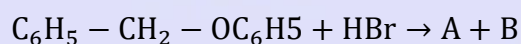
a. $A = C_6H_5CH_2OH, B = C_6H_6$

b. $A = C_6H_5CH_2OH, B = C6H5Br$

c. $A = C_6H_5CH_3, B = C_6H_5Br$

d. $A = C_6H_5CH_2Br, B = C_6H_5OH$

4 Give reason for the following:

a. During the electrophilic substitution reaction of haloarenes, para substituted derivative is the major product.

b. The product formed during $S_N{}^1$ reaction is a racemic mixture.

5 a. Name the suitable alcohol and reagent, from which 2-Chloro-2-methyl propane can be prepared.

b. Out of the Chloromethane and Fluoromethane, which one is has higher dipole moment and why?

6 a. Identify the major product formed when 2-cyclohexylchloroethane undergoes a dehydrohalogenation reaction. Name the reagent which is used to carry out the reaction.

b. Why are haloalkanes more reactive towards nucleophilic substitution reactions than haloarenes and vinylic halides?

7 a. Name the possible alkenes which will yield 1-chloro-1-methylcyclohexane on their reaction with HCl. Write the reactions involved.

b. Allyl chloride is hydrolysed more readily than n-propyl chloride. Why?

8 Account for the following : i) Orange colour of

$Cr_2O_7{}^2$ ion changes to yellow when treated with an alkali.

ii) Chemistry of actinoids is complicated as compared to lanthanoids.

b) Name an important alloy which contains some of the lanthanoid metals. Mention its use.

9 What is lanthanoid contraction? Write its any two consequences.

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