SOLUTIONS

1. Which of the following units is useful in relating concentration of solution

with its vapour pressure?

(i) mole fraction

(ii) parts per million

(iii) mass percentage

(iv) molality

2. On dissolving sugar in water at room temperature solution feels cool to touch.

Under which of the following cases dissolution of sugar will be most rapid?

(i) Sugar crystals in cold water.

(ii) Sugar crystals in hot water.

(iii) Powdered sugar in cold water.

(iv) Powdered sugar in hot water.

3. At equilibrium the rate of dissolution of a solid solute in a volatile liquid solvent

is _____.

(i) less than the rate of crystallisation

(ii) greater than the rate of crystallisation

(iii) equal to the rate of crystallisation

(iv) zero

4. Maximum amount of a solid solute that can be dissolved in a specified amount

of a given liquid solvent does not depend upon _____.

(i) Temperature

(ii) Nature of solute

(iii) Pressure

(iv) Nature of solvent

5. Low concentration of oxygen in the blood and tissues of people living at high

altitude is due to _____.

(i) low temperature

(ii) low atmospheric pressure

(iii) high atmospheric pressure

(iv) both low temperature and high atmospheric pressure

6. Considering the formation, breaking and strength of hydrogen bond, predict

which of the following mixtures will show a positive deviation from Raoult's

law?

(i) Methanol and acetone.

(ii) Chloroform and acetone.

(iii) Nitric acid and water.

(iv) Phenol and aniline.

7. Colligative properties depend on _____.

(i) the nature of the solute particles dissolved in solution.

(ii) the number of solute particles in solution.

(iii) the physical properties of the solute particles dissolved in solution.

(iv) the nature of solvent particles.

8. Which of the following aqueous solutions should have the highest boiling point?

(i) 1.0 M NaOH

(ii) 1.0 M Na_2SO_4

(iii) 1.0 M NH_4NO_3

(iv) 1.0 M KNO_3

9. The unit of ebulioscopic constant is _____.

(i) K kg mol^{-1} or K (molality)$^{-1}$

(ii) mol kg K^{-1} or K^{-1}(molality)

(iii) kg mol^{-1} K^{-1} or K^{-1}(molality)$^{-1}$

(iv) K mol kg^{-1} or K (molality)

10. In comparison to a 0.01 M solution of glucose, the depression in freezing point

of a 0.01 M MgCl2 solution is _____.

(i) the same

(ii) about twice

(iii) about three times

(iv) about six times

11. An unripe mango placed in a concentrated salt solution to prepare pickle,

shrivels because _____.

(i) it gains water due to osmosis.

(ii) it loses water due to reverse osmosis.

(iii) it gains water due to reverse osmosis.

(iv) it loses water due to osmosis.

12. At a given temperature, osmotic pressure of a concentrated solution of a

substance _____.

(i) is higher than that at a dilute solution.

(ii) is lower than that of a dilute solution.

(iii) is same as that of a dilute solution.

(iv) cannot be compared with osmotic pressure of dilute solution.

13. Which of the following statements is false?

(i) Two different solutions of sucrose of same molality prepared in different

solvents will have the same depression in freezing point.

(ii) The osmotic pressure of a solution is given by the equation $\Pi = CRT$

(where C is the molarity of the solution).

(iii) Decreasing order of osmotic pressure for 0.01 M aqueous solutions of

barium chloride, potassium chloride, acetic acid and sucrose is

$BaCl_2 > KCl > CH_3COOH >$ sucrose.

(iv) According to Raoult's law, the vapour pressure exerted by a volatile

component of a solution is directly proportional to its mole fraction in

the solution.

14. The values of Van't Hoff factors for KCl, NaCl and K2SO4, respectively, are

_____.

(i) 2, 2 and 2

(ii) 2, 2 and 3

(iii) 1, 1 and 2

(iv) 1, 1 and 1

15. Which of the following statements is false?

(i) Units of atmospheric pressure and osmotic pressure are the same.

(ii) In reverse osmosis, solvent molecules move through a semipermeable

membrane from a region of lower concentration of solute to a region of

higher concentration.

(iii) The value of molal depression constant depends on nature of solvent.

(iv) Relative lowering of vapour pressure, is a dimensionless quantity.

16. Value of Henry's constant KH _____.

(i) increases with increase in temperature.

(ii) decreases with increase in temperature.

(iii) remains constant.

(iv) first increases then decreases.

17. The value of Henry's constant KH is _____.

(i) greater for gases with higher solubility.

(ii) greater for gases with lower solubility.

(iii) constant for all gases.

(iv) not related to the solubility of gases.

18. We have three aqueous solutions of NaCl labelled as 'A', 'B' and 'C' with

concentrations 0.1M, 0.01M and 0.001M, respectively. The value of van't Hoff

factor for these solutions will be in the order_____.

1)i A < i B < i C (ii) i A > i B > i C (iii) i A = i B = i C (iv) i A < i B > i C

Very Short Answer Type Questions

1.   Define the term Solution?

2.   State the condition resulting in reverse osmosis.

3.   When is the value of Van't Hoff factor more than one?

4.   What is the sum or the mole fraction of all the components in a three   components system?

5.   Define mole fraction of a component in a solution. How is the molarity of a   solution different from its molarity?

6.   State the formula relating pressure of a gas with its mole fraction in a liquid   solution in contact with it.

7.   What would be the value of Von't Hoff factor for a dilute solution of K_2SO_4 in   water?

8.   10 ml of liquid A was mixed with 10 ml of liquid B. The volume of the resulting   solution was found to be 19.9 ml. What do you conclude?

9.   Define an "ideal solution".

10.   State Raoult's law for solutions of non-¬volatile solutes.

11.   Calculate the mass percentage of benzene and carbon tetrachloride if 22g of   benzene is dissolved in 122g of carbon tetrachloride.

Short Answer Type Questions

1.   Sodium chloride aqueous solution freezes at lower temperature than water but   boils at higher temperatures than water. Explain.

2.   Define

 (i) Mole fraction

 (ii) Molarity

3.   Calculate the osmotic pressure in Pascal exerted by a solution prepared by   dissolving l.0 g of polymer of molar mass 185000 in 450 mL of water at 37oC.

4.   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   mm Hg. what would be the vapour pressure of the solution?

5. State Henry's law correlating the pressure of a gas and its solubility in a solvent   and mention two applications for the law.

6. Calculate the number of moles of methanol in 5 liters of its 2 m solution, if the density of the solution is 0.981 kg litre–1. (Molar mass of methanol of 32.0 g mol–1).

Very Long Answer Type Questions

1. The freezing point of a solution containing 0.2 g of acetic acid in 20.0 g of benzene is lowered by 0.45° C. Calculate.

(i) The molar mass of acetic acid from this data

(ii) Van't Hoff factor [For benzene, Kf = 5.12 K kg mol–1]

What conclusion can you draw from the value of Von't Hoff factor obtained?

2.One litre aqueous solution of sucrose (molar mass = 342 g mol–1) weighing 1015 g is found to record an osmotic pressure of 4.82 atm at 293 K. What is the molarity of the sucrose solution? (R = 0.0821 atm L mol–1 K–1)

ELECTROCHEMISTRY

1. Which cell will measure standard electrode potential of copper electrode?

(i) Pt (s) H2 (g,0.1 bar) H+ (aq.,1 M) Cu2+(aq.,1M) Cu

(ii) Pt(s) H2 (g, 1 bar) H+ (aq.,1 M) Cu2+ (aq.,2 M) Cu

(iii) Pt(s) H2 (g, 1 bar) H+ (aq.,1 M) Cu2+ (aq.,1 M) Cu

(iv) Pt(s) H2 (g, 1 bar) H+

(aq.,0.1 M) Cu2+ (aq.,1 M) Cu

2. The difference between the electrode potentials of two electrodes when no

current is drawn through the cell is called _____.

(i) Cell potential

(ii) Cell emf

(iii) Potential difference

(iv) Cell voltage

3. Which of the following statement is not correct about an inert electrode in a

cell?

(i) It does not participate in the cell reaction.

(ii) It provides surface either for oxidation or for reduction reaction.

(iii) It provides surface for conduction of electrons.

(iv) It provides surface for redox reaction.

4. An electrochemical cell can behave like an electrolytic cell when _____.

(i) Ecell = 0

(ii) Ecell > Eext

(iii) Eext > Ecell

(iv) Ecell = Eext

5. Which of the statements about solutions of electrolytes is not correct?

(i) Conductivity of solution depends upon size of ions.

(ii) Conductivity depends upon viscosity of solution.

(iii) Conductivity does not depend upon solvation of ions present in solution.

(iv) Conductivity of solution increases with temperature.

6. The quantity of charge required to obtain one mole of aluminium from Al2O3 is

_____.

(i) 1F

(ii) 6F

(iii) 3F

(iv) 2F

7. The cell constant of a conductivity cell _____.

(i) changes with change of electrolyte.

(ii) changes with change of concentration of electrolyte.

(iii) changes with temperature of electrolyte.   (iv) remains constant for a cell.

8. Molar conductivity of ionic solution depends on _____.

(i) temperature.

(ii) distance between electrodes.

(iii) concentration of electrolytes in solution.

(iv) surface area of electrodes.

9. For the given cell, Mg|Mg2+|| Cu2+|Cu

(i) Mg is cathode

(ii) Cu is cathode

(iii) The cell reaction is Mg + Cu2+ ⟶ Mg2+ + Cu

(iv) Cu is the oxidising agent

Very Short Answer Type Questions

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

2. Consider the reaction : $Cr_2O^{2-}_7 + 14H^+ + 6e^- \rightarrow 2Cr^+ + 7H_2O$ What is the quantity of electricity in columns needed to reduce 1 mol of $Cr_2O^{2-}_7$.

3. Arrange the following metals in the order in which they displace each other from the solution of their salts.   Al, Cu, Fe, Mg and Zn.

3. The conductivity of 0.20 M solution of KCl at 298 K is 0.0248 S/cm. Calculate its molar conductivity.

4. Express mathematically relationship among the resistance (R) specific conductivity ?

5. What is the relationship between the standard EMF of the cell and the equilibrium constant of the cell reaction at 298 K?

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

7. Write Nernst equation for half cell reaction $M^{n+} + ne^- \rightarrow M$.

8. How much charge is required for the reductions of 1 mol of CH_3NO_2 to CH_3NH_2?

9. Can you store copper sulphate solutions in a zinc pot? Given $E^o_{Cu^{2+}/Cu} = 0.34$ V $E^o_{Zn^{2+}/Zn} = -0.76$ V

Short Answer Type Questions

1. Calculate the potential of a Zn/Zn^{2+} ion electrode in which the $[Zn^{2+}]=0.001$ M. $(E^o_{Zn^{2+}/Zn} = -0.76$ V, R = 8.314 $JK^{-1} mol^{-1}$, F = 96500 C mol^{-1})

2. Calculate the equilibrium constant for the following reaction at 298 K :   Cu (s) + $Cl_2(g) \rightarrow$ $CuCl_2$ (aq)   R = 8.314 $JK^{-1}mol^{-1}$, $E^o_{Cu^{2+}/Cu} = 0.34$ V   = 1.36 V,

3. Calculate the equilibrium constant of the reaction:
     Cu (s) + 2 Ag^+ (aq) $\Rightarrow Cu^{2+}$ (aq) + 2 Ag (s) $E^o_{Cell} = 0.46$ V

4. $Mg(s)|Mg^{2+} (aq)||Ag^+ (aq)|Ag(s)$

   (b)Write Nernst equation to calculate the cell potential of the above cell. If Ag^+ =0.114

   Mg^{2+} = 0.1 M. $E^o_{Ag^+/Ag}$ = 0.8 V $E^o_{Mg^{2+}/Mg}$ = − 2.37 V

5. Why does the molar conductance increase on diluting the solution of a weak electrolyte? Electrolytic conductivity of 0.30 M solution of KCl at 295 K is 3.72 x 10^{-2} S cm^{-1}. Calculate its molar conductivity.

6. The resistance of a conductivity cell containing 0.001M KCl solution at 298 K is 1500 W. What is the cell constant if conductivity of 0.001 M KCl solution at 298K is 0.146 × 10^{-3} S/cm?

7. How much electricity in terms of Faraday is required to
   produce?   (i) 20.0 g of Ca
   from molten CaO_2 (ii) 40.0 g of Al from molten Al_2O_3

8. Calculate the pH of the following half cell: $Pt(s)|H2(g)|H2SO4 (aq)$
   For the cell the oxidation potential is +0.3V, p H2(g) =1 atm

9. Calculate the standard cell potential of the galvanic cell in which the following reaction takes place: 2 Cr (s) + 3 Cd2+ (aq) → 2 Cr3+ (aq) + 3 Cd (s)
   Also calculate the value of the reaction.
   (Given: = − 0.40 V and F = 96500 C mol)

10. (a) Calculate the emf of the cell Mg(s) | Mg2+ (0.1 M) || Cu2+ (1 × 10-3 M) | Cu (s) Given :
    Eo Cu2 /Cu = + 0.34V,   Eo Mg2+/Mg = − 2.37V
    (b) Explain with examples the terms weak and strong electrolytes.

CHEMICAL KINETICS

1. The role of a catalyst is to change _____.

(i) gibbs energy of reaction.

(ii) enthalpy of reaction.

(iii) activation energy of reaction.

(iv) equilibrium constant.

2. In the presence of a catalyst, the heat evolved or absorbed during the reaction

_____.

(i) increases.

(ii) decreases.

(iii) remains unchanged.

(iv) may increase or decrease.

3. Activation energy of a chemical reaction can be determined by _____.

(i) determining the rate constant at standard temperature.

(ii) determining the rate constants at two

temperatures.

(iii) determining probability of collision.

(iv) using catalyst.

4. Consider the Arrhenius equation given below and mark the correct option.

a −E / RT k = A e

(i) Rate constant increases exponentially with increasing activation energy

and decreasing temperature.

(ii) Rate constant decreases exponentially with increasing activation energy

and decreasing temperature.

(iii) Rate constant increases exponentially with decreasing activation energy

and decreasing temperature.

(iv) Rate constant increases exponentially with decreasing activation energy

and increasing temperature.

5. Which of the following statements is not correct about order of a reaction.

(i) The order of a reaction can be a fractional number.

(ii) Order of a reaction is experimentally determined quantity.

(iii) The order of a reaction is always equal to the sum of the stoichiometric

coefficients of reactants in the balanced chemical equation for a reaction.

(iv) The order of a reaction is the sum of the powers of molar concentration

of the reactants in the rate law expression.

6. Which of the following statements is correct?

(i) The rate of a reaction decreases with passage of time as the concentration

of reactants dereases.

(ii) The rate of a reaction is same at any time during the reaction.

(iii) The rate of a reaction is independent of temperature change.

(iv) The rate of a reaction decreases with increase in concentration of reactant(s).

7. Rate law for the reaction A + 2B $\longrightarrow$ C is found to be

Rate = k [A][B]

Concentration of reactant 'B' is doubled, keeping the concentration of 'A' constant, the value of rate constant will be_____.

(i) the same

(ii) doubled

(iii) quadrupled

(iv) halved

8. Which of the following statements is incorrect about the collison theory of chemical reaction?

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

(ii) Number of effective collisions determines the rate of reaction.

(iii) Collision of atoms or molecules possessing sufficient threshold energy results into the product formation.

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

9. A first order reaction is 50% completed in 1.26×10^{14} s. How much time would it take for 100% completion?
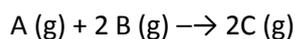
(i) 1.26×10^{15} s

(ii) 2.52×10^{14} s

(iii) 2.52×10^{28} s

(iv) infinite

10. Compounds 'A' and 'B' react according to the following chemical equation.

A (g) + 2 B (g) —→ 2C (g)

Concentration of either 'A' or 'B' were changed keeping the concentrations of one of the reactants constant and rates were measured as a function of initial concentration. Following results were obtained. Choose the correct option for the rate equations for this reaction.

Experiment Initial Initial Initial rate of

concentration concentration formation of

of [A]/mol L–1 of [B]/mol L–1 [C]/mol L–1 s–1

1. 0.30 0.30 0.10

2. 0.30 0.60 0.40

3. 0.60 0.30 0.20

(i) Rate = k [A]2 [B]

(ii) Rate = k [A] [B]2

(iii) Rate = k [A] [B]

(iv) Rate = k [A]2 [B]0

11. Which of the following statement is not correct for the catalyst?

(i) It catalyses the forward and backward reaction to the same extent.

(ii) It alters ΔG of the reaction.

(iii) It is a substance that does not change the equilibrium constant of a reaction.

(iv) It provides an alternate mechanism by reducing activation energy between reactants and products.

12. The value of rate constant of a pseudo first order reaction _____.

(i) depends on the concentration of reactants present in small amount.

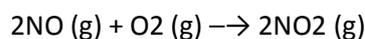(ii) depends on the concentration of reactants present in excess.

(iii) is independent of the concentration of reactants.

(iv) depends only on temperature.

III. Short Answer Type

13. Write the rate equation for the reaction $2A + B \longrightarrow C$ if the order of the reaction is zero.

14. How can you determine the rate law of the following reaction?

$2NO\ (g) + O_2\ (g) \longrightarrow 2NO_2\ (g)$

15. For which type of reactions, order and molecularity have the same value?

16. In a reaction if the concentration of reactant A is tripled, the rate of reaction becomes twenty seven times. What is the order of the reaction?

17. Derive an expression to calculate time required for completion of zero order reaction.

18. For a reaction $A + B \longrightarrow$ Products, the rate law is — Rate = k $[A][B]3/2$

Can the reaction be an elementary reaction? Explain.

19. For a certain reaction large fraction of molecules has energy more than the threshold energy, yet the rate of reaction is very slow. Why?

20. For a zero order reaction will the molecularity be equal to zero? Explain.

21. Why does the rate of a reaction increase with rise in temperature?

22. Why does the rate of any reaction generally decreases during the course of the reaction?

23. Thermodynamic feasibility of the reaction alone cannot decide the rate of the reaction. Explain with the help of one example.

24. Why can't molecularity of any reaction be equal to zero?

25. Why molecularity is applicable only for elementary reactions and order is applicable for elementary as well as complex reactions?

d and f block elements

1. Electronic configuration of a transition element X in +3 oxidation state is

[Ar]3d 5
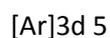
. What is its atomic number?

(i) 25

(ii) 26

(iii) 27

(iv) 24

2. The electronic configuration of Cu(II) is 3d9 whereas that of Cu(I) is 3d10. Which

of the following is correct?

(i) Cu(II) is more stable

(ii) Cu(II) is less stable

(iii) Cu(I) and Cu(II) are equally stable

(iv) Stability of Cu(I) and Cu(II) depends on nature of copper salts

3. Metallic radii of some transition elements are given below. Which of these

elements will have highest density?

Element Fe Co Ni Cu

Metallic radii/pm 126 125 125 128

(i) Fe

(ii) Ni

(iii) Co

(iv) Cu

4. Generally transition elements form coloured salts due to the presence of

unpaired electrons. Which of the following compounds will be coloured in

solid state?

(i) Ag2SO4

(ii) CuF2

(iii) ZnF2

(iv) Cu2Cl2

5. On addition of small amount of KMnO4 to concentrated H2SO4, a green oily

compound is obtained which is highly explosive in nature. Identify the

compound from the following.

(i) Mn2O7

(ii) MnO2

(iii) MnSO4

(iv) Mn2O3

6. The magnetic nature of elements depends on the presence of unpaired electrons. Identify the configuration of transition element, which shows highest magnetic moment.

(i) 3d7

(ii) 3d5

(iii) 3d8

(iv) 3d2

7. Which of the following oxidation state is common for all lanthanoids?

(i) +2

(ii) +3

(iii) +4

(iv) +5

8. There are 14 elements in actinoid series. Which of the following elements does not belong to this series?

(i) U

(ii) Np

(iii) Tm

(iv) Fm

9. Which of the following is amphoteric oxide?

Mn2O7, CrO3, Cr2O3, CrO, V2O5, V2O4

(i) V2O5, Cr2O3

(ii) Mn2O7, CrO3

(iii) CrO, V2O5

(iv) V2O5, V2O4

10. Gadolinium belongs to 4f series. It's atomic number is 64. Which of the

following is the correct electronic configuration of gadolinium?

(i) [Xe] 4f 75d16s2

(ii) [Xe] 4f 65d26s2

(iii) [Xe] 4f 86d2

(iv) [Xe] 4f 95s1

11. Interstitial compounds are formed when small atoms are trapped inside the

crystal lattice of metals. Which of the following is not the characteristic property

of interstitial compounds?

(i) They have high melting points in comparison to pure metals.

(ii) They are very hard.

(iii) They retain metallic conductivity.

(iv) They are chemically very reactive.

12. The magnetic moment is associated with its spin angular momentum and

orbital angular momentum. Spin only magnetic moment value of Cr3+ ion is

_____.

(i) 2.87 B.M.

(ii) 3.87 B.M.

(iii) 3.47 B.M.

(iv) 3.57 B.M.

III. Short Answer Type

13. Why does copper not replace hydrogen from acids?

14. Why EV

 values for Mn, Ni and Zn are more negative than expected?

15. Why first ionisation enthalpy of Cr is lower than that of Zn ?

16. Transition elements show high melting points. Why?

17. Ionisation enthalpies of Ce, Pr and Nd are higher than Th, Pa and U. Why?

18. Although Zr belongs to 4d and Hf belongs to 5d transition series but it is quite difficult to separate them. Why?

19. Although +3 oxidation states is the characteristic oxidation state of lanthanoids but cerium shows +4 oxidation state also. Why?

20. When orange solution containing $Cr_2O_7^{2-}$ ion is treated with an alkali, a yellow solution is formed and when H^+ ions are added to yellow solution, an orange solution is obtained. Explain why does this happen?